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TEST SCHEDULE & TEST PROCEDURES FOR STM-1 SYNCHRONOUS MULTIPLEXER

TEST SCHEDULE & TEST PROCEDURES

TSTP No.: TEC/TSTP/GR/TX/SDH-004/04.JAN.2011

(PROVISIONAL v-1)

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Test procedure and test schedule for STM-1 Synchronous Multiplexer
TEC/TSTP/GR/TX/SDH-004/04.JAN.2011

1. Introduction and scope:

This document illustrates the test schedules and test procedures in respect of the STM-1 Synchronous Multiplexer .

The objective of this test schedule is to ascertain and ensure that the network impairments are within the acceptable limits so as to cause no harm to the interconnecting networks.

The requirements outlined in this document shall be for Terminal Multiplexer as well as for Add Drop Multiplexer

2. Test Instruments / equipment required:

Sl. No.	Name of the Instrument required to test
1.	STM-1 SDH Analyzer with jitter
2.	Digitizing Oscilloscope
3.	Optical Spectrum Analyzer
4.	Optical Return Loss Measuring Set
5.	Ethernet Traffic Analyzer (10GE)
6.	Optical attenuator
7.	Optical Power Meter
8.	Relevant connectors, Patch cords etc.
9.	Frequency Meter

3. Test set up for various tests:

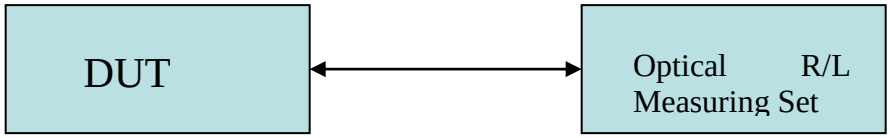

Fig.1: Optical return loss and other parameters test setup

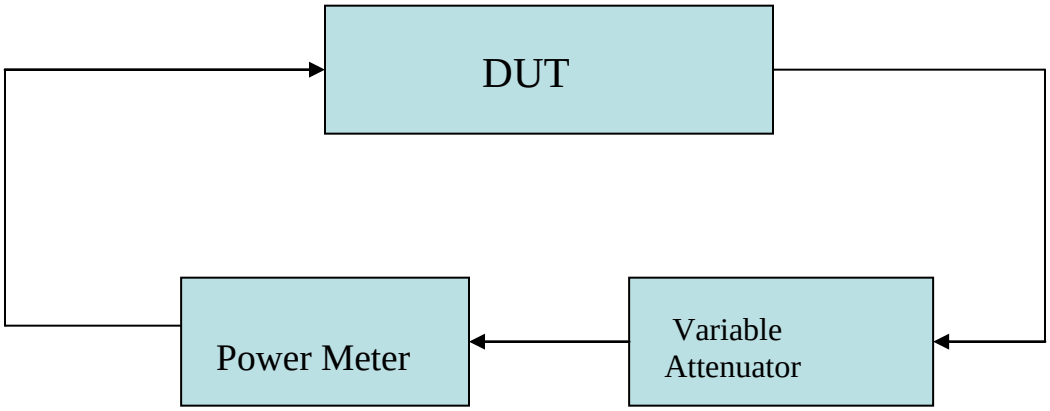

Fig. 2: Receiver sensitivity, Overload etc.

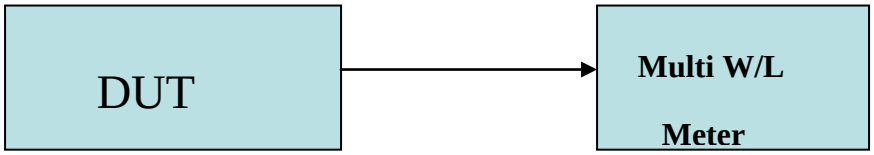

Figure-3: Wavelength measurement setup

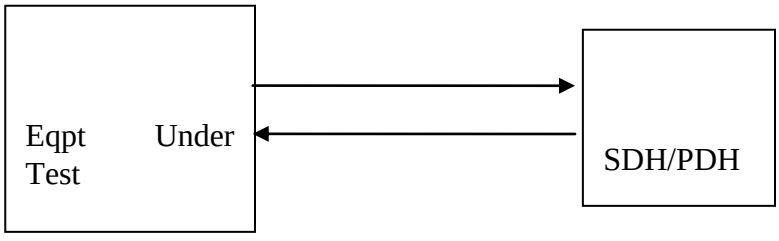

Figure-4: BER and other tests on 2 MBps

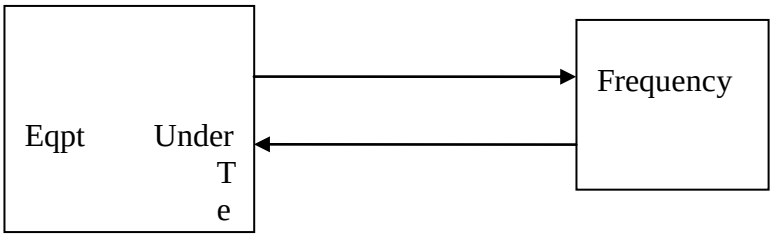

Figure-5: Check of frequency

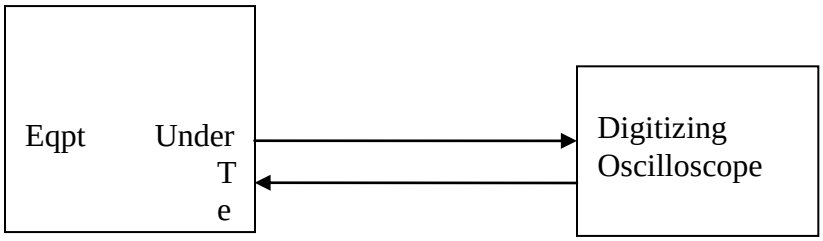

Figure-6: Check of pulse mask

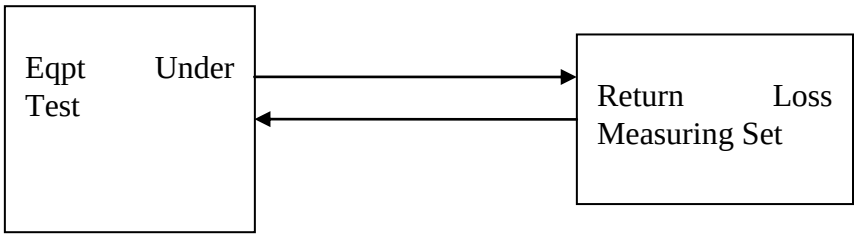

Figure-7: Check of R/L with N/W Analyzer

4. Test procedure for measuring various parameters:

Part-I: Technical Requirements

Cl. No.	Contents of the clause	Test procedures
	Part I – TECHNICAL REQUIREMENTS	Heading.
1.0	**Introduction** This document describes the generic requirements and specifications for an STM-1 Synchronous Multiplexer, for various applications in Indian Telecom Network. The basic multiplexing principles shall be as per ITU-T Rec. G.707 for SDH network-node interface. The Network Element shall meet various atomic and compound functions of the multiplexing equipment as specified in ITU-T Rec. G.783, with extensive management control capabilities as specified in ITU-T Rec. G.784. The equipment shall provide Network Node Interface (NNI) compliant to ITU-T Rec. G.707. The equipment shall provide optical line interface at 155.520Mb/s with standard optical interfaces as per ITU-T Rec. G.957. The details of the application codes are given later. The architecture of the equipment shall be as per ITU-T Rec. G.803 and the generic functions of equipment shall be as per ITU -T Rec. G.805. On the tributary side, the Network Element shall provide access to the constituent electrical signals through 2Mb/s and 34/45Mbps (auto-sensed or configured) as per ITU-T Rec. G.703 as well as standard optical line interface at STM-1 bit-rates as per ITU-T Rec. G.957. The equipment shall support Ethernet over SDH (EoSDH) as per ITU-T G.7041 and shall also optionally support EoPDH as per ITU-T G.8040. The Network Element shall thus provide access to the Ethernet interfaces such as Fast Ethernet and optionally Gigabit Ethernet.	For information only. No test is required.
2.0	**Functional requirements**	Heading, no test is required.
2.1	At functional level, the equipment shall broadly	No test required, except to ensure

	consist of the following sub-systems: • SDH VCx (x =12 & 3) cross-connect system • Traffic ports (SDH, PDH & Ethernet) • Clock reference sub-system • Traffic control sub-system • Power supply sub-system etc. The traffic/and line ports shall be equipped as detailed later in this document. The purchaser may convey specific requirements for interfaces.	the 100% system loading
2.2	STM-1 Synchronous Multiplexer shall be an SDH based multiplexing equipment, supporting a set of Synchronous Digital Hierarchy specifications as given in ITU-T Rec. G.707, constituting a Network Element. The Network Element shall meet various atomic and compound functions of the multiplexing equipment as specified in ITU-T Rec. G.783, with extensive management control capabilities as specified in ITU-T Rec. G.784. The equipment shall provide Network Node Interface (NNI) compliant to ITU-T Rec. G.707.	No test required
2.3	The equipment shall provide optical line interface at 155.520Mb/s with standard optical interface as per ITU-T Rec. G.957. The application code details are given later. The architecture of the equipment shall be as per ITU-T Rec. G.803 and the generic functions of equipment shall as per ITU -T Rec. G.805. On the tributary side, the Network Element shall provide access to the constituent electrical signals through 2Mb/s and 34/45Mbps (auto-sensed or configured) interfaces as per ITU-T Rec. G.703 as well as standard optical line interface at STM-1 bit-rates as per ITU-T Rec. G.957.	No test required
2.4	The equipment shall provide “Ethernet on SDH (EoS)” transport capability at Fast Ethernet user-interfaces @ 10/100BaseT, 100BaseFX and Gigabit Ethernet interfaces @ 1000BaseSX/LX using ITU-T G.7041 specified GFP encapsulation. Further, the equipment shall also support Link Capacity Adjustment Scheme (LCAS) as per ITU -T Rec. G.7042. The mapping of PDH tributaries shall be as per ITU-T Rec. G.707.	No test required

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td>2.5</td><td>Virtual concatenation @ VC12-X-v and VC3-X-v as per ITU-T Rec. G.707 shall be provided in the equipment.</td><td>From the NMS of the equipment, ensure that Virtual Concatenation at VC 12 and VC3 is supported</td></tr>
<tr><td>2.6</td><td>The system shall be engineered to support at least 8 Ethernet ports for offering Ethernet services. The interface support shall be @10/100BaseT, 100BaseFX and 1000BaseSX/LX @1310nm or a mix of these interfaces.</td><td>Ensure from the layout and engineering that at least 8 Ethernet ports are supported by the system. Ensure from the layout and engineering that at least 8 Ethernet ports are supported by the system.</td></tr>
<tr><td>2.7</td><td>In order to support the specified Ethernet interface requirements, there shall be adequate number of VCGs supporting GFP-F encapsulation in the system.</td><td>Ensure that in order to support 8 Nos. of Ethernet ports, 8 nos. of VCGs each supporting one GFP encapsulation is supported by the system.</td></tr>
<tr><td>2.8</td><td>The equipment shall at a minimum support the following Ethernet and VCG scalability requirements:
<table><tr><td>Number of VCGs</td><td>Max {8, number of Ethernet ports on the system}. For instance 2-port GigE switching card, useful for VCG aggregation application shall support Max {8,2} = 8 VCGs</td></tr><tr><td>VCG uplink bandwidth for Ethernet over SDH in ADM</td><td>Min {sum of port bandwidths, 155Mbps}; for instance for an 8x10/100 Mbps system, the uplink bandwidth shall be Min {800Mbps, 155Mbps} = 155Mbps including SDH overheads.</td></tr></table></td><td>Check the VCG scalability and note the same:

1. No. of VCGs shall be maximum : Ok / Not ok.

2. VCG uplink bandwidth for Ethernet over SDH in ADM shall be minimum : Ok / Not ok.</td></tr>
<tr><td>2.9</td><td>In Ring topology, the equipment shall support SNC/N or SNC/I protection mechanism configured per VC12, VC3, VC4 through EMS/LCT, as specified in the ITU-T Rec. G.841. The equipment shall provide protection to the members of VCG also.</td><td>From the EMS of the equipment make the following rings.

1.A 3.nodes ring with minimum granularity of VC2(STM-1e)

2. A three node ring with VC3 granularity (34/45 Mb/s interfaces.</td></tr>
</table>

		3 A three node ring with VC12 granularity 2 Mb/s interfaces). 4 A three node ring with VC3 and VC12 granularity. Record the test result. Go for 100 % loading.
2.10	Support of Ethernet over PDH (EoPDH) is optional. However, if supported, it shall conform to the requirements as per ITU-T Rec. G.8040 as detailed in Annexure-I.	The testing of Ethernet over PDH (EoPDH), when offered, shall be carried out as detailed at the end of this section.
2.11	The equipment shall support various types of cross-connections, viz., point to point unidirectional, point to point bi-directional and point to multi-point unidirectional and broadcast connections.	From the EMS of the equipment make the following connections. **1**. Point to point connections at VC12 level between node A and Node B. **2** Point to point connections at VC3 level between node A and Node C **3**. Point to Multipoint connection between node A to node B and f then to node C at Vc12 level. **4**. Point to Multipoint connection between node A to node B and then to node C at Vc13 level. Feed the PRBS on the concerned tributaries. Record the test results.
2.12	Provision shall exist to loop-back input digital signals at various higher or equivalent hierarchical stages of SDH multiplex hierarchy through the STM-1 equipment.	From the EMS of the equipment, arrange the loop back at following levels. **1**. Aggregate loop back on East port

		2. Aggregate loop back on West port **3.** Tributary loop back at input port at 2 Mb/s. **4**. Tributary loop back at input port at 34 Mb/s. **5** Tributary loop back at input port at MSTM-1e **6.** Tributary loop back at input port at 10/100 Base T port. **7.** Tributary loop back at output port at 2 Mb/s. **8**. Tributary loop back at output port at 34 Mb/s. **9.** Tributary loop back at output port at 2 MSTM-1e **10**.Tributary loop back at output port at 10/100 Base T port **11.** Loop back on VC12 port of East side of Cross connect **12.** Loop back on VC3 port of East side of Cross connect **13.** Loop back on VC4 port of East side of Cross connect **14**. Loop back on VC12 port of West side of Cross connect **15** Loop back on VC3 port of West side of Cross connect **16** Loop back on VC4 port of West side of Cross connect **17**. Loop back on VC12 port of Local side of Cross connect

		18. Loop back on VC3 port of Local side of Cross connect **19.** Loop back on VC4 port of Local side of Cross connect Feed the PRBS on the tributary interfaces and look that on loop back of the tributary the data is received back without any error. Tabulate the test result.
2.13	The equipment shall have provision for synchronization with the timing-signal extracted from SDH aggregate signals i.e., STM-1 signals terminating at the equipment. The equipment shall also have a provision to be synchronized with external 2MHz signal as well as 2048 Kb/s signal as per ITU-T Rec. G.703 with minimum three user-defined priorities exercised through LCT/EMS. Also, the equipment shall provide external 2Mbps and 2MHz timing outputs (selectable from a single physical port or two physical ports) with accuracy traceable to the system synchronization clock.	From the EMS of the equipment ensure that , it is possible to assign priority to any three Synchronisation source, on failure of Normal (Current) synchronization source. Verify and record the test result. Also verify and record that thee two clock output sources are provisioned in the equipment one @ 2048 Kb/s and other @ 2048 kHz.
2.14	The EMS requirements for the system have been detailed in the Appendix I to the GR.	No test required.
2.15	It shall be possible to configure the ADM equipment either as Terminal Multiplexers or as Regenerator by extracting/disabling the requisite hardware, and through software settings. The equipment shall not extend any alarm, upon disabling/extracting the hardware.	Configure the ADM as Terminal Multiplexer and record the observations. Now configure the ADM as Regenerator and put it in the link. Note that it works satisfactorily as Regenerator. Record the observations.
2.16	The hot-swapping of a card/unit shall not affect working of any other tributaries. Hot-swapping capability shall be provided for all cards/units including power supplies.	Remove and insert one by one all the PCBs from the system. On removal and re-insertion the equipment should restore automatically with any

		intervention from EMS of the equipment. Record the observation.
2.17	It shall be possible to configure the network as fully-protected, partially-protected or unprotected.	Configure the equipment in SNC protection. Note that it should be possible to provide protection to 100% of VCs, 50% of VC and rest of VC shall be possible to configure unprotected VCs. Finally configure all the VCs going to East and West direction as un protected VCs. Feed PBRS on the PHY interfaces and ensure that these connections are meeting the requirements of this clause. Record the observation. Configure the equipment in SNC protection. Note that it should be possible to provide protection to 100% of VCs, 50% of VC and rest of VC shall be possible to configure unprotected VCs. Finally configure all the VCs going to East and West direction as un protected VCs. Feed PBRS on the PHY interfaces and ensure that these connections are meeting the requirements of this clause. Record the observation.
2.18	The equipment is envisaged to work on S-1.1, L-1.1 @1310nm or L-1.2 optical interface @1550 nm as specified in the ITU-T Rec. G.957. The exact application-code requirements for optical interfaces for tributary and aggregate shall be specified by the purchaser.	Verify and record that the optical aggregate interface is either L.1 at 1310 nm or L.1.2 at 1550 nm as per ITU _T Rec G.957.
2.19	The provisioning of the order-wire shall be an optional requirement and shall be user specific. If provided, it shall support selective-calling mode of operation as detailed later in this document. There shall be no disconnection in the operation in the event of protection switching.	Make a call on EOW between node A and node C. Check that the conversation is not accessible at any other node. Similarly try with othernodes.

		Record the observation.
2.20	The equipment shall have the capability of providing the Timing Signal quality information as per ITU -T Rec. G.707 using 'S1' byte. The system shall provide configurable capability to select timing-reference using SSM algorithm. The equipment shall have the capability of providing the Timing Signal quality information as per ITU -T Rec. G.707 using 'S1' byte. The system shall provide configurable capability to select timing-reference using SSM algorithm.	Ensure that the equipment supports the S1 byte functionality and assigning of quality of as specified in S1 byte format is feasible. Assign the quality of clock from EMS as per the format of S1 at node A and note that the quality of clock displayed at node B and node C is the same. Record the observation in proper format.
2.21	The power-supply failure/EMS server break-down/ bugs in the software shall not affect the current tributary-connection map. The removal/replacement of any unit shall also not affect the existing connection-map. No reconfiguration shall be called for against this action.	Fail the power supply of node A and node B. Note that the connection maps configured on pre failure conditions shall still work. Similarly switch and disconnect the LCT/Server from the Network. Ensure that in this case also there shall be no loss any connection made on pre failure condition. Record the observation.;
2.22	There shall be no single point-of-failure in the system. In an ADM, the East & West-side TX/RX STM-N interfaces for an STM-1 ring shall be accommodated on two separate line cards. STM-N aggregate & tributary interfaces can be accommodated on the switch/matrix card by having east & west side interfaces on two separate switch/matrix cards	The East and West ports must be accommodated on two different PCB. So that the failure of one port East or West may not require the changing of whole system. In other words single card solution is un acceptable. Record the observation and reject the offer instantly.
2.23	**Differential Delay for VCAT Implementation** Differential delay in reference to VCAT implementation refers to the maximum delay in arrival times of different members of a VCAT group. The manufacturer shall ensure that the system is capable to compensate for all values of differential delay from 125µs right upto 30ms, as a continuous range. The systems capable to compensate for less than 30ms differential delay, shall be liable for rejection. Similarly, on the higher side, the systems capable to compensate for > 50ms differential delay, shall also	Make a VCG of 10 nos of VC12s from the Next Generation SDH analyzer and map it onto the STM-1 bit rate. Connect the next generation SDH analyzer to the fibre to act as one of the node. Feed Ethernet data on this pay load. Now give differential delay on member no#4 on this VCG and monitor the Ethernet data on node B. Note that there is no packet or frame loss of Ethernet. Give

	be liable for rejection. The range from 30-50 ms has been kept as a 'guard- band' for implementation tolerance. The same limit shall apply to all VCs i.e.- VC12 and VC3.	differential delay starting from 125µs and slowly increase upto 30 ms. Note that there is no packet/frame loss., observed on the receive Ethernet dat. Now increase the differential delay up 50 ms. Note hat still Ethernet data is received without any loss of packet/frame. Now increase the differential delay beyond 50 ms. Note that at this stage the data received should not be error free. The system is expected to loose frames etc at this stage. Record the observation in proper format.
3.0	**Equipment Interfaces** The equipment shall have three types of interfaces, namely- 1. **SDH interfaces** The equipment shall provide STM-1o interfaces to terminate optical interfaces. The SDH STM-1o interface shall conform to ITU-T Rec. G.957 and STM-1e interface shall conform to ITU -T Rec. G.703. There shall also be a provision for STM-1e tributary interface. 2. **PDH interfaces** 2Mbps, 34Mbps/DS-3 PDH electrical tributary interface options shall be provided conforming to ITU-T Rec. G.703. 3. **Ethernet over SDH interfaces** The equipment shall support IEEE 802.3 standard 10/100BaseT, 100BaseFX and optionally , Gigabit Ethernet @ 1000BaseSX/LX interfaces for transport of Ethernet over SDH in accordance with ITU-T Rec. G.7041 (GFP). The link capacity adjustment for Ethernet clients shall be provided as per ITU -T Rec. G.7042.	1. Note and record that the equipment under testing supports STM-1o, STM-1e aggregate interfaces. Also note that the equipment supports STM-1e as tributary interface also. Record the observation. 2. Note and record that the equipment under test supports 2Mbps, 34Mbps/DS-3 PDH interfaces electrical interfaces , conforming to ITU-T Rec. G.703 3. Note and record that the equipment under test support IEEE 802.3 standard 10/100BaseT, 100BaseFX (at 1310nm single-mode interface) Ethernet interfaces for transport of over SDH in accordance with ITU-T Rec. G.7041 (GFP). Also not and record that the equipment supports link capacity adjustment for Ethernet clients , which will be as per ITU-T Rec. G.7042.
4.0	**Network Requirements**	Heading, no test is required.
4.1	**Application topologies** The equipment is envisaged to work on **short haul**	Verify and record that the optical aggregate interface is either L.1 at

	application S-1.1 and **long haul** applications L-1.1 or L-1.2, as per ITU-T Rec. G.957.	1310 nm or L.1.2 at 1550 nm as per ITU -T Rec G.957 for Long haul applications.
4.2	**Network topologies** It shall be possible to configure the equipment to implement various network topologies – 1) Point to point/Linear-chain topology 2) Bus topology 3) Ring topology. Two-fibre application i.e., one dedicated fibre for transmit-direction and one for receive-direction is envisaged for all network applications as above.	Note and record that the equipment is able support **1.** Ring Topology, or a Hub topology where the traffic is groomed to STM-1 node from other equipments in its periphery. **2.** Point to point linear chain to work as terminal multiplexer. **3**. Bus topology, wherein the traffic can be inserted or drop at intermediate nodes. Record the observations
4.3	**Equipment configuration** The equipment shall support the following configurations- 1) Terminal Multiplexer 2) Add/Drop Multiplexer.	Configure and ensure that the equipment configuration as Ring and terminal Multiplexer is supported. Record the observations.
4.4	**Capability provision of ports in ADM/TM configuration** In the ADM configuration, it shall be possible to configure system to support the following types of SDH, PDH and Ethernet payloads – 1) STM-1o 2) STM-1e 3) 34.368Mb/s/DS-3 (44.736 Mb/s) [auto-sensed or configurable] 4) 2048 Kb/s PDH interface 5) Ethernet interface 10/100BaseT 6) Ethernet interface 100BaseFX @1310nm interface.	Configure and ensure that the equipment is supporting the tributary interfaces as specified in this clause. Record the observations.

	Note: Subscript "e" stands for electrical interface and "o" stands for optical interface.	
4.5	**Cross-Connect Capability** The STM-1 Synchronous Multiplexer shall provide cross-connect capability with a granularity of VC-4, VC-3 and VC-12 bit rates. It shall be possible to provide dynamic cross-connectivity between any hierarchical VC to any other VC of same hierarchal-level in an STM-1 ring (terminated on tributary ports) in completely non-blocking manner. Similarly, there shall also be possible provisioning between tributary to tributary ports for all VC hierarchies, subject to capacity constraints. The VC-3 and VC-12 cross-connect granularity shall be provisioned either using an integrated approach i.e., using cross connections at VC-4, VC-3 and VC-12 in the same equipment. It shall be possible to switch any VC12/VC3/VC4 from any physical port to any other VC12/VC3/VC4 of any physical port irrespective of whether is tributary port or aggregate port. The granularity of switching shall be minimum VC-12. The equipment shall implement the cross connect size as- • 4x4 VC4 equivalents at VC4 hierarchical level i.e., a total of 8 VC4s - HOVC. • 4x4 VC4 equivalent at VC12 and VC-3 hierarchical level i.e., a total of 8 VC4s, 8x3 VC3s or 8x3x21 VC12s - LOVC. Each port in the above description shall support any directions of transmission (TX or RX).The particular VC-4's granular up to VC-12 and VC-3 shall be dynamically assigned/ selected out of STM-1 on the 'West' side and STM-1 on the 'East' side through EMS. Only one no. of VC4 each, from both 'West' & 'East' directions, shall be available for termination physically in form of E1/E3/DS3's tributaries and/or a mix of them. • The TUs, in the east port in ring, the TUs in ring in the west port and the signals in the tributary ports shall be fully cross-connectable without	Ensure that the same cross connect supports the VC4,VC3 and Vc12 cross connections. Record the observations. As specified in this clause, cross connect dynamically any VC3 to any other VC3 from East side of cross connect to the West side of cross connect and vice versa. It should be non blocking. Also it shall be possible to drop or insert or drop and insert any VC3 from East or West side of cross connect. Similarly it shall be possible to cross connect dynamically any VC12 to any other VC3 from East side of cross connect to the West side of cross connect and vice versa. It should be non blocking. Also it shall be possible to drop or insert or drop and insert any VC12 from East or West side of cross connect. It shall be possible to assign any physical port to any VC12, VC3 andVC4 port of cross connect. The size of cross connect shall be 4x4 VC4 equivalent. **1**.It shall be possible pass through a VC4 at an intermediate node in a ring or a Bus. Drop a VC4 from East port as well as west port at an intermediate node in the ring. **2**. It shall be possible to possible pass through a ll the 3 nos of VC3 at an intermediate node in a ring or a Bus. Drop all the three VC3s

	blocking. This will facilitate rearrangement of TUs on the main STM -1 route, thereby permitting efficient capacity utilization. • In addition, the equipment in ADM configuration shall support "Drop-and-Continue" or "Broadcast" capability, where the connection of one TU to a Tributary interface will not restrict its continuation along the main STM-1 route. • The equipment shall also support local cross-connect capability between tributary interfaces without having any interconnection with the main STM-1 signal. This is intended to facilitate remote provisioning of leased -line services.	from East port as well as west port at an intermediate node in the ring. **3.** It shall be possible to possible pass through a ll the 63 nos of VC12 at an intermediate node in a ring or a Bus. Drop all the 63 nos of VC12s from East port as well as west port at an intermediate node in the ring. Conduct the test making a ring and equipping full tributaries required in each of the above configuration. Feed the PRBS making a cascading loop of 10-15 tribs and ensure that requirement stated in this clause is fully met by the equipment under evaluation. Record the observation and draw the test set up . From the EMS of the equipment make a local on the cross connect on Add/drop side. Feed the PRBS and confirm the connection. Record the observations.
4.5.1	**Type of connections on SDH path-layer** The equipment shall provide support for the following types of connections:	No test is required.
4.5.1.1	**Bi-directional connection** Bi-directional connections shall provide connectivity in both directions of flow of signals at VC12, VC3 and VC-4 for point to point applications. This shall be used for normal two-way transmission of traffic.	The normal connections between nodes of a Ring or Terminal Multiplxer at 2 Mb/s,34 Mb/s and STM-1 are the bi directional connections. Create some connections and record the observations.
4.5.1.2	**'Drop & Continue' connection** The equipment shall provide support for 'Drop & Continue' mode of connection where the signals received from one port shall be dropped at a port and	From the EMS of the equipment under test, go for drop and continue mode of operation. Select

	continued via a third port, as per requirement, for onward transmission. Such configuration shall be possible through management system control. This feature shall be provisioned @VC12, VC3 and VC4 levels. The drop and continue channels may also be aggregated using VCAT to form a drop & continue VCAT Point-to-Multipoint/GFP packet transport.	one VC12 for this function. Create drop and continue connection at node B and terminate the connection at node C. Feed the PRBS on the trib and verify that PRBS is received at node B and node C. Insert errors in the data and note that errors are received on all the nodes. Record the observations. Again make VCG at node A Create drop and continue connection at node B and terminate the connection a t node C. Assign Ethernet interface on this VCG. Feed Ethernet data on this VCG . Note that the data is received at node B and node C also. Insert intentional error in the data and note that the errors are received at node B as well as node C. Record the observations. Repeat the test for VC3 and VC4 also and . Record the observations. There should be no limit on Drop and continue connections within the capacity of the system.
4.5.1.3	**Unidirectional Broadcast connection** The unidirectional broadcast connection shall support point to multi-point transmission of the same signal. It shall be unidirectional. This type of connection shall be required for video transmission applications. This feature shall be provisioned @VC12, VC3 and VC4 levels. The equipment shall also support aggregating one or more unidirectional broadcast connections using VCAT to form a Broadcast packet transport.	In a ring of three nodes configure a broadcast connection by multiplying on VC12 port onto several ports (say 4 ports.)connection at Node A and assign a Local port (Add/Drop port) to this connection. At Node B make pass through connections of the same VC-12 from west port to the East port as well as drop these VC-12 at node “B” by giving a soft patch connection of same VC-12s from the West port to four the Local ports (Add/Drop ports) . At node C drop

		the same VC-12s by assigning 4 nos of local ports (Add/Drop ports). Feed the 2048 Kb/s PRBS data to the connection from node A and verify on Node B and C on all the local ports The broad cast feature so defined shall be available on the EMS of the DUT and enabling this feature in the configuration management , the broadcast connections can be made. Enable the feature and assign the Local ports and VC12 ports by going logging on to node A, node B and node C. Similarly realize one broadcast connection for VC-3 level .
4.5.1.4	**Loop-backs at SDH Layer** The equipment shall be capable of providing local as well as remote user-configurable (times loopback) loop-backs at the interface ports and at the input of the matrix and at the output of the matrix. There shall be no limitation on the loop-backs and the loop-backs at, VC-4, VC-3 & VC-12 levels shall be possible. It shall be possible to control/manage the loop-backs using local craft terminal and EMS of the system.	From the EMS of the equipment make loop back s at tributary interfaces at 2Mb/s, 34 Mb/s and STM-1 Mb/s. Feed PRBS and note that after loop back, it is received back without any error. Record the observations. Similarly create the loop backs on VC4, VC3 and VC12 level at the matrix level and record the observations.
4.6	**Equipment Redundancy** The equipment shall provide complete redundancy for– 1. **Control/Processor** The equipment shall provide for (1+1) hot-standby mode redundancy of Control/Processor card in the equipment if its failure results in affecting the traffic. In-case control / processor card failure is non-traffic affecting, hot standby redundancy shall not be required for Control / Processor unit. Immediately upon insertion of a healthy card, the system shall revert to its pre-failure NMS/EMS configuration.	1 In a three node ring make certain connections between node A to Node B , Node A to node C and node B to node C for PDH traffic at 2 Mb/s and 34 Mb/s and Ethernet traffic at 100 Base T. Feed the data over these connections and note that the data is received without any error. Now remove the Control processor from the system in the case one processor is supported, there should not be any error or loss of

	There shall be support for dual-homing for EMS connectivity for no loss of EMS connectivity, through two Gateway NEs (GNE's) on a ring. Both GNEs shall have control card equipped. In case of total loss of EMS connectivity to the system/network, the system design shall provide local storage of all performance & fault data, as specified in Appendix I to GR, for all connections pertaining to all NEs, in the sub-network.. In-built intelligence shall be there in EMS for selection of appropriate GNE at distant end of a DCN link upon failure of control card at one of the GNE's, for EMS connectivity. **Note:** The performance data as envisaged above for SDH connections shall also be ensured for Ethernet client too. 2. **Switch/Matrix** There shall be provision for a parallel hot-standby switch/matrix unit as per details outlined in clause 4.5 (for SDH cross-connect) to take-over the traffic during failure of the working card. 3. **Power Supply** The system shall provide power supply at the chassis level. For uninterrupted working of the equipment during failures, provisioning for a parallel hot-standby power supply at chassis level shall also be made as an optional requirement to the purchaser. 4. There has to be complete redundancy for **Timing Circuitry** against failures. **Note** The changeover for all redundancy actions, whenever provided, shall be completed within 50 ms.	data etc. The system should continue to work in pre failure condition. In case the equipment meets this condition that all the pre failure connections are working satisfactorily, then thr=ere is no need of hot standby Control processor. If the normal working of the system is getting affected on removal of control processor card, then 1+1 hot standby Control processor is required by the system. Alternatively the vendor can support t option of dual homing, wherein the data shall be written in parallel on two nodes that are marked as GNE nodes. All the data shall be written in the control processors of these two GNE nodes. In case of failure of one control processor, data from the other node shall be available. Take the test and record the observations. 2. Now go the EMS of the equipment, under the configuration management find out the inventory of the equipment in each subrack. The EMS should show two Switch matrix cards. Now go to the Graphical display of the sub rack. The graphical view should show two Control/processor cards in two positions in the subrack. Now remove one of the Switch matrix cards and there should be an alarm in the position of card removed. Now go to Alarm configuration of the equipment and there should be an alarm relating to this Switch matrix card removal. Now go to

		"fault Analysis' and the Fault log should indicate alarm of the missing unit. Note that no other alarm should come due this Switch matrix unit missing. Remove the Switch matrix cards from all the three nodes and no other alarm should come except the Unit missing alarm. Also verify that it should be possible to disable this alarm from the EMS of the system. Further to ensure that during the cross-connection process, the cross- connections information is written onto the Normal as well as standby Switch matrix. Cards Remove the normal Switch matrix card and ensure the cross connections are working. Now insert the Normal card back into its position and remove the standby card, again ensure that the cross-connections made earlier are still working. **3. Power supply:** Common power supply with hot standby: Configure the equipment and make certain connection between the nodes i.e Node "A" and Node "B", Node "A" and Node "C" and Node "B" and Node "C" at 2 Mb/s level and 34Mb/s level. and ensure that all the connections made are working by feeding the PRBS data onto them and data is received OK without errors. Now remove one of the power supply unit and note that data is still received without error and on the removal and reinsertion of power supply unit does not result any alarm. **i)** Now remove the second Power supply unit and note that again the data on the channel is working OK and on the removal

		and reinsertion of power supply unit does not result any alarm. Go the EMS of the DUT and select the Fault configuration and note that no alarm should have come. Now select the Performance management log history and note that during the testing period no B1,B2, B3 and V5 would have come. **ii)** Now remove the second Power supply unit and note that again the data on the channel is working OK and on the removal and reinsertion of power supply unit does not result any alarm. Go the NMS of the DUT and select the Fault configuration and note that no alarm should have come. Now select the Performance management log history and note that during the testing period no B1,B2, B3 and V5 would have come. Record the observation in proper tabulation form.
5.0	**Transport media** The equipment in the longhaul application shall operate on ITU-T Rec. G.652 Single-Mode Fibre cable as per TEC GR Nos. – 1) GR/OFC-01/ 04.SEP.2003 (with all amendments) on Metal Free Optical Fibre Cable 2) GR/OFC-02/03 SEP.2003 (with amendments) on Armoured Optical Fibre Cable 3) GR/OFC-05/01.JUL.2000 (with amendments) on Metal-Free Optical Fibre Ribbon Cable. 4) GR/OFC-06/01.JAN.2001 (with amendments) on Armoured Optical Fibre Ribbon Cable.	No test is required. Take an under taking from the vendor that his system will work on the type of cable specified below, without any addition compensation module.

6.0	**Performance Requirements** The equipment shall be tested for error performance as follows: a) **In laboratory:** BER performance over simulated hop shall be tested better than $1x10^{-10}$ for 48 hours on each channel at reference receive-level (nominal level). Also IETF RFC 2544 compliance shall be tested for end-to-end Ethernet service. b) **In field:** BER performance for 48 hours shall be established to conform to ITU-T Recs. G.826 & G.828.	At the end of bench testing, put the system for stability test for 48 Hrs. This test shall be conducted on one 2 Mb/s Trib put on loop back at the distant node . Feed PRBS on to nis tributary and record that the error performance of the link is better than$1x10^{-10}$ for 48 hours Similarly take the same test on 34 Mb/s trib and here too the test condition of$1x10^{-10}$ for 48 hours should be test. On Ethernet port run RFC 2544 test continuously and note that no packet of frame is lost in 48 Hrs test. Record the observation. Attach the printout of the test with test results. In the field all the test sited above shall be conducted and the parameters limits is same as that laboratory test results.
6.1	**Resilience & Protection**	Heading, no test is required.
6.1.1	**Network Protection** The equipment shall support SNC/N path-protection mechanisms at VC12, VC3 & VC4 hierarchical levels in accordance with ITU-T Rec. G.841 at all STM-1 traffic interfaces. All electrical STM-1 and optical STM-1 traffic ports shall participate in any combination of SNCP schemes established by LCT/EMS. Traffic ports participating in the protection schemes shall belong to same unit or to different modules. It shall be possible to provide SNC/N protection to all the tributaries emanating from a node or to selected tributaries or no protection {as required} may be provided to any of the configured tributaries. Similarly, there shall be provision for selective protection/no protection to individual paths with a	**Test procedure of VC-12 level SNC-N Test (Performance degraded path):** For VC12 level 63 connection shall be possible in the case of STM-1 payload. Configure the equipment in the Ring mode using minimum three nodes and one regenerator between the two nodes . From the EMS of the system under test select the "Configuration management". Under the configuration management select the protection provisioning. Configure 32 bi-directional connection at VC-12 level of

	multiplex-section on a ring. Such protection mechanism configurations shall be possible through EMS/LCT. There shall also be configurable support for SNC/I protection and MSP (1+1) linear protection on STM-1 ports. The following summarizes network protection mechanisms requirements in the equipment: **SDH Layer Protection requirements** • Linear MSP for STM-1 interfaces • AU4/ TU3/ TU12 (1+1) SNCP protection at STM-1 interfaces in accordance with ITU-T Rec. G.841 with 'Inherent' as well as 'Non-intrusive monitoring'. The following nesting (combination) of network protection switching shall be supported: • Nesting of a linear (1+1) MSP with SNCP for any order of VC i.e., VC4, VC3 & VC12 • Dual-homed connectivity between two rings shall be supported via 'drop & continue' functionality as described in ITU-T Rec. G.842. **MAC Layer** • In addition to SDH level protection, there shall also be configurable STP (MSTP) protection offered to packet traffic as per IEEE 802.1s standard if an L2 switch is provisioned. • In Ring topologies, on a link failure, it shall be possible to achieve protection switching and reversion of Ethernet traffic in 50 ms with less than 1200 km of ring fibre circumference, and fewer than 16 nodes in the ring, The L2 protection mechanisms shall be based on G.8032. This shall be a revertive mode of operation • The layer-2 protection shall be configurable through LCT & EMS per Ethernet user-flow.	STM-1 payload from node "A' to node "B". Also provide the protection to these 32 VC-12s in the other direction of transmission**.** Assign the local ports to two aforesaid VC-12s. Also configure 31 bi-directional connections at VC-12 level of STM-1 payload from node "A" to node "C". Also provide the protection to these 31 VC-12s in the other direction of transmission**.** Assign the local port connections**.** The protection path should be selected by the click of mouse at the source and sink VCs position on the protection soft buttons on the GUI, not on the manual configuration method**.** It may be noted that while configuring a VC connection between Node "A" to node "C" via node "B" , no configuration is required at "B". the EMS shall automatically make "***pass through connections***" at the intermediate nodes, only the end nodes are required to be defined It may be noted that the NMS should support the graphical display of the connections as well as alpha numerical display of the connection maps on the GUI. Also configure the 1_{st} SDH analyzer which is placed between node "A" and node "B" in the "Through mode working " interfacing data from node "A" the timing of this SDH Analyser shall be the "Recovered clock" from incoming data and This SDH Analyser shall retransmit the same data towards node "B". Feed the 2 Mb/s PRBS data on one of the tributary port from the

		2nd SDH analyzer and receive it back on the corresponding tributary port a node "C" without any error. Now inject the intentional error from the 2nd SDH Analyzer, note that the protected VC-12 should switch over to protection, but same shall be received back on the 2nd SDH Analyzer faithfully. In order to avoid frequent switching over of VCs on the protection, it will be possible to set a threshold or disable the switching over due to errors . In general there are generally two options on the EMS of the equipment are available viz. one is that the on receipt of error on the normal path, the VC shall switch over to the protection and the second one is that it will send indication on the EMS that performance on the normal has degraded. Both the option are soft selectable and the testing team has to ensure it while testing the SNC-N protection. This shall be applicable on the SNC-N protection at the all levels i.e. SNC-N protection at VC-3 and VC-4 levels Now from the 1St SDH Analyser, select the STM-1 out going side payload interfacing node "B" . From this STM-1 payload select the VC12# 1. Also enable the "Error injection and analysis mode from the 1st SDH Analyzer. Select the V5 error injection from the menu. Insert the V5 errors continuously at 1in 10^8 rate. Immediately after enabling the error injection, the VC12#1 should switch over to protection path. Now note the following **a.** Go to the EMS of the

		equipment under test , Log on to the node "C". The EMS shall indicate that the VC-12#1 is working on protection channel. **b.** The EMS of the equipment shall notify the switching over and also shall indicate the time of switching over to protection i.e the "Time stamp" feature verification **c.**There shall be a bust of V5 error received on VC12 #1 at the time of switching over. Now open the fibre at Node A note that again VC12#1 shall switch over to normal path, because this VC12#1 has shifted to protection earlier Confirm from the EMS of the equipment. Record the observations. Repeat the test for VC3 and VC4 also. **Record the observations.**
6.1.1.1	**Sub-Network Connection Protection (SNC-N) - Details** SNC-N protection shall be provided at – 1. VC-4 level 2. VC-3 level 3. VC-12 level. This protection is applicable for ring configuration using two-fibres. The container generated from a PDH interface is mapped to form two virtual containers. Each of these two containers has the same data payload and is independently transmitted in both directions of transmission around the ring/network. At the receiving-end multiplexer, both the VCs are received & monitored. The VC with better performance is selected and demapped to the container level. As both the VCs are continuously monitored the matrix can switch the de-mapping	Test procedure is as stated above.

	process to the second VC in the event of a signal failure or signal degradation of the selected VC. It shall be possible to configure the network as fully protected network, partially protected network and unprotected network via EMS.	
6.1.2	**Protection Switching Time for SNC/P** The protection switching for LO-VCs and HO-VCs shall be completed within 50 ms. Protection switch completion time excludes the detection time necessary to initiate the protection switch and the hold-off time.	In the above test set up (5.1.1) put the 2nd SDH analyzer for projection switching time measurement . Repeat the fibre failure test and measure the protection switching time measurement. Take the observation and record the observation.
6.2	**System Restoration** The equipment shall provide system restoration as follows: ■ It shall identify the failures in the connected route by monitoring the SDH Overhead bytes. ■ The memory shall be non-volatile to avoid any loss of data in case of total system failure. The cross-connection map shall acquire back its pre-failure condition after restoration of faults.	Fail the system i.e. node failure condition. Note that all the connections made before the switching off the nodes shall remain in existence on re booting of the system. The connections made for SNC protection switching may be retained for this test. Switch off all the nodes and again switch on. Note that all the connection made shall retain in the memory. Record the observation.
6.3	**Optical Line Interfaces** The optical line interfaces are required to provide the interface between two line equipments connected by an optical path. It is intended to achieve transverse compatibility at any interface signal in the optical-section. The equipment shall meet the optical interfaces specifications @ S-1.1, L-1.1 at 1310nm or L-1.2 at 1550 nm as per ITU-T Rec. G.957.	Note that the optical line interface required shall either be specifications @ L 1.1 at 1310nm or L 1.2 at 1550 nm as per ITU-T Rec. G.957. Ensure them and record the observations.
6.3.1	**Digital Signal** The STM-1 line shall be in accordance with ITU-T Recs. G.957, G.707 and G.783.	Conform that the SDH structure is as per ITU-T G.783 , G.707 and Line parameters are as per ITU-T Rec. G.957.

6.3.2	**Nominal bit-rate** The nominal bit rate in the synchronized mode shall be in accordance with ITU-T Rec. G.811. The nominal bit rate in the free-running mode shall be as follows: STM-1: 155.520 Mb/s ± 4.6ppm (nominal).	Check the line rate , note that it should be: 155.520Mb/s ± 4.6ppm **Take observations and record the test results.**
6.3.3	**Optical parameters** The optical parameter values for the specified application-code shall meet the requirements given in ITU-T Rec. G.957 for the system operating wavelengths specified therein. The definitions of the various parameters are as given in ITU-T Rec. G.957.	Take the following optical test 1 Launched power, 2. Overload. 3. Optical Return Loss. 4. Optical Reflectance 5. Spectral width 6. SMSR/RMS as applicable **Take observations and record the test results.**
6.3.4	**Receiver Sensitivity** The values given in ITU-T Rec. G.957 against minimum sensitivity of receiver at reference point "R" are worst case end-of-life values for long haul application. The beginning-of-the-life values are specified to be 2-4dB better than the given values in above referred tables.	Take the test and record the test. The receiver sensitivity should be 3 dB better for the end of life value.
6.3.5	**Eye pattern** The shape of the optical pulse of the transmitter at reference point 'S', shall conform to the eye pattern mask as given in figure 2/ITU-T Rec. G.957. **Type of connectors** FC-PC/SC/LC connectors shall be provided at FDF/ODF end. In the equipment end, it shall be SC, LC, FC-APC or any other international standard	Take the eye pattern and extinction ratio using communication Analyser. Take the printout and attach with the test results. Record the type connectors used for optical in put and output ports.

	connectors. In case any proprietary connector is used at any of the ends, suitable adapters/patch-cords etc., shall be provided by the manufacturer as an integral part of the offer.	
6.4	**Jitter and Wander Performance for SDH interfaces** Jitter requirements for optical interfaces at STM-1 level shall be as given in ITU-T Rec. G.783. The STM-1 wander parameters shall be as per ITU-T Rec. G.813.	Test details are in the subsequent paras.
6.4.1	**SDH interfaces - Jitter and Wander** The jitter and wander specifications of SDH interfaces at STM-1 aggregate level shall be as per ITU-T Recs. G.783, G.825, G.811 and G.813 as applicable.	Test details are in the subsequent paras.
6.4.1.1	**Jitter and Wander Generation** The output jitter and wander shall meet the short term stability as specified in table 6/ITU-T Rec. G.813 or table 7/ITU-T Rec. G.813. Further, the equipment shall meet the jitter and wander limits as specified in ITU-T Rec. G.783.	Take the STM-1 optical output Jitter and wander test and attach the test result. These tests should be conducted on all the optical interfaces
6.4.1.2	**Jitter and Wander Transfer** The jitter and wander transfer function of an SDH regenerator shall be under the curve given in ITU -T Rec. G.783, when input sinusoidal jitter up to the mask level, levels specified in ITU-T Rec. G.783, is applied. The jitter and wander transfer characteristics shall be as per Para 15/ITU-T Rec. G.783.	Take the Jiiter and wander transfer test on regenerator. Attach the printouts an dtest results.
6.4.1.3	**Jitter and Wander Tolerance** SDH terminals and regenerators shall meet the jitter tolerance specifications given in ITU-T Rec. G. 783, with reference to figure 15.2/ITU-T Rec. G.783 with parameters specified type-wise and bit rate-wise. The jitter and wander tolerance of STM-1 interface shall be as per ITU-T Rec. G.825.	Take the STM-1 optical input Jitter and wander tolerance test and attach the test result.

6.4.2	**PDH interfaces: (Jitter and Wander)**	Heading, no test is required.
6.4.2.1	**Input Jitter and Wander Tolerance** The input jitter and wander tolerance shall be as per ITU-T Rec. G.823.	Take the input jitter and wander tolerance test on 2 Mb/s and 34 Mb/s interfaces. This test is required to be taken on alternate tribs. Record the test results and print out etc. Also take the test with 2048 Kb/s±50 ppm and 34368 ±20 ppm.
6.4.2.2	**Jitter and Wander Transfer characteristics** The jitter and wander characteristics shall be per ITU-T Rec. G.823.	Take the Jitter and wander transfer test on regenerator. Attach the printouts and test results.
6.4.2.3	**Jitter and Wander Generation**	Heading, no test is required.
6.4.2.3.1	**Jitter and Wander from tributary mapping** Jitter and wander from the tributary mapping shall be as specified in ITU-T Rec. G.783.	Take the output jitter and wander generation test on 2 Mb/s and 34 Mb/s interfaces due to tributary mapping. This test is required to be taken on alternate tribs. Record the test results and print out etc. Also take the test with 2048 Kb/s±50 ppm and 34368 ±20 ppm.
6.4.2.3.2	**Combined Jitter & Wander from tributary-mapping and pointer adjustments** Combined jitter and wander from tributary mapping and pointer adjustments shall be as per ITU-T Rec. G.783.	Take the output jitter and wander generation test on 2 Mb/s and 34 Mb/s interfaces due to tributary mapping and pointer adjustments as per the pointer movements specified in ITU-T Rec.G.783 . This test is required to be taken on alternate tribs. Record the test results and print out etc. Also take the test with 2048 Kb/s±50 ppm and 34368 ±20.
6.5	**DS-3 interface - Jitter and wander**	Heading, no test is required.
6.5.1	**Maximum permissible Jitter tolerance** The maximum permissible Jitter tolerance shall be as per table-1/ITU-T Rec. G.824.	Take the input jitter and wander tolerance test on 45 Mb/s interfaces. This test is required to be taken on alternate tribs. Record the test results and print out etc. Also take the test with ±20 ppm.

6.5.2	**Output wander** The wander at the out of interface shall not exceed the limits as specified in table-3/ITU-T Rec. G.824.	Take the output wander test on 45 Mb/s interface and record the observations and printouts.
6.5.3	**Input Jitter and wander tolerance** Input jitter and wander transfer characteristics shall be as per table-11 of ITU Rec. G.824 and figure 9/ ITU -T Rec. G.824.	Take the input jitter and wander tolerance test on 45 Mb/s interfaces. This test is required to be taken on alternate tribs. Record the test results and print out etc. Also take the test with ±20 ppm.
6.6	**STM-1 Electrical Interface**	Heading, no test is required.
6.6.1	**General Characteristics** The Interface Requirements for the STM -1 tributary interface shall be as per para 12/ITU-T Rec. G.703. Nominal bit rate : 155520 kb/s Tolerance : ± □ 20ppm Code : CMI (Code Mark Inversion)	Take the Bit rate test and record the readings Take the pulse mask test and record the observations. Record the observations.
6.6.1.1	**Specifications at the input ports** The digital signal presented at the input port should conform to table 11/ ITU-T Rec. G.703 and figures 22 & 23/ITU-T Rec. G.703 modified by the characteristics of the interconnecting coaxial pair. The attenuation of the coaxial cable should be assumed to follow an approximate √f law and to have a maximum insertion loss of 12.7dB at a frequency of 78MHz. The return loss characteristics should be the same as that specified for the output port.	Take the BER test after adding a coaxial cable loss of 12.7dB at a frequency of 78MHz.in the circuit at the input port and note that the BER test is passed successfully meeting the requirements 1X 10^{-10} with 2^{23} -1 from a DTA. Repeat the test at ±4.6 ppm. Also take the return loss at the input port and record the readings.
6.6.1.2	**Specifications at output ports** The specifications at the output port are given as below and as per figures 22 & 23/ITU-T Rec. G.703. Return Loss : ≥ 15 dB over freq. range 8 MHz to 240MHz. **Type of connector** : BNC/Spinner/SMA/SMB.	Take the return loss on output port and record the results. Note the connectors provided.

<table>
<tr><td>6.7</td><td>PDH Tributary Interfaces</td><td>Heading, no test is required.</td></tr>
<tr><td>6.7.1</td><td>34 Mb/s Electrical Tributary Interface

The Interface requirements for the 34 Mb/s Tributary Interface shall be as per ITU-T Rec. G.703.</td><td>.Note that the electrical interface of the 34 Mb/s tribs are as per ITU-T Rec. G.703.</td></tr>
<tr><td>6.7.1.1</td><td>General characteristics

Bit rate : 34368 Kb/ s ± 20ppm
Code : HDB3</td><td>Take the Bit rate test and record the readings

Note that the line code is HDB3.

Take test on all the trib interfaces equipped.</td></tr>
<tr><td>6.7.1.2</td><td>Specification at output ports

The specification at output ports are given as below and as per figure 17/ITU-T Rec. G.703.

Note: Refer to figure 17/ ITU-T Rec. G.703 for (b) to (h) above.

Return Loss: The Return loss at output port shall be as follows-

<table><tr><th>Frequency Range (kHz)</th><th>Return Loss (dB)</th></tr><tr><td>860 to1720</td><td>6</td></tr><tr><td>1720 to 51550</td><td>8</td></tr></table>
Type of connector: BNC/Spinner/SMA/SMB.</td><td>Take the pulse mask on oscilloscope and record the all the parameters specified in this clause.

Take the return loss on output port and record the results.

Note the connectors provided.</td></tr>
<tr><td>6.7.1.3</td><td>Specifications at the Input ports
The digital signal presented at the input port should conform to table 8/ITU-T Rec. G.703 and figure 17/ITU-T Rec. G.703 modified by the characteristics of the interconnecting coaxial pair. The attenuation of the coaxial cable should be assumed to follow an approximate "square root of f" law and to have a maximum insertion loss of in the range of 0 to 12 dB at a frequency of 17184 KHz.</td><td>Take the BER test after adding a coaxial cable loss of 12 dB at a frequency of 17184 Khz.in the circuit at the input port and note that the BER test is passed successfully meeting the requirements 1X 10^{-10} with 2^{23} -1 from a DTA.</td></tr>
</table>

<table>
<tr><td></td><td>The Return loss at the input port shall be as follows-

<table><tr><th>Frequency Range</th><th>Return Loss</th></tr><tr><td>860 KHz to 1720 KHz</td><td>> 12dB</td></tr><tr><td>720KHz to 34368-KHz</td><td>> 18dB</td></tr><tr><td>34368 to 51550KHz</td><td>> 14dB</td></tr></table></td><td>Repeat the test at ±20 ppm.

Also take the return loss at the input port and record the readings.</td></tr>
<tr><td>6.8</td><td>2Mb/s Electrical Interface
The interface requirements for the 2 Mbps tributary interface shall be as per ITU-T Rec. G.703.</td><td>Note that the electrical interface of the 2 Mb/s tribs are as per ITU-T Rec. G.703.</td></tr>
<tr><td>6.8.1</td><td>General Characteristics

Bit rate : 2048 kb/s ± 50 ppm
Code : HDB3.</td><td>Take the Bit rate test and record the readings.</td></tr>
<tr><td>6.8.2</td><td>Specification at the input ports
The digital signal presented at the input port shall be modified by the characteristics of the interconnecting cable. The attenuation of this cable shall be assumed to follow √f law and the loss at a frequency 1024 KHz shall be in the range 0 to 6 dB.

Return loss at the input port shall be as follows:

<table><tr><th>Frequency Range</th><th>Return Loss</th></tr><tr><td>51.2 KHz to 102.4KHz</td><td>> 12dB > 12dB</td></tr><tr><td>102.4KHz to 2048 KHz</td><td>> 18dB > 18dB</td></tr><tr><td>2048KHz to 3072KHz</td><td>> 14dB > 14dB</td></tr></table></td><td>Take the BER test after adding a coaxial cable loss of 6 dB at a frequency of 1024 Khz.in the circuit at the input port and note that the BER test is passed successfully meeting the requirements 1X 10^{-10} with 2^{15} -1 from a DTA.

Repeat the test at ±20 ppm.

Also take the return loss at the input port and record the readings.</td></tr>
<tr><td>6.8.3</td><td>Specification at output ports
The specifications at the output port are given as below and as per figure 15/ITU-T Rec. G.703.

<table><tr><th>Frequency Range (kHz)</th><th>Return Loss (dB)</th></tr><tr><td>51 to 102
102 to 3072</td><td>6
8</td></tr></table>
Type of connector
Wire-wrapping type, the wire-wrapping pin should be able to take wire 0.6 mm diameter. Alternatively IDC type or D-type terminations shall also be acceptable. The wire diameter in the case of IDC and D-type</td><td>Take the pulse mask on oscilloscope and record the all the parameters specified in this clause.

Take the return loss on out put port and record the reading.

Record the type connectors being in use, it should be either wire wrapping type or IDC type.</td></tr>
</table>

	termination shall be min. 0.5 mm diameter. The crimping tool and a minimum of 20m. connection-cable, shall be supplied as an integral part of the offer.	
6.9	**44.736 Mb/s Electrical interfaces (DS-3)** The electrical interface of 44.736 Mb/s shall be as per clause 8 of ITU-T Rec. G.703. The card for DS3 interface must be software configurable as a 34Mb/s card to accept a 34Mb/s PDH signal as defined in ITU Rec. G.703. The electrical interface for 34Mb/s signal shall be in accordance with ITU Rec. G.703 and the multiplexing of 34 Mb/s signal to SDH hierarchy shall be as per ITU Rec. G.707. Nominal line rate : 44. 736 Mb/s	Verify and record that the electrical interface of 44.736 Mb/s is as per ITU-T Rec.G.703 .
6.9.1	**Line rate accuracy** In a self-timed, free running mode, the line rate tolerance shall be +/- 895bits/s (+/-20ppm) or better.	Record line bit rate. It should be 44. 736 Mb/s+/- 895bits/s (+/-20ppm) or better.
6.9.2	**Line code** B3ZS (bipolar with three-zero substitutions).	On the Oscilloscope, verify and record that the Line coding is in accordance with B3ZS.Take the Screen print and record other parameters specified in in ITU-T Rec. G.703.
6.9.3	**Frame structure** The signal shall have the frame structure defined in recommendation ITU-T Rec. G.752.	Verify the frame structure of the DS-3 interface, it should be as per ITU-T Rec. G.752.
6.9.4	**Medium** Unbalanced coaxial line shall be used for each direction of transmission.	Note and record that the input and output interfaces are unbalanced.
6.9.5	**Test load impedance** Unbalanced 75 ohms coaxial line shall be used for each direction of transmission.	Verify and record that the impedance of input and output ports are 75 ohms (Unbalanced).
6.9.6	**Pulse shape** The shape of every pulse that approximates an isolated pulse (is preceded by two zeros and followed by one or more zeros) shall conform to the mask in Figure 14 of ITU Rec. G.703. See clause 5.2 of ITU Rec. G.703 for allowable procedures to be followed	Take the pulse shape at the output port and note that it conforms to the mask in Figure 14 of ITU Rec. G.703. Ensure that it meets the requirements specified in this

	in checking conformance. This mask includes an allowance of ± 3% of the peak pulse amplitude at any point on the mask relative to the pulse mask in the earlier version.	clause.
6.9.7	**Power level** A wideband power measurement of an AIS signal (as defined in Recommendation G.704) using a power level sensor with a working frequency range of 200 MHz shall be between - 4.7 dBm and +3.6dBm, including the effects of a range of connecting cable lengths between 68.6 meters (225 feet) and 137.2 meters (450 feet). A low-pass filter having a flat pass-band and cut-off frequency of 200 MHz shall be used. The roll-off characteristics of this filter are not important **or,** an alternate power level specification of the power of an all-ones signal (Note 2/ ITU Rec. G.703) is useful for some equipment qualifications. It requires that the power in a 3 kHz ± 1 kHz band centred at 22,368 kHz be between -1.8dBm and +5.7 dBm. It further requires that the power in a 3 kHz ± 1 kHz band centred at 44,736 kHz be at least 20dB below that at 22 368 kHz.	Measure the power level and record the readings.
6.9.8	**Pulse imbalance** 1) The ratio of amplitudes of positive and negative isolated pulses shall be between 0.90 and 1.10. 2) Positive and negative isolated pulses shall both conform to the mask of figure 14/ITU Rec. G.703.	From the pulse mask of the output signal, confirm that the ratio of amplitudes of positive and negative isolated pulses Also confirm that Positive and negative isolated pulses shall both conform to the mask of figure 14/ ITU Rec. G.703. Record the test results.
6.9.9	**DC power** There shall be no DC power applied at the interface.	Measure and record that there is no DC power applied at the interface. Record the observations.
6.9.10	**Verification access** Access to the signal at the interface shall be provided for verification of signal specifications. **Type of connector**: BNC/Spinner/SMA/SMB.	Note that there is an access to port for verification of signal. Record the observations. **Type of connector**: Note that

		connectors used by the manufacturer are either of the following BNC/Spinner/SMA/SMB. Record the observations.
6.10	**Ethernet over SDH Interface** The equipment shall support Ethernet over SDH at 10/100BaseT and 100BaseFX Ethernet interfaces in accordance with ITU -T Rec. G.7041 (GFP). **Termination for Ethernet interfaces** Ethernet tributaries shall be terminated on termination panel. The same shall be extended to the respective Ethernet IO cards through back-panel connectivity. However, direct termination of Ethernet interfaces on Ethernet IO cards using RJ-45 connectors with UTP -cat.5 or any other appropriate international standard cable for respective Ethernet interfaces, shall also be acceptable. **Note:** The exact nos. of 10/100BaseT, 100BaseFX and 1000Base SX/LX Ethernet interfaces shall be as per requirements of the purchaser.	Verify and record that the equipment under test support Ethernet over SDH at 10/100BaseT and their encapsulation is as per ITU-T Rec. G.7041 (GFP). Note that the system engineering has been done in such a manner that the terminations of Ethernet ports as defined in this clause are brought on a termination panel, which are further extended to the I/O ports of the Ethernet cards using RJ-45 connectors with UTP-cat.5 or any other appropriate international standard cable for respective Ethernet interfaces Record the observation. Please note that in the case of validation of product is as per PO, the other condition, if any, is also met. Record the observation.
7.0	**System Requirements**	Heading, no test is required.
7.1	**Synchronization** The synchronization of the system shall be done in accordance with ITU-T Rec. G.783. The synchronization network shall be based on Primary Reference Clock. The Internal clock/Holdover-mode clock interface shall meet the timing requirements the Option-1 of the ITU-T Rec. G.813. The SDH Equipment (slave) Clock shall meet the requirements	Confirm and record that the synchronization of the equipment is as per ITU –T Rec.G.783 and it is based on Primary Reference Clock. The accuracy of internal free

	related to the SDH equipment as per ITU-T Rec. G.781 as well as G.813.	running clock and hold over accuracy is a s per Option-1 of the ITU-T Rec. G.813. The SDH Equipment (slave) Clock shall meet the requirements related to the SDH equipment as per ITU-T Rec. G.781 as well as G.813. Take the test and record the observations.
7.1.1	**Synchronization References** The synchronization references shall be in accordance with the ITU-T Rec. G.783. The SDH equipment Terminal Multiplexers and Add/Drop Multiplexers shall have provision of deriving the timing references from six types of inputs apart from its internal oscillator- 1. Incoming STM-1 signal 2. External clock at 2048 KHz as per ITU-T Rec. G.703. 3. External clock at 2048 Kb/s as per ITU-T Rec. G.703. It shall be possible for user to select minimum three timing-reference signals and their priority configured through management software. The equipment shall generate the Timing Marker and shall be able to transfer it to other nodes via 'S1' byte in the Section-Overhead. In the event of selected reference timing as mentioned above is lost, the SDH equipment shall switch over to next priority reference timing within 300 ms to 1800 ms. It shall be possible to provide both manual and automatic reversing timing signal through software. The WTR period for automatic reversing shall be as per ITU-T Rec. G.781.	From the EMDS of the equipment configure the System timing to work on following input timing references. 1. Incoming STM-1 signal 2. External clock at 2048 KHz as per ITU-T Rec. G.703. 3. External clock at 2048 Kb/s as per ITU-T Rec. G.703. *4. Traffic carrying tributary at 2048 Kb/s with retiming facility.* This shall be timing sources apart from built in free running oscillator. Take the necessary tests and record the observations.
7.1.2	**Frequency Accuracy** The frequency accuracy of the internal oscillator of the SDH equipment in free-running condition shall be ±4.6 ppm (The test time shall be minimum 24 hours).	Measure the frequency accuracy of the internal oscillator and its accuracy shall be ±4.6 ppm (The

		test time shall be minimum 24 hours). **Take the test and record the test results.**
7.1.3	**Hold-over mode accuracy** The holdover mode short term and long term accuracy shall be as per ITU-T Rec. G.813.	Create the hold over condition and note that the accuracy of the hold over frequency is as per ITU-T Rec.G.813. **Take the test and record the test results**
7.1.4	**Clock bandwidth** The clock bandwidth shall be in the range of 1~10 Hz as specified in ITU-T Rec. G.813 for internal clock and hold-over mode and as per ITU-T Rec. G.812 for transit node and local node clock.	Note that the bandwidth of internal oscillator and hold over mode is in the range of 1~10 Hz for G813 clocks and for G.812 for range of 1~10 Hz **Take the test and record the test results** Note that the bandwidth of internal oscillator and hold over mode is in the range of 1~10 Hz for G813 clocks and for G.812 for range of 1~10 Hz **Take the test and record the test results**
7.1.5	**Frequency pull-in and pull-out range** The minimum pull-in and pull-out range shall be ± 4.6 ppm for hold-over mode and internal clock. For transit and local node clocks it shall be as per ITU-T Recs. G.812 & G.813.	Arrange the testing of frequency pull-in and pull-out and not that the equipment accepts the pull-in and pull-out range of ± 20ppm for hold-over mode and internal clock . For transit and local node clocks it shall be as per ITU-T Recs. G.812 **Take the test and record the test results**
7.1.6	**Timing output interface** The SDH equipment shall provide timing-output interfaces supporting 2048 KHz and 2048 Kbps, selectable from a single physical port or two physical ports, for external synchronization. The output specifications shall conform to ITU -T Rec. G.812, as applicable.	Verify and record the observations that there are two clock outputs are supported by the equipment one at one at 2048 KHz and the other at 2048 Kbps, for external synchronization. Take the jitter and wander test on the clock outputs to ensure there accuracy as

		per G.813 for internal and holdover mode clock, as per G.812 for transient and local node clock. **Take the test and record the test results. Attach the printouts of jitter and wander tests.**
7.1.7	**Specification of clock ports** The specification of the input and output port for 2048 KHz shall be as follows:	No test required.
7.1.7.1	**Specifications of 2048 KHz clock interface**	No test required.
7.1.7.1.1	**Specification at input port** The received digital signal presented at the input port shall be modified by the characteristics of the interconnecting cable. The attenuation of this cable shall be assumed to follow √f law and the loss at a frequency 1024 KHz shall be in range 0 to 6 dB. Return loss at the input port shall be ≥ 15 dB.	Take the return loss at the input port of the External clock and it should be as per the limits specified in this clause. Connect the a roll of coaxial cable between the clock input port and the instrument whose loss at 1024 KHz is 6 dB. **Take the test and record the test results.**
7.1.7.1.1.1	**Jitter and wander specifications** The input jitter tolerance and input wander tolerance of holdover/internal clock shall be as per ITU -T Rec. G.813. For transit and local node clocks it shall be as per ITU -T Rec. G.812.	Run the input jitter tolerance mask and input wander tolerance mask for 2048 Khz clock input as well as 2048 Kb/s clock inputs. The jitter and wander masks for G.813 shall be as specified in G.813 and for local and transient node clocks , the jitter and wander masks shall be as per G.812. **Run the masks, record the observations and attach the print outs.**
7.1.7.1.2	**Specification at output port** The output port shall meet the specification as given in Table 11/G.703 and shall meet the mask given in figure 20/G.703. The port impedance shall be 120 Ω	On the oscilloscope take the test of pulse masks for 2048 Khz clock input as well as 2048 Kb/s clock inputs.

<table>
<tr><td></td><td></td><td>Take the test and record the test results.</td></tr>
<tr><td>7.1.7.1.2.1</td><td>Jitter and wander specifications
The output jitter and wander shall be as per ITU-T Rec. G.813 for Hold over/ internal clock, and for transit as well as local node clocks shall be as per ITU-T Rec. G.812.</td><td>Take the Jitter and wander test on the output clock ports. The Jitter and wander test mask for equipment working on internal/holdover clock shall be as per G.813 and shall be as per G.812 for Local and transient node clocks.

Run the masks, record the observations and attach the print outs</td></tr>
<tr><td>7.1.7.2</td><td>Specification of 2048 Kb/s interface</td><td>No test required.</td></tr>
<tr><td>7.1.7.2.1</td><td>Specification at input port
The received digital signal presented at the input port shall be modified by the characteristics of the interconnecting cable. The attenuation of this cable shall be assumed to follow √f law and the loss at a frequency 1024 KHz shall be in range 0 to 6 dB.

Return loss at the input port shall be as follows:

<table><tr><th>Fr4equecny range (KHz)</th><th>Return Loss (dB)</th></tr><tr><td>51-102</td><td>12</td></tr><tr><td>102-2048</td><td>18</td></tr><tr><td>2048-3072</td><td>14</td></tr></table></td><td>Take the return loss at the out port of the External clock and it should be as per the limits specified in this clause. Connect the a roll of coaxial cable between the clock input port and the instrument whose loss at 1024 KHz is 6 dB.
Take the test and record the test results</td></tr>
<tr><td>7.1.7.2.1.1</td><td>Jitter and wander specifications
The jitter and wander at the input port shall be as per ITU-T Recs. G.812 and G.813 as applicable.</td><td>Already covered above.</td></tr>
</table>

<table>
<tr><td>7.1.7.2.2</td><td>Specification of output port
The output port shall meet the specification as given in table 7/ITU-T G.703 and shall meet the mask given in figure 15/ITU-T G.703. The port impedance shall be 120Ω . Return loss at the input port shall be as follows:
<table><tr><th>Fr4equecny range (KHz)</th><th>Return Loss (dB)</th></tr><tr><td>51-102</td><td>6</td></tr><tr><td>102-3072</td><td>8</td></tr></table></td><td>Take the return loss at the out port of the External clock and it should be as per the limits specified in this clause. Connect the a roll of coaxial cable between the clock input port and the instrument whose loss at 1024 KHz is 6 dB.

Take the test and record the test results</td></tr>
<tr><td>7.1.7.2.3</td><td>Jitter and wander specifications
The jitter and wander at the input port shall be as per ITU-T Rec. G.812 and G.813 as applicable.</td><td>Already covered above.</td></tr>
<tr><td>7.1.8</td><td>Tributary Re-timing [optional requirement]

The equipment shall provide optional capability for E1 tributary re-timing option w.r.t. local STM-1. The tributary synchronization solution may be provided by a separate board or may be provided on a common E1 board provided it offers per-E1 configuration for tributary re-synchronization. Any other architecture for tributary re-synchronization shall also be acceptable.

The specifications at the input port and output port shall be same as clause 7.1.7 as above.</td><td>Note that there is a card either built in or separate that support the retiming of E1 port data contents to use it as one of the inputs.

When it is retimed its outpour clock specifications shall be same as 2048 KHz clock input specified above. It shall meet input out specifications of 2048 kb/s clocks. Take Jitter and wander tests, pulse mask tests and record the observations</td></tr>
<tr><td>8.0</td><td>Technical Specifications</td><td>Heading, no test is required.</td></tr>
<tr><td>8.1</td><td>SDH Multiplexing Structure
The SDH Multiplexing Structure shall be in accordance with ITU-T Rec. G.707, as detailed in figure 6-1/ ITU-T Rec. G.707.</td><td>With help of SDH analyzer take the SOH and POH of the equipment under test and record the observations. It should be as per figure 6-1/ ITU-T Rec. G.707.

Take the test and record the test results</td></tr>
<tr><td>8.1.1</td><td>Multiplexing method
The equipment shall adopt the Multiplexing methods for one no. of AUG into STM-1 frame as per Para</td><td>Using SDH analyzer verify the multiplexing technique adopted. It</td></tr>
</table>

	7/ITU-T Rec. G.707. The various multiplexing options of VCs into STM –N and their position in STM-1 frame shall be as per Para 7/ ITU-T Rec. G.707.	shall be as per ITU-T G.703 references given in this clause. **Take the test and record the test results**
8.1.2	**Pointer Applications** The equipment shall provide the pointer generation and pointer interpretations as per Para 8/ITU-T Rec. G.707. The pointer shall accommodate the difference in phases of VC-n and the SOH as well as differences in the frame rates. The equipment shall process STM-1 AU pointer, AU-4 pointer, AU pointers of other mapped tributaries, TU-3 pointer and TU12 pointer etc., (as applicable) as specified in para 8/ ITU-T Rec. G.707.	Take the pointer tests using pointers movements specified in ITU-T Rec.G.783 **Take the test and record the test results.**
8.1.3	**Section Overhead** The SOH shall be added to the payload to create an STM-1. The SOH information shall further be classified in to Regenerator Section Overhead (RSOH) and Multiplex-Section Overhead (MSOH). The termination of Regenerator Section Overhead shall be done at the Regenerator and Multiplexers; whereas termination of Multiplex Section Overhead shall only be done at Multiplexers. The Section Overhead and its various functions shall follow the recommendations given in Para 9/ ITU -T Rec. G.707.	With help of SDH analyzer take the SOH of the equipment under test and record the observations. It should be as per figure 6-1/ ITU-T Rec. G.707. Verify the RSOH and MSOH also **Take the test and record the test results**
8.1.4	**Regenerator Section Over-Head (RSOH)** The Regenerator Section Overhead shall provide for the following bytes. A1,A2 : Framing bytes J0 : Regenerator-Section trace byte B1 : BIP-8 , error monitoring byte E1 : Engineering Order-wire byte D1- D3 : 192 Kbps Regenerator-Section DCC bytes	With help of SDH analyzer , select the RSOH and look for the byte listed in this clause. Verify the function of each of the byte and ensure these bytes support the functionality they have been assigned. **Take the test and record the test results**
8.1.5	**Multiplex section Over-Head (MSOH)** The Multiplex Section Overhead shall provide for	With help of SDH analyzer , select the MSOH and look for the byte

	following bytes. B2 : BIP-Nx24, Error Monitoring bytes K1, K2 : Automatic Protection switching, APS bytes D4 - D12 : 576 Kbps Multiplex-Section DCC bytes E2 : Engineering Order-wire bytes S1 : Synchronization Status Message byte M1 : Multiplex Section Remote Error Indication byte Z0 : Spare byte The STM-1 Section Over-head shall be as per ITU-T Rec. G.707.	listed in this clause. Verify the function of each of the byte and ensure these bytes support the functionality they have been assigned. **Take the test and record the test results**
8.1.6	**Virtual Container POH** Two categories of Virtual Container POH shall be supported by the SDH equipment.	With help of SDH analyzer , select the POH for VC4,VC3 and Vc12 levels payloads and look for the byte listed in this clause. **Take the test and record the test results**
8.1.6.1	**Higher Order Virtual Container POH: VC-4/VC-3 POH:** The VC-4 and VC-3 POH shall be located in the first column of the container VC-4 and VC-3 POH shall be as under- J1 : Path trace byte B3 : Path BIP8 byte C2 : Signal Label byte G1 : Path Status byte H4 : Position Indicator byte K3 Automatic Protection Switching Channel byte	With help of SDH analyzer , select the POH for VC4 and VC3 levels payloads and look for the byte listed in this clause. Verify the function of each of the byte and ensure these bytes support the functionality they have been assigned **Take the test and record the test results**
8.1.6.2	**Lower Order Virtual Container POH: (VC-3 /VC-12 POH):** VC3/VC12 POH shall be as follows:	With help of SDH analyzer , select the POH for vc12 levels payload

	V5 : Error Monitoring byte J2 : Path trace byte K4 Automatic Protection Switching byte Various functions for K3 and K4 bytes have been defined in ITU-T Rec. G.707. The defined functions shall be adhered to.	and look for the byte listed in this clause. Verify the function of each of the byte and ensure these bytes support the functionality they have been assigned. **Take the test and record the test results**
8.2	**Mapping of Tributaries in to Virtual Containers (VCs)** The accommodation of asynchronous tributaries as defined in ITU-T Rec. G.702 shall be possible. The equipment shall support the asynchronous mapping of 2Mbps, 34/45Mbps PDH signals into their respective VCs as specified in Para 10/ITU-T Rec. G.707.	With help of SDH analyser, ensure the mapping of tributaries specified in this clause as per ITU Rec. G.707. No proprietary mapping has been involved. Also verify the mapping of Asynchronous and Synchronous mapping of 2048 Kb/ s payloads **Take the test and record the test results**
8.2.1	**Information Payload** The payload structure shall be organized in accordance with the ITU-T Recs. as given in para 6.2.2 /ITU-T Rec. G.707.	Ensure that the payload area at different containers is as per ITU _T Rec. G.707 **Take the test and record the test results**
8.3	**Engineering Order-wire Channel (Optional requirements)** EOW, if provided, shall use E1 or E2 bytes to provide for voice communication between Terminals to Terminals. No other byte shall be used for order-wire purpose. The order-wire shall have the facility of selective calling. The order-wire channel shall be a 64Kb/s PCM channel (or emulated over IP for VoIP EOW) and shall comply with performance requirement laid down in ITU-T Rec. G.712.	Ensure that only E1 or E2 bytes of SDH overheads have been used for EOW and no other byte/ channel is utilized for EOW. The order wire shall support selective calling facility. Take the Voice test as per ITU-T G.712 on Order wire and record the test results. Also verify the signalling etc., both audio and visual indications should be provisioned. In case the VOIP EOW is used , it must support the G.712 requirements and the manufacturer shall arrange the

		testing of VOIP EOW **Take the tests and Record the test results**.
8.4	**Maintenance signals** The maintenance signals philosophy shall be as per para 6.2.4/ITU-T Rec. G.707.	Verify the maintenance signal provisioning as per para 6.2.4/ITU-T Rec. G.707. **Take the observations and record the results**.
8.4.1	**Maintenance, Performance Monitoring and Alarm Signals** a) ITU-T designated overhead bytes shall provide in-service monitoring. Major alarm signals such as Loss of Signal (LOS), Loss of Frame (LOF), and Loss of Pointer (LOP) resulting in Alarm Indication Signal (AIS) are required to be transmitted downstream. In response to the different AIS signals, Remote Defect Indication (RDI) /Enhanced Remote Defect Indication (E-RDI) as applicable is to be sent upstream. The Remote indication operation such as REI and RDI shall be as per Appendix II of ITU-T Rec.G.806 and the AIS generation shall be as per Appendix II of ITU-T Rec. G.806. The generation of Enhanced RDI shall be in accordance with Appendix VII of ITU-T Rec. G.783 respectively. The defect, anomaly, correlation and restoration shall be as defined in ITU-T Recs. G.783 and G.806. The detail of alarms is as given in para 5.2.1. b) Performance monitoring at each level in the maintenance hierarchy is based on Bit-Interleaved-Parity (BIP) checks calculated on a frame by frame basis. These BIP checks are inserted in the Overheads associated with the **Section and Path.** Errors detected in the Higher Order (HO) Path and Lower Order (LO) Path BIPs cause the respective Remote Error Indication (REI) signals to be sent upstream. The REI generation and transmission shall be in accordance with Appendix III of ITU-T Rec. G.806. It shall be possible to assign the programmable threshold to performance monitoring mechanisms such as B1 Error, B2 Error, B3 Error and BIP-2 Errors. The programming of threshold shall be from 1	Note that the Maintenance, Performance monitoring and Alarm signals are as per the specifications in this clause and the ITU-0T standards referred in this clause have been complied. **Take the observations and record the results**. Note that error insertion at rate of from 1 in 10^4 to 1 in 10^9 through software. Is possible through NMS of the equipment., **Take the observations and record the results**

	in 10^5 to 1 in 10^{10} through software. c) Details of section level and path level maintenance & performance monitoring and alarm signals shall be provided by the various byte functionalities shall be as specified in ITU-T Rec. G.707. d) The parameters to be monitored in the system shall be as given in ITU-T Rec. G.783. e) The equipment shall support various Defects, Anomalies, and Defects/Correlation, Performance monitoring and consequent actions as outlined in ITU-T Recs. G.783 and G.806.	
8.4.1.1	**Alarms** The following Alarms and consequent actions shall be possible to monitor via EMS & LCT of the equipment. Classification of the alarms as Critical/Major/Minor/shall be provisioned: 1. Loss of signal (LoS) 2. Loss of Frame (LoF) 3. RS-TIM 4. MS-AIS 5. B-2 Err.* (Excessive) $1x10^{-3}$ 6. MS-RDI 7. AU-AIS 8. AU- LOP 9. HP- UNEQ 10. HP-TIM 11. HP- RDI 12. B-3 Err.* (Excessive) $1x10^{-3}$ 13. LP- TU-AIS 14. LP- UNEQP 15. LP- TIM 16. TU- LOP 17. TU-LOM 18. V-5 Error* 19. LP- RDI 20. GFP alarms as per G.7041- • LFD • CSF 21. LCAS alarm as per G.7042.	Note that all the alarms specified in this clause are complied. Simulate the test using SDH analyzer and note that the EMS of the equipment is reporting the alarm. **Take the observations and record the results**

8.4.2.1	**Performance degradation counters** • *B1err, B2err, B3err, V5err* • *LP-REI* • *HP-REI.* The EMS and equipment shall support monitoring of BIP-errors. Also EMS shall support the monitoring of consequent action due to Excessive errors in the higher order path and lower-order path. On exceeding the B3 and V5 errors, a remote error indication, an anomaly shall be sent to the remote end in the form of HP -REI and LP -REI. Similarly Remote Defect Indications are also the anomalies created due to defects at the receiving stations.	Note that ▪ B1err, B2err, B3err, V5err are provisioned in the EMS of the equipment. With the help of SDH analyzer simulate the error test and record the observations ▪ Note that ▪ LP-REI ▪ HP-REI. are provisioned in the EMS of the equipment. With the help of SDH analyzer simulate the error test and record the observations
8.4.3	**Concatenation mechanism**	Heading, no test is required.
8.4.3	**Virtual Concatenation** The equipment shall support the virtual concatenation at VC12 and VC3 levels as specified in para 11.2/ ITU-T Rec. G.707. But VC3 based VCG's shall be optional to purchaser's requirements. The details of VCG shall be as per clause 7.4.7 (as follows) of this GR.	Note that Virtual concatenation is supported by the equipment as per ITU-T Rec G.707. Make VCGs at VC12 ,VC3 and VC4 levels. From the EMS equipment. **Take the observations/tests and record the results**
8.4.4	**Generic Framing Procedure** The equipment shall support the encapsulation of Ethernet and other higher-layers clients' data supporting GFP-Framed as per ITU-T Rec. G.7041.	Ensure that GFP is supported by the equipment as per G.7041. **Take the test and record the observations**.
8.4.5	**Link capacity Adjustment Scheme** The equipment shall support the Link Capacity Adjustment Scheme as specified in ITUT Rec. G.7042. The addition/deletion of VCn's from a VCG shall be hitless. Implementation of LCAS in the system shall not introduce/contribute additional latency in the data path.	Ensure that LCAS is supported by the equipment as per G.7042. **Take the test and record the observations** **Take the test and record the observations.**
8.4.5.1	**LCAS requirements** LCAS signalling between peers is carried in the SDH path overhead as outlined in ITU-T Rec. G.7042 and G.707. The following LCAS capabilities shall be	Note that the requirements specified in this clause are supported by the equipment. Remove some VCs from VCG at

	supported. • Basic LCAS Operation • LCAS and 1+1 Path Protection • LCAS Group Identifiers • LCAS Inter-working. The LCAS feature specified above shall be applicable to all Virtually Concatenated payloads configurable through EMS/LCT.	intermediate node and note that the Ethernet still works, after the reduction of effective bandwidth. **Take the test and record the observations**
8.4.5.2	**LCAS Interworking** When two nodes use virtual concatenation for a network connection, it is possible that one side is configured to use LCAS on the connection, and the other side is not (or does not support LCAS). That is, when a node is using LCAS on a VC bundle (LCAS Configuration is enabled), it sends LCAS control messages. If a node does not receive any LCAS control messages, it assumes that the peer is not using LCAS.	Note that the requirements specified in this clause are supported by the equipment . Remove some VCs from VCG at intermediate node and note that the Ethernet still works, after the reduction of effective bandwidth. **Take the test and record the observations.**
9.0	**Ethernet Service requirements** The following services shall be offered- • **Point-to-Point Dedicated (P2PD)** A point-to-point dedicated service shall map Ethernet traffic into one transport path and transport the traffic to another Ethernet interface on the far end. There is no aggregation at either side of the network. Alternatively, the Ethernet traffic from one port can be mapped on a module to another. The P2PD service is used to offer dedicated Ethernet Private Line services. • **Point-to-Point Shared (P2PS)** A point-to-point shared service shall map Ethernet traffic from multiple Ethernet interfaces on one Ethernet IO module into one transport path and shall transport the traffic across the network to another Ethernet module. The P2PS service is used to offer "Ethernet Virtual Private Line" services.	Verify and ensure that the requirements specified in this clause are supported by the equipment **Take the test and record the observations.**

	• **Internet Access Service** An Internet access service shall allow multiple subscribers access the hub-site router for Internet access. This service shall aggregate traffic in two locations: at the subscriber side and at the hub-site. On the subscriber site, the node shall statistically multiplex Ethernet traffic from multiple Ethernet ports on the same card onto a transport path. At the hub-site, the node shall statistically multiplex traffic from multiple transport paths onto one single Ethernet interface. The IAS service is used to offer shared Ethernet access to Internet services. • **Transparent LAN Service** A transparent LAN service shall allow multiple Ethernet devices in multiple locations to appear as a single private LAN (virtual LAN or VLAN). Each device shall attach to an Ethernet port on an individual node. Each node shall connect to another node in a point-to-point or linear-chain topology. Each Ethernet device can exchange data with any other device on the LAN with the same virtual identifier (VLAN). The transparent LAN services can be configured for individual customers (separate Ethernet devices) but shall share the trunk bandwidth between nodes. Apart from the same, there shall be support for point to point, point to multi-point as well as multi-point to multi-point services on all Ethernet ports in accordance with ITU-T & MEF standards, as defined previous and subsequent clauses in the GR.	
9.1	**Layer 2 Services Implementation Requirements** The equipment shall support VCAT/GFP over any of the SDH interfaces in the equipment, and shall aggregate the packet traffic through packet-switching subsystem (Ethernet MAC), and encapsulate the packet traffic within GFP/VCAT/LCAS channels and forward the same over various STM-N interfaces in the system. This mechanism shall provide significant efficiency while transporting data through the SDH	Check that right sizing of VCAT pipes for point to point Ethernet-Lines, multi-point to multi-point Ethernet-LAN and encapsulating the packet traffic within GFP/VCAT/ LCAS channels and forwarding the same over various STM-N interfaces are possible on

	network through the following features: 1. Right sizing the VCAT pipe for point to point Ethernet-Lines (EPL, EVPL etc.) services. 2. Right sizing the VCAT pipe for multi-point to multi-point Ethernet-LAN (EPLAN, EVPLAN etc.) services. 3. Statistical multiplexing with SLA shall facilitate the purchaser to offer data services at multiple QoS classes with different SLA contracts.	any of the SDH interfaces. Also check that the system provides statistical multiplexing with different class of services for different SLA contracts.
9.1.1	**Service QoS Implementation**	Heading, no test is required.
9.1.1.1	**Fixed-rate Point to Point Ethernet Private Line service** Point to point data private-line service shall be offered through right-sized GFP/VCAT with guaranteed bandwidth between the two end points.	Ensure that a right-sized GFP/VCAT pipe provides a guaranteed bandwidth between the two end points.
9.1.1.2	**Burtsable Ethernet Private Line & LAN service** Burstable Ethernet Private Line & LAN service is a service instance wherein traffic from multiple Ethernet user-ports shall be aggregated using 802.1Q & 802.1ad defined Q-in-Q and transported through VCAT/GFP, for shared private line & LAN services. This shall be an overbooked service. The devices shall offer layer-2 traffic management and OAM features, such as port-rate limiting, ingress policing, troubleshooting etc. The SLA (service level agreements) for such services shall include CIR (Committed Information Rate), EIR (Excess Information Rate), COS (upto 4 classes of service) with 802.1P classification. This service shall facilitate node-based over-subscription. Thus bandwidth allocation between two SDH nodes on a ring shall be allocated permanently (for example STM1-2v), and traffic from multiple Ethernet customers shall be multiplexed with CIR/EIR (as configured) overbooking through VCAT path.	Load all the ports upto their maximum traffic bearing capacities with right sized VCAT/GFP and run the RFC 2544 scripts. Record the results.
9.1.1.2.1	**Additional layer 2 service attributes** ▪ The system shall provide layer-2 encapsulation and forwarding through MPLS using PWE3 as per RFC-3916 or ITU-T G.8112, ITU-T G.8121, ITU-T Y.1720 & & IETF draft Martini draft-ietf-pwe3-ethernet-encap-09.txt and related drafts. **[optional**	This is an optional requirement. If provided, create a pseudo wire tunnel and check that the Ethernet traffic flow (through put) remains

	requirement] ▪ Solid demarcation point between provider and customer, in the form of MEF UNI1.0. Per-customer unique identifiers for SLA monitoring and service identification. **[optional requirement]** ▪ Ethernet OAM&P as described below: a. The system shall support CFM as per IEEE 802.1ag. b. The system shall support Ethernet link OAM in accordance with IEEE 802.3ah . • IEEE 802.3ad link aggregation and protection on service and trunk ports.	constant and as per the size of the pipe and which can be limited through the EMS.
9.1.2	**Layer 2 functionality specifications** In order to realise the above-mentioned services, there shall be in-built layer-2 bridging & aggregation functionality as per IEEE 802.1D in the system. There shall be support for VLAN stacking (Q-in-Q) per IEEE 802.1ad on all ports. The users shall be identified based on MAC address/Physical port of arrival/VLAN-ID (C-VLAN) @IEEE 802.1q, as configured. There shall be customer and provider MAC address separation and learning. The transport-side VLAN (S-VLAN) shall be configured through LCT/EMS. For Ethernet Virtual Private Lines (EVPL) & Ethernet Virtual Private LAN (EVPLAN) services, multiple Ethernet user-ports shall share a configured VCG between two points. The VCG selection shall be based on VLAN-ID based, MAC based, and port based which shall be configured through EMS & LCT. The VCG selection may also be pre-configured through EMS. The purchaser shall convey exact requirements. Also there shall be provision for non-shared VCAT bandwidths against specific Ethernet ports which shall be used for Ethernet Private Lines (EPL). Either the support for EPL, EVPL, EPLAN, and EVPLAN services shall be configurable per Ethernet port on a common IO card or standalone Ethernet IO cards shall be provided for shared and dedicated access. The service requirements of MEF and ITU-T Recs. G.8010, G.8011, G.8011.x series shall be complied for Ethernets services. Some of the service implementation details are given in the following sections. Exact details regarding VLAN	Check the following: 1. that all the Ethernet services are configurable through the EMS. 2. VLAN stacking as per Q-in-Q is possible. 3. different services can share a common VCG between two end points. 4. VLAN-ID based, MAC based, and port based VLAN-ID based, MAC based, and port based selection of VCG is possible. 5. non-shared VCAT bandwidths for specific Ethernet service as Ethernet Private Lines (EPL) can be configured. 6. the support for EPL, EVPL, EPLAN, and EVPLAN services shall be configurable per Ethernet port on a common IO card or standalone Ethernet IO cards are provided for shared and dedicated access.

	administration for connectivity services are outlined in Appendix II of the GR.	
9.1.3	**Layer-2 Switching/Aggregation Implementation** The GR envisages layer-2 aggregation for both Fast & Gigabit Ethernet. . The switch matrix on the Ethernet line card shall be non-blocking and shall support switching from any Ethernet/VCG port on that card to any other Ethernet/VCG port. The switching capacity shall, at a minimum, equal the sum of capacities of Ethernet face plate ports and VCG ports. The equipment shall support 8 nos. of Fast Ethernet interfaces and 1 no. of GigE interface in ADM mode . The manufacturer shall ensure support for 1000BaseSX and 1000BaseLX @1310nm interfaces. The purchaser shall communicate exact interface requirements for 1000BaseSX/LX. The aggregated Ethernet traffic from layer-2 switch shall be encapsulated using GFP techniques and mapped onto SDH payload through virtually concatenated VCn's (VCGs) with configurable LCAS implementation. The equipment shall optionally support Ethernet line card redundancy. The client traffic in this configuration connects to one port on each card. If one of the cards fails, the traffic shall be carried using the other card. The switching times in the case of hardware failures shall be of the order of a few seconds. This configuration is expected to be used for providing services with high availability or when handing off traffic aggregated over one or several rings to external equipment (e.g. a core router). **Note:** The description of Ethernet switch- considers each of the TX and RX direction of an Ethernet interface as separate for calculation of switch- The TX & RX direction of a Gigabit Ethernet interface is taken as equivalent of 1Gb/s in calculating the switch capacity. Similarly, each of the TX & RX direction of a Fast Ethernet interface is taken as equivalent of 100Mb/s in calculating the switch capacity.	Check that - 1. The eqpt. Supports - 8 no. of FE - 1 no. of GE. 2. The capacity of the switch matrix is total of all the interface ports. 3. The switch matrix is non-blocking and that switching from any Ethernet/VCG port on a card to any other Ethernet/VCG port on the same card or any other card is possible. 4. Redundancy of Ethernet line card is optional. If provided, check that the client traffic is connected to a port in each card and when a card fails, , the traffic is carried using the other card. 5. Also check that the switching time in the case of hardware failures shall be of the order of a few seconds.
9.1.3.1	**Bridging specifications** 1. VLAN IEEE 802.1Q support on all ports 2. VLAN priority IEEE 802.1P support on all ports	Ensure from the vendor that the indicated international standards

	3. IEEE 802.1s RSTP support on all ports 4. IEEE 802.1ad Q-in-Q on all ports 5. IEEE 802.3ad LAG on all trunk ports.	are being used.
9.1.3.2	**Bandwidth granularity** @ 1 Mbps for Fast Ethernet and Gigabit Ethernet with rate limiting per port through LCT & EMS.	Check that the bandwidth can be configured in steps of 1 Mbps.
9.1.3.3	**Details of Ethernet interface provisioning** **Ethernet Private Line/LAN & Virtual Private Line/LAN services** The system shall perform layer-2 aggregation of the Ethernet user-flows sensitive to the C-VLAN's carried in the terminated Ethernet flows at Ethernet user ports. There shall be VLAN-based VCAT selection through EMS, for backhaul. Various Ethernet flows across multiple Ethernet user-ports on an Ethernet switch card with specific C-VLAN shall be aggregated and backhauled through a configured VCAT group (VCG). The QoS requirements are already explained before. The equipment shall support a minimum of 8 nos. of 10/100BaseT ports and 1 no. of GigE port in ADM mode. In case, no. of Ethernet ports supported per card is more, the quantity of Ethernet IO cards shall go down accordingly. The bandwidth, so provisioned, for a particular Ethernet port shall be indicated through GUI on the NMS/EMS (or LCT) server as well as shall be available in printable format for Service Level Agreement (SLA) obligations & for QoS certification. **Note:** The unutilized bandwidth after Ethernet backhaul applications shall not be blocked for other tributary applications.	The requirements have already been verified earlier. However, check that VLAN-based VCAT is selectable through the EMS and that the bandwidth for a particular service can be provisioned through the EMS.
9.1.4	**Ethernet connectors** Ethernet tributaries (at electrical level) shall be terminated on Ethernet tributary cards using RJ-45 connectors with UTP-Cat.5 cable or any other appropriate international standard cable. International industry standard connectors shall be provided for optical Ethernet ports.	Note that the Ethernet tributary uses RJ-45 connectors with UTP-Cat.5 cable or any other industry standard connectors.
9.1.5	**Ethernet-line service - PROVISIONING DETAILS** The Ethernet interface provisioning is envisaged	Check that VCGs can be

	through Ethernet interface (IO) cards. In Ethernet Private Line applications, a bandwidth in the form of a Virtual Concatenated Group (VCG), VCn-X-v where n=12, 3 & 4, shall be provisioned at the backhaul of Ethernet interfaces through EMS/LCT as per the following details: **Fast Ethernet 10/100BaseT interface** VC12-X-v where X=1 to 46 and, VC3-X-v where X=1 to 2. **1000BaseSX/LX interface** VC12-X-v where X=1 to 63 and, VC3-X-v where X=1 to 3.	provisioned with any no. of VCs and upto the maximum no. of VCs as indicated for FE as well as GigE.
10.0	**8.0 Mechanical standards** 1. The equipment shall be housed in the standard sub-racks preferably 19" width or ETSI standard rack. The sub-rack/chassis shall be fitted with motherboard duly masked to avoid short-circuiting. The sub-rack shall have protruded impressions on the top and base-plate of sub-rack assembly to act as built-in guides known as "CNC guide forming" for holding the PCBs in the sub-rack. The back and forth movement of PCBs shall be very smooth without any significant play towards the sideways. 2. The guides in the sub-rack shall be made with CNC machines/tools. In case of CNC tool being used to make guides, in order to maintain the accuracy, the technique adopted shall use a single DIE punching. The plastic guides shall not be permitted. **3.** If bottom and top plates are used as PCB holder/guides, in order to avoid bending/sagging of top and base-plates during transportation, installation and maintenance process, the metal-sheet used for these plates shall be minimum 1.2 mm in thickness for mild-steel material, 1.5 mm for Aluminium material and in case of stainless-steel material; the thickness of metal-sheet shall be 1.0 mm. For Horizontal PCB entry designs, the chassis should be strong enough to avoid any operational /	Note that the sub rack is either as per ETSI standards or specifically specified in this clause. Note that sub-rack shall have protruded impressions on the top and base-plate of sub-rack assembly to act as built-in guides known as "CNC guide forming" **Record the observations** Note that guides are not made by die punching The plastic guides shall not be permitted. **Record the observations** Measure the thickness of plates with the help of micrometer and record the observations. Verify and ensure that the connectors used on the PCB and their mating connectors on the mother-board shall have tight grip to avoid jacking problems. **Record the observations.** Insert the cards in wrong

	transportation issue. 4. The connectors used on the PCB and their mating connectors on the mother-board shall have tight grip to avoid jacking problems. The connectors used shall be professional grade telecom connectors of international industry standards. (Euro type or better). 5. The slots for interfaces in the sub-rack shall be universal, supporting any type of PCBs in any position except for common control, matrix, power supply and line cards. No damage shall take place to PCBs when loaded in the wrong slot. The PCBs shall have the provision of locking/screwing to the sub-rack. 6. The input/output terminations of tributary signals shall either follow extended mother-board using connectorised connections or directly from proper connectors at the mother-board. 7. The termination of 2048 Kb/s signals in each case shall adopt wire-wrapping, IDC, D-type connectors. No soldering for connections shall be permitted. There shall be proper covers on the sub-racks/main-racks or similar arrangements to avoid the ingress of dust. 8. The height of main-rack shall be strictly as per this document till specified otherwise. The main-rack shall be made from metal-sheet of minimum 2.0 mm thickness and shall be covered from three-side minimum, with top and base covers. The thickness of the back-covers shall be 1.0 mm minimum. The base-plate of the main-rack shall be 2.0 mm minimum. 9. The main-rack shall have adequate provision of holding/fixing the sub-racks in their positions. It shall be ensured that there is no lateral movement of sub-racks when fitted in main-rack. The main-rack shall have the proper fixing arrangements on floor, preferably with a base-plate and expansion-bolts etc. The thickness of base plate shall be minimum 2.0 mm. The main-rack supplied with equipment shall be uniform in size irrespective of the loading of the	positions. Take out the card and reinsert in their respective marked positions ansd ensure that there is no damage of any kind to these card due to wrong insertion **.** **Record the observations.** Note that the input/output terminations are as specified in this clause. **Record the observations.** Note that the termination of 2048 Kb/s signals in each case shall adopt wire-wrapping or IDC, D-type connectors. **Record the observations.** Measure the thickness of the plate with micrometer and **Record the observations.** Verify and ensure that the adequate arrangements are there to hold the sub rack into main rack. **Record the observations.** Measure the thickness of the plate with micrometer and **Record the observations** Ensure that the subrack/rack complies with the requirements of this clause. **Record the observations** Ensure that the subrack/rack complies with the requirements of

	equipment for all consignments by the manufacturer. 10. The manufacturer shall specify the mechanical standard of racks and sub-racks in their manual and shall maintain the size and standard of racks, sub-racks, connectors etc., during supply of the equipment. The main-rack shall have sufficient space preferably in the sideways for running the input out cabling etc. This shall specifically be ensured during the testing, field trial and QA of the equipment. 11. The permanent wiring such as distribution of power-supply and grounding etc. shall be pre-wired. During the testing and supply of the equipment the racks and subracks quality supplied by the manufacturer shall be ensured. 12. The front opening of the sub-rack/main-rack is envisaged. No rear-side/side-way opening shall be permitted. The access to data terminations shall be from the front side only.	this clause. **Record the observations**
11.0	**Minimum equipment for testing** The equipment fully equipped with common modules and engineered to cater the tributary interfaces as per the table below, shall be offered. Minimum quantity for individual tributaries shall be-	Note that the equipment offeed by the manufacturer for approval is as per this clause. List out the equipment offered the approval.
12.0	**Field Trial** The equipment shall be subjected to field trial for a minimum 4 weeks with working traffic using minimum three ADM nodes in ring configuration. Out of the three nodes, traffic between the two nodes shall preferably be loaded to its full capacity to ensure satisfactory handling capacity of the equipment	Take field trail of 4 weeks after fully loading the equipment. **Record the observations and tests.**

PART II: GENERAL REQUIREMENTS

1.0	**Reference Documents**	Heading, no test is required.
1.1	Whatever that has not been specifically stated in this document, shall deem to be as per relevant latest ITU-T recommendations.	Refer only the latest ITU-T rec.
1.2	All references to TEC GRs imply for the latest issues.	Refer the latest TEC GRs.
2.0	**Engineering requirements:**	Heading, no test is required.
2.1.	The equipment shall be fully solid-state and adopt state of the art technology.	For information only, no test is required.
2.2.	The equipment shall be compact and composite in construction and light-weight. The manufacturers shall furnish the actual dimensions and weight of the equipment.	For information only, no test is required.
2.3.	All connectors shall be reliable and of standard type to ensure failure-free operation over long periods and under specified environmental conditions.	The manufacturer shall provide a certificate of the CACT approval.
2.4	All cables shall be of Gigabit Ethernet ready standards.	Verify and note down.
2.5	The equipment shall be housed in standard 19” rack,	Verify and note down.

	600mm rack or slim-rack with a maximum height of 2750mm and with front-access. The ETSI racks shall also be accepted. However, it is desirable that the height of the rack is 2200 mm.	
2.6	The equipment shall provide natural cooling arrangements. But the purchaser may allow use of fans if the natural cooling arrangement is not found adequate provided: • The fan failure is reported through LCT/NMS. • Multiple fans are there in one tray. • Fans are DC operated. • MTBF is better than 80,000 hours.	In the case the equipment does not support the natural cooling, Ensure the following **1.** Fan failure is report through EMS of the equipment **2.** Record the redundancy provisioning of the fans. It should minimum be 1+1 hot standby **3.** Fans should be operated on DC power supply. Calculate the MTBF of the fan and note that it should not be less than 80000 Hrs.. Fail one fan/set of Fans and monitor the temperature of the shelf for one min. one hour and note down that the temperature does no deteriorate. Record the test results.
2.7	The plug-in units shall be of suitable type to allow their removal/insertion while the	Remove/insert the plug in units and not that there

	equipment is in energized condition.	is no damage to the equipment. Record the observation.
2.8	The mechanical design and construction of each card/unit shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport and conforming to DoT document QM-333 (Issue – March,2010) - "Specification for environmental testing of electronic equipment for transmission and switching use".	This clause is covered under QM-33 Vibration test.
2.9	The plug-in units shall be of suitable type to allow their removal/insertion while the equipment is in energized condition.	Remove/insert the plug in units and not that there is no damage to the equipment. Record the observation.
2.10	Each sub-assembly shall be clearly marked with schematic reference to show its function, so that it is identifiable from the layout diagram in the handbook.	Verify from the literature of the equipment that each sub-assembly is clearly marked with schematic reference to show its function, so that it is identifiable from the layout diagram .
2.11	Each terminal block and individual tags shall be numbered suitably with clear identification code and shall correspond to the associated wiring drawings.	Verify and ensure that each terminal block and individual tags is numbered suitably with clear identification code and corresponds to the associated

		wiring drawings.
2.12	All controls, switches, indicators etc., shall be clearly marked to show their circuit diagrams and functions.	Verify and ensure that all controls, switches, indicators etc., are clearly marked to show their circuit diagrams and functions
2.13	Facility to mount fixed-attenuator, if required, shall be provided in the receive-chain of the system.	Verify and ensure that facility to mount fixed-attenuator, if required, are provided in the receive-chain of the system
3.0	**Operational Requirements:**	Heading, no test is required.
3.1	The equipment shall be designed for continuous operation.	This will be verified during the field trial of the equipment.
3.2	The equipment shall be able to perform satisfactorily without any degradation at an altitude upto 3000 meters above mean sea level.	A certificate in this regard may be procured from the vendor and the same may be enclosed with the tst results.
3.3	Wherever the visual indications are provided, green colour for healthy and red colour unhealthy conditions shall be provided. Some other colour may be used for non-urgent alarms.	Ensure and record that visual indications are provided. Green colour for healthy and Red colour unhealthy conditions are provided. Some other colour LED is used for non urgent alarms.
3.4	The design of the equipment shall not allow plugging	Verify and ensure the same.

	of a module in the wrong slot or upside down.	
3.5	The removal or addition of any cards shall not disrupt traffic on other cards.	Verify and ensure the same. Removal and insertion of any cards in a BER measurement condition should not disturb the BER. Ensure that no error is reported.
3.6	*If special tools required for wiring, it shall be provided along with the equipment*	Obtain a certificate from the manufacturer.
3.7	*In the event of a bug found in the software, the manufacturer shall provide patches and firmware replacement if involved, free of cost. Compatibility of the existing hardware shall be maintained with future software/firmware.*	Obtain a certificate from the manufacturer.
3.8	*In the event of a full system failure, a trace area shall be maintained in non-volatile memory for analysis and problem resolution.*	Ask the manufacturer to simulate and demonstrate the requirement.
3.9	*Necessary alarms (indicators) for indication of faults at various levels of hardware shall be provided on the individual modules.*	Verify the same if provided.
3.10	*Live insertion and hot swap of modules must be possible to ensure maximum network availability and easy maintainability.*	Verify and ensure the same. Removal and insertion of any cards in a BER measurement condition should not disturb the BER. Ensure that

		no error is reported.
3.11	*The hardware and software components shall not pose any problems in the normal functioning of all network elements wherever interfacing with similar network for voice, data and transmission systems.*	Ensure the compliance.
3.12	*It shall be possible to selectively shut-off client transmitters and mask traffic alarms raised against the client port.*	Ensure the compliance.
3.13	*Visual indication to show power ON/OFF status shall be provided.*	Ensure the compliance.
4.0	**Quality Requirements**	Heading, no test is required.
4.1	The manufacturer shall furnish the MTBF values. The calculations shall be based on the guidelines as contained either in the DoT-QA document No.: QM-115 (January'1997) - "Reliability Methods and Predictions" or any other international standard.	Verify the calculations for MTBF and MTRR and ensure that the calculations are as per QA manual QM-115. Record the observations.
4.2	**a)** 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	Get a copy of the ISO certificate awarded to the company.

	to be submitted. **b)** The instrument shall be manufactured as per the latest DoT QA Guidelines indicated in Quality Manuals QM-118 { Quality and Reliability in product design}, QM-205 { Guidelines for Standards of Workmanship for Printed Boards}, QM-206 { Guidelines for Standards of Workmanship for Printed Board Assemblies}, QM-210 {Guidelines for Standards of Workmanship for Surface Mounted Devices} and QM-301 { Transmission Equipment General Documentation}.	These requirements shall be verified by the QA wing in accordance with the quality manuals mentioned.
4.3	The instrument shall conform to the requirements for environment as specified in the DoT-QA document No.: QM-333 (Issue March 2010) - "Specification for environmental testing of electronic equipment for transmission and switching use". The applicable tests shall be taken for environmental category B2 including vibration test.	Climatic tests shall be conducted separately as per Category B-2 of QM-333. Vibration test shall also be conducted as per the same quality manual.
5.0	**Maintenance requirements:**	Heading, no test is required.
5.1	Maintenance philosophy shall to replace faulty units/subsystems after quick on-line analysis through	In order to provide quick maintenance by replacing the faulty units all the

	SW. The actual repair will be undertaken at centralized repair centers. The corrective measures at site shall involve replacement of faulty units/sub-systems.	traffic affecting units shall have the front access and shall not involve any screw to mount them. Also ensure that online analysis is provided in case Built-In-Test Equipment facility is supported by the equipment.
5.2	The equipment shall provide easy access for servicing and maintenance.	Verify that easy access, front access in particular is provided for ease of maintenance.
5.3	**Suitable alarms shall be provided for identification of faults in the system and faulty units.**	Check that LEDs are provided to indicate the faults in the system and also for the faulty units.
5.4	**As and when bugs are found/determined in the software, the manufacturer shall provide patches/firmware replacement, if involved, free of cost for three years. Modified documentation, wherever applicable, shall also be supplied free of cost.**	Get a certificate from the vendor that in case of any bug in the software, the patch shall be supplied free of cost.
5.5	Ratings and types of fuses used are to be indicated by the supplier.	Ensure from the documents supplied by the manufacturer that the types of fuses used and their ratings are provided.
5.6	The manufacturer/supplier shall furnish the list of recommended spares for three years	This is a purchaser requirement and shall be the part of tender This is a purchaser

	maintenance.	requirement and shall be the part of tender
5.7	The supplier shall have maintenance/repair facility in India.	Inspect the and verify the repair facility of the manufacturer in India and record the sufficiency of the facilities. Inspect the and verify the repair facility of the manufacturer in India and record the sufficiency of the facilities.
5.8	Supplier shall guarantee the spares so long as the equipment is in service, at least for 10 years from the date of supply. The purchaser would like to stock spares as and when the supplier decides to close down the production of the offered equipment. In such an event, supplier shall give a two years notice to the purchaser so as to stock the spares.	This is purchaser requirement and should reflect in the tender document.
6.0	**Power supply:** ent shall be powered by the -48V DC power supply from the station power plant and shall meet the following requirements - ower supply is –48V DC with a variation over the range –40V to –60V. The equipment shall operate over this range without any degradation in performance.	a) The equipment shall work on the nominal voltage of - 48 V DC supply. Now reduce this voltage to -60 V DC and then increase it to -40 V DC. Check that in both the cases, the equipment is functioning perfectly. Note down the minimum and maximum voltages at which the equipment functions correctly : Minimum voltage : Maximum voltage :

	ment shall be adequately protected in case of voltage variation beyond the range specified in sub clause (a) and also against reverse input polarity. consumption should be minimal. The actual power consumption to be furnished by the manufacturer. d DC voltages in the equipment shall have adequate protection against over- voltage, short-circuit and overload.	(b) Check that the equipment is not damaged while the input polarity is reversed : (OK / Not OK) © Note down the power consumption of the equipment : (d) Check that the following protections are provided by the derived voltages : (i) over voltage : Ok / Not Ok (ii) short circuit : Ok / Not Ok (iii) overload : Ok / Not Ok
7.0	Accessories:	Heading, no test is required.
7.1	The supplier shall provide one complete set of: All necessary interfaces, connectors, connecting cables and accessories required for satisfactory and convenient operation of the equipment. Types of connectors, adopters to be used and the accessories of the approved quality shall be clearly indicated in the operating manuals which should be in conformity with the detailed list in the GR; Software and the arrangement to load the software at site. Note: **Additional sets may be ordered optionally.**	Ensure that the supplier has supplied one complete set of the following: a) Set of connectors, connecting cables, adapters and any other accessories required for satisfactory working of the equipment. b) A copy of the software on a CD and detailed procedure in the eqpt. manual as to how to down load the same at site.
7.2	Special tools, extender boards, extender cables and	Special tools , extender boards,

	accessories as essential for installation, operation, maintenance as well as for repair of the equipment shall be clearly indicated and supplied along with the equipment.	extender cable and accessories for the installation operation and maintenance of equipment shall be noted and be supplied along with the equipment.
8.0	Documentation: Technical literature in English language only with complete layout, detailed block-schematic and circuit diagram of various assemblies shall be supplied. The repair philosophy of the equipment shall be specified by the manufacturer. All aspects of installation, operation and maintenance shall be covered in the manuals. The manuals shall include the following:	Ensure that the technical literature is in English language. It contains the complete layout detailed block schematic and circuit diagrams of various assemblies. Ensure that the repair philosophy is defined in the documents in respect of installation, operation and maintenance. Further the manual shall include the following.
(i)	**Installation, Operation and Maintenance Manual-** Safety measures to be observed in handling the equipment. Precautions for installation, operation and maintenance. Test jigs & fixtures required and procedures for routine maintenance, preventive maintenance, trouble-shooting and sub-assembly replacement.	a) Ensure that the safety measures have been listed in handling the equipment b) Ensure that the precautions for installation, operation and maintenance are given in the manual. c) Ensure that the details of test jigs and fixture if any, required procedures for routine maintenance, preventive maintenance trouble shooting and sub assembly replacement have given in the manuals. d) Internal and external mechanical parts are illustrated.

	d) Illustration of internal and external mechanical parts.	
(ii)	**Repair Manual (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 re-ordering of spares. **c) Systematic trouble-shooting chart (fault tree) shall be given for the probable faults with their remedial actions.**	**Repair manual :** Verify the documents for the following : a) Ensure that the repair manuals contain the list of replaceable parts and their source and approving authority. b) Ensure that the repair manuals contain the detailed ordering information for all replaceable parts. c) Ensure that the repair manuals contain the list of the trouble shooting provided with a fault chart with their remedial actions.
9.0	**Protection requirements:**	Heading, no test is required.
9.1	The equipment shall have a terminal for grounding the rack.	Check that terminal for grounding the rack is provided.
9.2	Protection against short circuit/ open circuit in the accessible points shall be provided	Check that the protection against short circuit/open-circuit in the accessible points is provided. Also that all switches/controls panels have suitable safeguards against accidental operations.
9.3	All switches/controls on front panel shall have suitable safeguards against accidental operation.	Check that accidental operation of switches/controls on front panel does not create any problem in the system.
9.4	The equipment shall be adequately covered to safe-	Note that the equipment is provided with front panel cover.

	guarded against entry of even dust, insects etc.	
10.0	Safety Requirements	Heading, no test is required.
10.1	**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].**	A test certificate from independent and accredited laboratory will be acceptable on this account.
10.2	**The equipment shall conform to IS-13252 (1992) – "Safety of information technology equipment including electrical business equipment" [equivalent to IEC publication 950 (2005)] and IEC 215 {1987} - "Safety requirements of radio transmitting equipments" {for Radio Equipments only}.**	-- as above --
10.3	**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.**	-- as above --
11.0	**General Electromagnetic Compatibility (EMC) Requirements:** - The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report shall be furnished from a test agency.	The manufacturer shall be asked to submit a certificate and the test results from an accredited test lab for the compliance of EMC standard laid down in this clause.

(a)	**nd radiated emission:** **Name of EMC Standard**: "CISPR 22 {2005} with amendment 1 (2005) & amendment 2 (2006) - Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment". **Limits:-** i) To comply with Class A as per the specific requirement of CISPR 22 {2005} with amendment 1 (2005) & amendment 2 (2006). **ii) The values of limits shall be as per TEC Standard No. TEC/EMI/TEL-001/01/FEB-09.**	---- Do ----
(b)	**Electrostatic discharge:** **MC Standard**: IEC 61000-4-2 {2001) "Testing and measurement techniques of Electrostatic discharge immunity test". **Limits: -** Contact discharge level 2 {± 4 kV} or higher voltage; **ii) Air discharge level 3 {± 8 kV} or higher voltage;**	---- Do ----
©	**Immunity to radiated RF**:	---- Do ----

	MC Standard: IEC 61000-4-3 (2006) "Testing and measurement techniques-Radiated RF Electromagnetic Field Immunity test" **Limits:-** Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz, and Under test level 3 (10 V/m) for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz. **Terminal Equipment without voice interface (s)** **Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz, and for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz.**	
(d)	**Immunity to fast transients (burst):** **IC Standard**: IEC 61000- 4- 4 {2004) "Testing and measurement techniques of electrical fast transients/burst immunity test" **Limits:-** **Test Level 2 i.e. a) 1 kV for AC/DC power lines; b) 0. 5 kV for signal / control / data / telecom lines;**	---- Do ----
(e)	**Immunity to surges:**	

	MC Standard: IEC 61000-4-5 (2005) "Testing & Measurement techniques for Surge immunity test" **Limits:-** For mains power input ports : (a)1.0 kV peak open circuit voltage for line to ground coupling (b) 0.5 kV peak open circuit voltage for line to line coupling **ii) For telecom ports : (a) 0.5 kV peak open circuit voltage for line to ground (b) 0.5 KV peak open circuit voltage for line to line coupling.**	---- Do ----
(f)	**Immunity to conducted disturbance induced by Radio frequency fields:** **C Standard**: IEC 61000-4-6 (2003) with amendment 1 (2004) & amd. 2 (2006) "Testing & measurement techniques-Immunity to conducted disturbances induced by radio- frequency fields. " **Limits:-** t level 2 {3 V r.m.s.}in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines. **Note-1:** The equipment shall satisfy Class A limits. **Note-2**: The test agency for EMC tests shall be an accredited agency and details of accreditation shall be submitted. **Alternatively,** EMC test report from a non-accredited test lab, which is audited by an accredited lab / accrediting authority for the availability of all	---- Do ----

	the essential facilities (test equipment, test chamber, calibrations in order, test instructions, skilled personnel etc.), required for performing the tests according to the EMC test methods audited, may be acceptable. However, such accredited lab / accrediting authority should take responsibility of the test results of the "non accredited lab" along with indication of period of such delegation and the submitted test report should be of such valid period of delegation. The audit report, mentioning above facts, should be provided along with EMC test report. **Note-3:** For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. TEC/EMI/TEL-001/01/FEB-09 and the references mentioned therein unless otherwise specified specifically. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that frequency range and test level are met as per above mentioned sub clauses (a) to (f) and TEC Standard No. TEC/EMI/TEL-001/01/FEB-09. The details of IEC/CISPR and their corresponding Euro Norms are as follows: **IEC/CISPR** — **Euro Norm** CISPR 22 — EN 55022 IEC 61000-4-2 — EN 61000-4-2	

	IEC 61000-4-3 IEC 61000-4-4 *IEC 61000-4-5* IEC 61000-4-6 IEC 61000-4-11	EN 61000-4-3 EN 61000-4-4 *EN 61000-4-5* EN 61000-4-6 EN 61000-4-11	

Appendix I

EMS Requirements

ELEMENT MANAGEMENT SYSTEM REQUIREMENTS

1.0	**GENERAL OPERATIONAL & FUNCTIONAL FEATURES**	
	1. The EMS shall be multi-user system and based on Graphical User Interface.	1. Check that the EMS supplied is a multi-user system and GUI based.
	2. It shall be possible to generate customized reports for various types of faults, performance history, security management etc. It shall be possible to generate Circuit PM reports for example: at VC12, VC3, VC4, and these reports shall contain details of performance statistics. It shall also be possible to view and export current and historical PM data at circuit level.	2. Check that it is possible to generate customized reports for various types of faults, performance history, security management etc. The monitoring of performance statistics in a pre-defined/customized format shall be possible for interfaces.
	3. It shall be possible to have a view of selected sub-networks/rings controlled by the Element Management System as per	3. Check that the EMS is able to provide a view of the sub-networks/rings and by zooming-in, it is possible to drill down up to

	requirement. It shall be possible to drill down up to module-level in each NE for configuration and fault management. A cut-through to NE craft page may also be provided to perform the above operations.	module-level in each NE for configuration and fault management.
	4. The EMS shall be able to diagnose its own faults and generate report on demand by running diagnostic software.	4. Check that by running diagnostic software, the EMS is able to diagnose its own faults.
	5. The Element Manager shall provide the complete view of the network elements and the interconnecting links. The EMS shall have the ability to include the network elements and the links in the visual/graphical map of the domain. The visual maps shall display the elements and the links in different colour depending upon the status of the links.	5. Check that the EMS provides the complete view of the network elements and the interconnecting links in the visual/graphical format. Also check that the visual maps display the elements and the links in different colour depending upon the status of the links - green colour for healthy and amber/yellow colour for degraded condition and red for unhealthy condition.
	6. It shall provide the ability to drill down to the individual element, then to subsystem, then to card and then to port level configuration template from the domain-map by clicking on the icon of the network element.	6. Check that it is possible to access the individual element, then to subsystem, then to card and then to port level configuration template from the domain-map by clicking on the icon of the network element.
	7. The Element Manager shall have suitable system level backup mechanism for taking backup of EMS data of at least one month.	7. Ensure that the EMS have suitable system level backup mechanism for taking backup of EMS data of at least one month and that there is no magnetic tapes used for the objective,
	8. The EMS shall provide the visual presentation of the Network Element's status and the alarms. It shall also present the complete map of the network domain with suitable icons and in suitable colour like green for healthy, red for non-operational, yellow for	

	degraded mode of operation etc. 9. It shall be possible to take any Network Element out-of-service & in-service from the EMS. It shall be possible to restart the Network Element from EMS. 10. The configuration of the various network elements like creating, viewing, and editing shall be possible from the EMS. The configurations of the network elements shall also be stored at suitable non-volatile storage place in EMS from where it can be retrieved in case of primary server failure. 11. Manufacturer shall provide soft copy of his EMS on a CD The setup/procedure to download the software shall be clearly mentioned in the system manual of the equipment. 12. **Circuit-Management** 12.1 It shall be possible to create/manage Higher Order cross-connect circuits at VC-4 level and shall be able to carry out Lower Order cross-connection at VC-3 and VC-12 granularities. 12.2 It shall be possible to insert a node in a ring or between a pair of nodes and create pass	only DVD, CD shall be provided. 8. Check that the EMS provides visual presentation of the Network Element's status and the alarms. 9. Check that it is possible to take any Network Element out-of-service & in-service from the EMS. Also check that restarting the Network Element from EMS is possible. 10. Check that it is possible to configure the various network elements like creating, viewing, and editing from the EMS and this configuration of the network elements is stored at suitable place in EMS from where it can be retrieved in case of failure. 11. Ensure that the manufacturer provides soft copy of his EMS on a CD on per-link or per-ring basis (or as asked for by the purchaser). Also note that the setup/ procedure to download the software is clearly mentioned in the system manual of the equipment.

	through cross-connects automatically for the circuits flowing across the new node. 12.3 It shall be possible to remove or edit route of a circuit. 12.4 User shall be able to see alarms and PM at circuit level. 12.5 Creating and Managing diversely routed VCG-VCG LCAS Circuits 12.6 It shall be possible to discover the cross-connects created in an NE of a network and promoting those created cross connects in to circuits in the EMS. 12.7 It shall be possible to see affected circuits by selecting an alarm. 12.8 LOS alarm shall be indicated visually on the EMS. 13. It shall be possible to create a virtual network element (aka black box) for achieving end to end topology and circuit management. 14. Adding one network element shall automatically add the same as a part of the sub network of other network elements. 15. EMS shall be able to synchronize to NE automatically for configuration and alarms on connection re-establishment. 16. **Calendar Management** It shall be possible to execute any schedulable	12. **Circuit-Management** 12.1 Check that it is possible to create higher and lower order cross connects i.e., with VC-12, VC-3 and VC-4. 12.2 Check that it shall be possible to insert a node in a ring or between a pair of nodes and create pass through cross-connects automatically for the circuits flowing across the new node. 12.3 Check that it is possible to remove or edit route of a circuit. 12.4 Verify that the alarms and performance monitoring at circuit level is possible. 12.5 Check that VCG members of VCG LCAS can be diversely routed. 12.6 Check that any cross connect created in the NE through an LCT is discovered by the EMS and shall show as a circuit. 12.7 Check that it is possible to see affected circuits by selecting an alarm. 12.8 Note that the EMS display the LOS alarm. 13. Verify that through the EMS, it is possible to create a virtual network element for achieving end to end topology and circuit

	administrative command i.e.- NE backup, , performance, etc., at any time by attaching a time tag to the command and it shall be executed when the Network real time matches the time tag. It shall be possible to define both time and date. If no date is mentioned, the command shall be executed daily at the time indicated. 17. The supplier shall provide all necessary interface details (with the documents) for integration of its EMS with existing or proposed NMS (irrespective of its brand/make) and also provide time bound support for its integration, under obligation of a Non-Disclosure Agreement (NDA). 18. The EMS shall have a messaging system which will generate and send alert messages on telephone (fixed or mobile) or e-mail or SMS to the designated personnel depending upon the location of NE. 19. The supplier shall provide infrastructure requirements to the purchasers for setting up the EMS. The items of infrastructure include A/C power, Air conditioning load, space etc.	management. 14. Check that when a network element is added, it becomes the part of the sub network of other network elements automatically. 15. Check that the EMS is able to synchronize to NE automatically for configuration and alarms on connection re-establishment. 16. **Calendar Management:** Check that any administrative command like NE backup, software download, performance, operator log-in/ log-out etc. attach a time tag to the command and is executed when the network real time matches the time tag. Check that it is possible to define both time and date. 17. Ensure that the supplier provides all necessary interface details (with the documents) for integration of its EMS with existing or proposed NMS (irrespective of its brand/make) and also provide time bound support for its integration, under obligation of a Non-Disclosure Agreement (NDA). 18. **Messaging system:** Check that the EMS

	20. All critical components and units of the EMS i.e. – LAN interfaces, hard-disk, processor etc., shall be fault resilient. 21. It shall be possible to interconnect a Disaster Recovery EMS with an existing EMS, in future, through a manual switchover between them. The issues regarding hardware and software compatibility with regards to existing server platform shall be subject to a mutual understanding on the issue between purchaser and manufacturer. 22. Installation & commissioning of the EMS shall include supply & installation of cables, distribution frames, electrical switches etc. 23. Format for creation of database of rings, network elements, circuits, ADM/DXC/TMs etc., and their numbering scheme, details of built up points across various rings other commissioning details, supplementary information, order reference, dates etc. shall be prescribed by purchaser at the time of validation of EMS. This shall be available on signing the NDA between purchaser and manufacturer	has a messaging system which will generate and send alert messages on telephone (fixed & mobile), e-mail or SMS to the designated personnel depending upon the location of NE, on generation of alarms. 19. Obtain an infrastructure requirements from the supplier for setting up the EMS. The typical items of infrastructure include A/C power, Air conditioning load, space etc. 20. Check that all critical components and units of the EMS i.e. – LAN interfaces, hard-disk, processor etc., are fault resilient. 21. Check that it is possible to interconnect a Disaster Recovery EMS with an existing EMS with manual switchover between them. 22. Note that whosoever installs and commission the EMS, shall be liable to arrange and supply cables, distribution frames, electrical switches etc. 23. The purchaser shall prescribe a format for creation of database of rings and their

	24. The purchaser shall validate all the components of EMS and features of EMS. All the instruments necessary for carrying out validation test shall be arranged by supplier.	numbering scheme, details of built up points across various rings other commissioning details, supplementary information, order reference, dates etc. 24. Note that all the components of EMS and features of EMS shall be validated. All the instruments necessary for carrying out validation test shall be arranged by supplier.
2.0	EMS ARCHITECTURE & SERVER SPECIFICATIONS	No test required.
2.1	**Architecture:** 1. It shall be ensured that EMS connectivity to sub-network is not disrupted and there is no loss of EMS performance and fault data from the sub-network. To ensure EMS connectivity to the sub-network under control-card failure, there shall be provision to connect two Gateway NEs (GNEs) in a sub-network from EMS. The performance and fault data for the sub-network shall be available even if the master control-card at one GNE fails. In case of total loss of EMS connectivity, the sub-network shall continue to provide the services without any deterioration. 2. In case of total loss of EMS connectivity, it is recommended that the performance data of the NE shall be stored in the controller card, and shall be sent to central EMS server upon restoration of EMS connectivity. It is	1. For no loss of EMS data, check that dual-homed connectivity of EMS to two Gateway NEs (GNEs) in a sub-network under control-card failure, has been provided. The performance and fault data for the sub-network is be available even if the master control-card at one GNE fails. In case of total loss of EMS connectivity, the sub-network continues to provide the services without any deterioration. 2. Ensure that in case of total loss of EMS connectivity, the performance data of the NE is stored in the controller card, and is sent to

	recommended that minimum of 32 fifteen Min intervals and 2 twenty four Hr intervals of performance and fault data messages containing a minimum of 100 alarms shall be stored by the system. The response time shall however, be reviewed depending upon total NE load and topology by purchaser during testing of EMS. 3. In case of loss of EMS connectivity, the LCT privilege shall remain for monitoring and for local configurations, as privileged by EMS administrator. 4. The centralized EMS may consist of standalone application server, database server and firewall server or it can be a standalone EMS server subject to scaling requirements. Any other server required for meeting the purchase requirements shall be quoted separately by the bidder. 5. The connectivity of the EMS client to EMS for privileged operation shall be through a log-in password. 6. As a cost effective measure, two display units are adequate for all the servers (application, database, and firewall servers). Purchaser is at discretion to convey any additional requirements. It shall be possible to access any server from any of the display. 7. The purchaser shall communicate requirements for (1+1) server backup or internal constituents of server.	central EMS server upon restoration of EMS connectivity and that 6400 performance and fault data messages containing a minimum of 100 alarms are stored by the system. The response time shall depend upon total NE load and topology by purchaser during testing of EMS. 3. Check that in case of loss of EMS connectivity, monitoring of faults and local configurations is possible through LCT. 4. Check that the centralized EMS consists of standalone application server, database server and firewall server or it is a standalone EMS server which is scaleable. Also check whether any other servers, if required by the purchaser, are provided or not. 5. Check that the connectivity of the EMS client to EMS for privileged operation is through a log-in password. 6. Check that unless mentioned by the purchaser, only two display units are provided for all the servers (application, database, and firewall servers) and that it is possible to access any server from any of the

<table>
<tr><td></td><td></td><td>display.

7. Check the provision of (1+1) server backup or internal constituents of server as required by the purchaser.</td></tr>
<tr><td>2.2</td><td>SCALABILITY ASPECTS

1. The EMS shall be able to support NEs as per table given below.

<table><tr><th>NE Type</th><th>Minimum Number of NE per EMS</th></tr><tr><td>STM-1 ADM</td><td>3000</td></tr></table>
The vendor may optionally propose NMS for better scalability in which case, it shall have functionalities like trail management, fault management and performance monitoring.

2. Operating system and applications for EMS including database server shall be multi-user with minimum 25 concurrent users (including local terminals at EMS site and remote terminals i.e. LCTs). Any more requirements may be communicated by purchaser.</td><td>1. Ensure that the EMS is able to support minimum 3000 fully equipped network elements. Also ensure that the EMS is scalable to the extent the purchaser demanded, if at all.

2. Ensure that the OS of the EMS including database server provide a multi-user system. Ensure that the no. of concurrent users including local terminals at EMS site and remote terminals i.e. LCTs to operate simultaneously, is as per the requirements demanded by the purchaser..

3. Note that atleast four operator terminals are provided at the EMS site and that the EMS has the capability to connect at least 10 local terminals at EMS site which is again upgradeable to 25 local terminals.

Also note that the operator terminals at the EMS site are of latest technology with</td></tr>
</table>

	3. A minimum of four operator terminals will be provided at the EMS site. The EMS shall be equipped to connect to at least 10 local terminals at EMS site. It shall be upgradeable to 25 local terminals. The operator terminals at the EMS site are recommended to be PC Pentium IV with 160 GB HDD, 17" video display, Ethernet interface (10/100 Mbps) with industry standard operating system LINUX/UNIX/Windows but having GUI.	Pentium IV PC with 160 GB HDD, 17" video display, Ethernet interface (10/100 Mbps) with industry standard operating system LINUX/UNIX/Windows having industry standard GUI based operating system. Ensure that the EMS supports 32 bit IP addressing.
2.3	**EMS Server specifications:** The recommended EMS/NMS server shall be single or multi-server based (desired with user specific 2 servers for redundancy) each with 4 cores and expandable to minimum 8 cores with additional CPU, if applicable, 64 bit system with at least 1.5 GHz clock, 2 GB RAM per core and one GB Cache memory. However, the purchaser may choose single server as per network needs. The system disc shall be minimum of 160 GB. OS and RDBMS mirroring shall be provided. The system shall provide 160 GB DAT drives as back up devices. The system shall support at least 6X DVD for loading of software and configuration. The system shall have Hard disk storage implemented on RAID 5 architecture of Disk Storage which shall be site configurable. The RAID system shall be hardware based and shall have redundant RAID controller. The Hard-Disk storage shall provide for no single point of failure. Alternate specifications, if any, may be prescribed by the purchaser.	Check and ensure the support of the following features of the EMS Server : a.. the EMS/NMS server is either single or multi-server based (as per user requirement) each with 4 core processors and expandable to minimum 8 processors, b. it is a 64 bit system with at least 1.5 GHz clock, 2 GB RAM per core and one GB Cache memory, c. the system disc is 160 GB with OS and RDBMS mirroring and 160 GB DAT drives is provided as back up devices. d. the system supports at least 6X DVD for loading of software and configuration.

	1. EMS/NMS hard-disk memory shall be sufficient to store all the information as indicated in the document and any other necessary system for at least one month duration. 2. EMS/NMS server shall have redundancy for, disk, power supply and LAN interface. 3. Industry standard relational database (RDBMS) for storing all the data related to the network and the system shall be used. 4. The database interface shall be open so that a centralized EMS at a future date is able to retrieve information from the EMS database using TCP/IP stack and do post processing. The data base structure for all the databases used in the system shall be provided. 5. The memory of the EMS/NMS Server shall be sufficient to store the data of fully loaded equipment nodes (as per respective type/ category of equipment) at a minimum. It shall be capable of storing performance/ fault history of 30 days of the network under its domain. This shall be ensured during the testing of the equipment. 6. EMS shall be supplied with a Work Station using 17" colour screen with key and Mouse etc.	e. the hard-disk storage shall be site configurable and shall be implemented on RAID 5 architecture. f. the RAID controller is redundant, g. the Hard-Disk storage shall provide for no single point of failure. Verify and ensure the support of the following: 1. the memory of the EMS/NMS Server is sufficient to store data of 3000 fully loaded equipment nodes and is capable of storing performance/ fault history of 30 days. 2. the disk, power supply and LAN interface of the EMS/NMS server are redundant. 3. relational database server (RDBMS) for storing all the data related to the network and the system is of industry standard. 4. the database interface shall be open so as to retrieve information from the EMS database using TCP/IP stack in future. 5. the memory of the EMS/NMS Server is sufficient to store the data of fully loaded equipment nodes (3000) at a minimum. It shall be capable of storing performance/

		fault history of 30 days of the network under its domain. This shall be ensured during the testing of the equipment. 6. the supplied EMS has Work Station using 17" colour screen with key and Mouse etc.
2.7	**SPECIFICATIONS FOR LOCAL CRAFT TERMINAL/CLIENT TERMINAL/ WORK STATION** The LCT desktop shall have state-of-the-art hardware, and industry standard GUI based operating system, as per the configuration specified by the purchaser.	The configurations of the LCT shall be verified during supply and shall be as per the requirements specified by the purchaser.

FCAPS TEMPLATE FOR SDH TRASNMISION PRODUCTS

	Network Management Functions	Heading, no test is required.
	General Functions The equipment EMS shall provide general management functions described in ITU-T Rec. G.784. The filters for performance and fault management shall also be as per ITU-T Rec. G.784. The other management functions as defined in ITU-T Rec. G.784 shall be as under: 1. Configuration Management 2. Fault Management 3. Performance Management 4. Security Management 5. Software Management 6. Inventory Management. FCAPS shall be evaluated in terms of the circuits/connections which shall be identifiable in terms of ADM/TM/DXC based on addressing mechanism.	Check that the equipment provides a centralized EMS and a local management capability through an LCT. Both these capabilities allow managing the required cross-connections and also for carrying out supervisory, maintenance, fault localization & performance functions (FCAPS). Check that the equipment is also manageable through F-interface (local management interface) as well as through remote management interface, viz., SNMPv2c (or later) interface. Note that the EMS provides the following general management functions: 1. Configuration Management

		2. Fault Management 3. Performance Management 4. Security Management 5. Software Management 1. Inventory Management.
	Configuration Management The equipment EMS shall support configuration and provisioning capabilities as per ITU-T Recs. G.783 and G.784. The system shall support 'Point & Click' provisioning in a vendor's sub-network, subject to clearance by Inventory Management. The following configuration provisioning shall be possible: 1. To partition the network as defined in ITU-T Rec. G.803 on request and control either in full or with limited network resources. 2. Network Element creation in the NE Management domain. 3. Programming of a multiple interface unit. 4. To create, update, delete and retrieve the managed network topology data. 5. Assigning the equipment protection to a unit/interface. 6. Selection of protection switching within the managed network and protection switching	Under the configuration management, check that the following functionalities can be configured: 1. Partitioning the network on the basis of the full or limited network resources. This shall be as per G.803. 2. Creation and also deletion of the NEs. 3. Programming of a multiple interface unit 4. Creation, update, deletion and retrieval of the managed network topology data. 5. Assigning the equipment protection to a unit.

	granularity. 7. Matrix connections. 8. Error detection thresholds. 9. Network Element configuration. 10. Software download (local & remote). 11. Protection switching enabling/disabling for individual traffic interface at virtual containers. 12. Ethernet/ interface bandwidth through VCAT and MAC configurations. 13. Enabling/disabling of LCAS 14. Enabling/disabling of FEC (if implemented) 15. DCC multiple management configurations 16. Configuration related to multiple management options etc.	6. Selection of protection switching within the managed network and protection switching granularity. 7. Creation, deletion of cross connections. 8. Setting thresholds for the detection of errors. 9. Configuring the NEs. 10. Local & remote software download. 11. Enabling/disabling of protection switching for individual traffic interface at virtual containers. 12. Configuration of Ethernet/ interface bandwidth through VCAT and MAC. 13. Enabling/disabling of LCAS. 14. Enabling/disabling of FEC. 15. Configuration of DCC multiple management options. 16. Configurations related to multiple management options etc.

	Fault Management The equipment management system shall support 'Fault Management Functions' as described in the ITU-T Rec. G.784. The 'Equipment Management Function' within the Network Element shall perform a persistency check on the fault-cause, before it declares a fault causing failure. The time taken to declare the fault shall be as per ITU-T Rec. G.784. Each failure and clearance, thereof, shall be time-stamped. The atomic functions associated with the failure shall be as per ITU-T Rec. G.784. The equipment shall do surveillance of alarms & their detection, reporting of relevant events and conditions that lead to the generation of alarm after filtering. The system shall support the alarm history as per ITU-T Rec. G.784. Further, the element management system shall support the following: 1. Alarm notification to be generated and recorded shall include: type, occurrence, severity, probable cause and clearing. 2. Alarm and status display. 3. Fault correlation control. 4. Storing and processing of current alarm information, up to module/unit level. 5. Storing and processing of historical alarm information for approximately 30 days with a minimum of 10000 historical alarms supported.. The EMS/LCT shall provide on-line logging capability for historical alarms and events with sufficient information such as managed resources, alarm/event type, alarm severity, day and time of	Check that the persistency check on the detection and the reporting of faults is as per G.784. Each failure and clearance, thereof, shall be time-stamped. An alarm report shall include type of fault, occurrence time, clearance time, severity, probable cause etc. Also check that the following functionalities are provided : 1. Generation and reporting of the path alarm notification include type, occurrence, severity, probable cause and clearing. 2. Path alarm is shown graphically by the EMS/LCT. 3. Correction control of fault. 4. Storing and processing of current alarm information. 5. The EMS/LCT shall provide on-line logging capability for historical alarms and events with sufficient information such as managed resources, alarm/ event type, alarm severity, day and

	occurrence etc. The retrieving functions with filtering capabilities for historical alarms and events shall be provided as well. 6. FCS errors for Ethernet clients. 7. Assigning alarm severity i.e., Critical, Major, and Minor	time of occurrence etc. 6. FCS errors for Ethernet clients. 7. It should be possible to assigning alarm severity i.e., Critical, Major, Minor & Deferred.
	Performance Management The equipment shall support the 'Performance Management' functions in accordance with ITU-T Rec. G.784. The performance management shall consist of set of functions that evaluate and report on the behaviour of network element and their effectiveness relating to the communication taking place on the network. The performance management shall deal with definitions, evaluation and reporting of equipment performance. It shall be possible to store all the performance and traffic statistics for a month. It shall also be possible to generate daily, weekly, monthly reports for any of the performance monitoring points of the individual elements or circuits. The report generation shall be supported for text and graphic reports. These functions shall be implemented using information flows at the reference points S1 & S2 and filtering functions as described in ITU-T Rec. G.783. The performance monitoring shall conform to ITU-T Recs. M.2100, M.2101, M.2120, G.821, G.826, G.828 and G.829. The near-end performance monitoring, far-end performance monitoring, performance data collection and performance history shall be as per	The performance management of the system shall conform to ITU-T Recs. M.2100, M.2101, M.2120, G.828 and G.826. The near-end performance monitoring, far-end performance monitoring, performance data collection and performance history shall be as per ITU-T Rec. G.784. The following performance monitoring functionalities are required to be provided by the equipment: 1. Thresholds of the error counters shall be settable. 2. Reporting and monitoring of the

	ITUT Rec. G.784. Performance history for minimum 30 days shall be supported with configurable launch-time and performance evaluation/integration period. The main performance functionality to be provided shall be as under: • Configuration of threshold concerning the error counters. • Performance reporting and monitoring. • **Performance history (data logging):** The EMS shall store the performance data of the sub-network in terms of configured circuits. In addition to, the following shall also be some of the different parameters that shall be stored- ➢ The collection of the performance counters shall be performed at pre-assigned rate as per ITU-T Rec. G.784. ➢ The EMS shall support configurable scheduling of the performance measurement, collection, storage and transfer of the performance statistics. It shall also support presentation of the performance statistics in graphical and text mode as and when requested.	performance data. 3. Logging the performance history shall be possible wherein the following different parameters are stored - ➢ The collection of the performance counters shall be performed at pre-assigned rate as per ITU-T G.784. ➢ Configure scheduling of the performance measurement, collection, storage and transfer of the performance statistics. Check that it l also supports presentation of the performance statistics in graphical and text mode as and when requested.
	Security Management The management system shall provide adequate security to the data and for the access to the management system as per the following details:	The management system of the equipment shall provide adequate security to the data.

	1. The EMS shall have the capability of supporting the management of Network through local and remote Operators. The authorizations and the privileges of the operators (Remote and Local) shall depend upon the Login and Password. a. Low level protection for read only access to faults and performance information. b. Medium level protection for access to configuration status and features. c. High level protection for control of access to change in the configuration and control parameters. 2. Network management security features shall include operator authentication, command, menu-restriction and operator privileges. The EMS shall support multilevel passwords as below. a. The system administrator shall be able to monitor and log all operator activities in the EMS and NE. b. The dynamic password facility shall be provided in which the operator may change his password at any time. 3. All log-in and log-out attempts shall be logged in the security log file of the EMS system. 4. The network and the management system shall be protected against intentional or accidental abuse, unauthorized access and loss of communication. 5. The system shall provide a record of all the log-ins in respect of all three password levels for a period of at least six months. 6. The EMS shall be able to back up and restore the data base to and from external storage media.	1. Note and verify that there are three levels of access to the management system and each level requires a separate programmable password for the following leveled access: **a) Low Level:** Low level access for read only and shall have the access to faults and performance information only; **b) Medium Level:** Medium level protection for access to configuration status and features; **c) High Level:** High level protection access for control of access to aforesaid clauses and to change the configuration and control parameters. 2. Also, check that security features like operator authentication, command, menu-restriction and operator privileges are provided in the EMS : a. Check that the System Administrator is capable to define the level of access for each assigned password. EMS blocks the access to the operator in case of unauthorized

	7. EXTERNAL SECURITY MEASURES [OPTIONAL REQUIREMENTS] Network security may require deployment of external devices/machines/ firmware at the network operation centre [NOC], like- **1.** firewalls **2.** access control servers **3.** data encryption devices/use of PKI keys **4.** anti-virus packages. **5.** In the data communication network (DCN) for management system, VLAN tags/MPLS labels may be used for security to information flows from Gateway NEs (GNEs) to DCN Gateways with IPSec, PKI security options. The purchaser may communicate requirements as per his network security needs.	commands or wrong password being tried for five consecutive times. Check that the system administrator shall be able to monitor and log all operator activities in the EMS and LCT. b. Dynamic password facility has been provided which is changeable. 3. Each log in and log out attempt is logged in the security log file of the EMS system. 4. The EMS/NMS has adequate protection against intentional or accidental abuse, unauthorized access and loss of communication. 5. Ensure that the EMS is able to record all log-ins for a period of at least six months. 6. Check that the EMS provides the back up and restore the data base to and from external storage media. 7. The requirements for the external security measures are optional, but if provided, check that external devices/machines/ firm-ware like firewalls, data encryption devices/use of PKI keys, access control servers,

		anti-virus packages, VLAN tags/ MPLS labels etc. are provided.
	Inventory management 1. It shall indicate the absence or presence of any physical module in hardware elements. It shall also indicate the usage of module i.e. how many ports are in use, which interface is in use and which are free to be used etc. 2. The EMS shall be able to discover and keep the device information. 3. The EMS shall be able to keep track on any change in the network inventory reported chronologically. 4. The EMS shall provide the inventory information to the Network Management layer (NML)/Service Management Layer (SML) so that SML is able to create and activate a service to the customer automatically. This shall also assist SML in providing the network inventory to which the SML shall add the customer identification and maintain this information in its database. 5. The EML shall be able to show inventory based on the available device inventory in terms of circuits' or cross connects utilization.	1. Check that it is possible to indicate the absence or presence of any physical module and also how many ports are in use, which interface is in use and which are free to be used. 2. Check that the EMS provides discovery and the device information. 3. The EMS provides any change in the network inventory reports the change of events chronologically. 4. Check that on the basis of the inventory information provided by the EMS to the Network Management layer (NML)/ Service Management Layer (SML), the SML can create and activate a service to the customer automatically. 5. Check that the EML provides the inventory information in terms of circuits' utilization.

	Software Management It shall be possible to carry out the following tasks under the software management function: 1. Loading of new system software. 2. Examine contents of all system memory and disk memory. 3. At the time of downloading the software, the message shall be displayed that the software has been downloaded successfully or failed and at what stage. 4. The EMS shall support FTP/TFTP for downloading of Software, configuration, etc., to the Network Element. 5. The operator terminals (local & remote) shall not allow loading of any software without the terminal administrator's authorization. 6. The EMS shall enable operations like changing the system configuration, reconfiguration of input and output devices, loading a new software package, etc. Both automatic and manual reconfiguration capabilities shall be available.	Under the software management, check that the following activities are possible: 1. loading of new software. 2. examines contents of all system memory and disk memory. 3. display of downloading message of software such as downloaded successfully or failed and at what stage. 4. EMS support of FTP/TFTP for download of software, configuration, patches etc., to the Network Element. 5. loading of any software is not possible without the terminal administrator's authorization. 6. EMS enables system configuration and reconfiguration of input and output devices, loading a new software package etc. and also both automatic and manual reconfiguration capabilities.

	Software Download Local & remote software download via management system to NEs shall be possible, including the means of identification of software module versions. No loss of data/traffic & connection-map shall take place during the software down-loading process.	Check that downloading the software is possible via the management system. There shall be the means of identification of the software module versions. Note that no loss of data & connection-map have taken place during the software down-loading process.
	Management Interface The complete details of the management interface and the protocols, as pertaining to each layer of the protocol-stack implemented in the management system, shall be made available, for the purpose of integrating the local management capabilities with the centralized NMS at a later date. The requirements, in brief, shall be: • Protocol details at all layers of TCP/IP stack. • PHY I/F at each layer. • Database structures. • Number formats. • Node addressing system. • Complete application software details etc.	Ensure that the complete details of the management interface and the protocols, as pertaining to each layer of the protocol-stack implemented in the management system, is available, for the purpose of integrating the local management capabilities with the centralized NMS at a later date. Check that the following details are provided: • Protocol details at all layers of TCP/IP stack. • PHY I/F at each layer. • Database structures. • Number formats. • Node addressing system. • Complete application software details etc.

	Southbound Interface The system shall provide at least one remote management interface and one Local Management Interface at each Network Element as conforming to ITU-T Rec. G.773. The system shall provide an SNMP version2c [or later interface] with standard MIBs Browzer. It shall be implemented on UDP/IP stack at all Gateway NEs (GNEs) to interact with a centralized Element Management System (EMS). Or else ITU-T specified Qx or Bellcore specified TL1 interface implemented on TCP/IP or HTTP interface API based remote management interface shall also be acceptable. **Note-1** The equipment shall provide an Ethernet port for Work Station/Network Server connectivity with standard RJ-45 connector. **Note-2** The purchaser may validate vendor's claim for management functions as well as protocol compliance for Qx or SNMPv2c interface (or later interface) or HTTP through NMS Protocol Analyzer etc.	Check the provisioning of two management interfaces: remote management interface and Local Management Interface. Ensure that SNMP version2c [or later interface] has been provided on all the Gateway NEs (GNEs) to interact with a centralized Element Management System (EMS). Run the standard MIBs Browser with SNMP version2c [or later interface]. In case SNMP is not provided, ensure that either ITU-T specified Qx or Bellcore specified TL1 interface implemented on TCP/IP remote management interface has been provided. Ensure that an Ethernet port with RJ-45 connector has been provided for Work Station/Network Server connectivity. Check the management functions and also the protocol compliance for Qx or SNMP interface through NMS

		Protocol Analyzer.
	Northbound Interface For remote management purposes, the equipment shall provide remote and local management interfaces at NEs as outlined in the GR. The northbound interface of the EMS towards NMS layer shall be TMF 814 CORBA [version 2 or higher] or XML. The purchaser shall verify the CORBA IDLs or XML, as the case may be, during the product testing.	Ensure that the northbound interface of the EMS towards NMS layer is either TMF 814 CORBA [version 2.0 or higher] or XML. Check the CORBA IDLs or XML to verify the vendor's claim of supporting claimed northbound interface.
	Local Management Interface The manufacturer shall provide a Work Station/Network Server, which shall act as a manager of management activities, i.e. monitoring and controlling NEs or an NE within its management domain. The Local Craft Terminal i.e., a Personal Computer shall support the local management of NEs. The Local Craft Terminal and Network Server shall be operating simultaneously. The inter–office communication shall be facilitated through DCC channels or dedicated data-link. The equipment shall provide Ethernet/USB/V.24/V.28/RS232/RS-485 for connecting a PC-server as a Local Craft Terminal. The manufacturer shall provide a Work Station/Network Server, which shall act as a manager of management activities, i.e. monitoring and controlling NEs or an NE within its management domain. The Local Craft	Check that the Work Station/Network Server act as a manager and perform monitoring and controlling NEs within its management domain. The LCT i.e., a Personal Computer supports the local management of NEs and that both the LCT and Network Server are able to operate simultaneously. The inter–office communication is facilitated through DCC channels or dedicated data-link and for this

	Terminal i.e., a Personal Computer shall support the local management of NEs. The Local Craft Terminal and Network Server shall be operating simultaneously. The inter–office communication shall be facilitated through DCC channels or dedicated data-link. The equipment shall provide Ethernet/USB/V.24/V.28/RS232/RS-485 for connecting a PC-server as a Local Craft Terminal.	purpose the equipment provides V.24/V.28/ RS232/RS-485 interface for connecting a PC-server as a Local Craft Terminal.
	User Interface The management system shall be provided with user-friendly interfaces based on Windows/UNIX/LINUX icons & menus and mouse to accomplish management function that needs user interventions. The EMS start-up and shut-down shall be user friendly, and shall provide installation documents and user guides.. The EMS shall be able to provide an onscreen nested geographical view of the managed network in the management domain of the manufacturer. It shall be possible to access any managed node with in the whole network in the managed domain. The EMS shall be able to depict the failure state of each link and node in the displayed network. Further, it shall also be possible from the EMS system to get the details of status of an individual managed NE, such as equipment presence, settings, alarm status etc.	Check that the management system is provided with user-friendly interfaces based on Windows/UNIX/LINUX icons & menus and mouse. The EMS start-up and shut-down are user friendly, and provide on-line help. The EMS provides an on-screen nested geographical view of the managed network in the management domain of the manufacturer and any managed node can be accessed . The EMS is able to depict the failure state of each link and node in the displayed network. Also check that details of status of an

		individual managed NE can be obtained through the EMS.
	Embedded Control Channel: Twelve bytes D1 to D12 shall be used for Embedded Control Channel (ECC) protocol stack in accordance with the ITU-T Rec. G.784. There shall be additional requirement for multiple management options using DCC channels as outlined in the following clause.	Check and ensure that all the management information flow though the twelve DCC bytes D1 to D12. Ensure that for the management information flow, no other method id adopted.
	Multiple Management Options The equipment shall support Embedded Control Channels (ECC) transported over DCC bytes viz., D1 to D12 to be used for transfer of management information, in accordance with ITU-T Rec. G.784. Each of STM-N (whether it is line or tributary) shall have accompanying ECC. The equipment shall provide handling of all the ECC/DCC from/to all STM-N interfaces. The flow of protocols between the Work Station/Server and SDH equipment NE to NE shall strictly flow through Embedded Control Channels D1 to D12 with additional functionalities as below- • D1-D3 bytes of RSOH – DCCr • D4-D12 bytes of MSOH – DCCm The configuration for the above shall be provided through EMS. It shall be possible to allow DCC bytes which are unused by the equipment to flow	Check that the twelve DCC bytes are grouped as DCCr (D1 – D3) and DCCm (D4 – D12) and these DCCr and DCCm are selectable through the EMS. Verify that it is possible to map as well as retrieve DCC information to/from D1-D3 and D4-D12, local Ethernet Qx/SNMP management port, embedded VC12 in STM-N ports or physical E1 ports at local end. There are 4 options for management

	transparently through the equipment. It shall be possible to map/retrieve DCC information to/from D1-D3 and D4-D12, local Ethernet Qx/SNMP management port, embedded VC12 in STM-N ports or physical E1 ports at local end. It shall be possible to transparently pass through D1-D3 and D4-D12. This is required for allocation of one of the sets to IP or OSI DCC. Otherwise dual stack IP/OSI DCC shall be provided. The equipment shall provide multiple management options, in addition to the conventional use of DCC bytes, to allow greater scope for inter-vendor interoperability and simplification of operation, administration & management of the network. The following options shall be provided in the equipment for physical access to the DCC information on STM-N line- **1.** Tunneling DCC in to assigned VC-12 embedded in outgoing STM-N line frame or, **2.** Termination of DCC at E1 interface/s as part of an external DCN or **3.** Termination at Ethernet traffic interface/s as part of an external DCN. **4.** Termination at remote management interface at Gateway NEs (GNEs) on Ethernet interface. Or else, the equipment shall provide dual IP or OSI	have been stipulated in the GR. Note as to which option the the vendor is supporting and verify the same. Instead of supporting one of the options given in the GR, the vendor may also provide IP or OSI DCC routing stack in which case configuration of DDCr (D1-D3) and DCCm (D4-12) shall be provided as either IP-DCC or OSI-DCC through EMS. Verify that the equipment provides in-built intelligence to auto-sense as to which DCC block is relevant to it. The other DCC block shall be transparently tunneled across either at physical layer through one (and more VC12) or routed through IP/OSI stack. Also verify that the termination of DCC at Qx/SNMP/TL-1 remote management interface at GNE #1 & 2 at Ethernet interface/s are provided.

<table>
<tr>
<td></td>
<td>DCC routing stack in accordance with ITU-T Rec. G.7712. In such cases, configuration of DDCr (D1-D3) and DCCm (D4-12) shall be provided as either IP-DCC or OSI-DCC through EMS. The equipment shall provide in-built intelligence to auto-sense as to which DCC block is relevant to it. The other DCC block shall be transparently tunneled across, either at physical layer through one (and more VC12) or routed through IP/OSI stack. Termination of DCC at Qx/SNMP/TL-1 remote management interface at GNE #1 & 2 at Ethernet interface/s shall essentially be provided.

Regarding tributary STM-1 DCC termination, the system shall provide physical layer transparent tunneling of DCC information across desired STM-N aggregate lines.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extending DCC to central EMS Sever

The ports and the bandwidth requirements for DCC connectivity to an IP/MPLS network for extending the connectivity of network elements to the centralized EMS shall be indicated by manufacturer to the purchaser. Bandwidth requirement per NE/EMS shall also be specifically indicated by the manufacturer.</td>
<td>Ascertain and note that for extending the connectivity of network elements to the centralized EMS, the bandwidth requirements for DCC connectivity to an IP/MPLS network indicated by manufacturer.</td>
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<tr>
<td></td>
<td>List of Constituents for a DCN

<table>
<tr><td>Dual-stack (IP and OSI) Routers</td><td>The quantity shall be conveyed by purchaser.</td></tr>
<tr><td>LAN Switches</td><td>The quantity shall be conveyed by purchaser.</td></tr>
</table>
</td>
<td>Note that the quantities of the constituents for the implementation of the DCN are conveyed by the vendor.</td>
</tr>
</table>

	Interface converters between Ethernet/to E1 G.703	The quantity shall be conveyed by purchaser	Vendor shall supply these items with the equipment as a part of the package.
	Ethernet adaptors 100BaseFX @1310nm	The quantity shall be conveyed by purchaser.	
	Specifications Broad specifications of LAN Switch and Routers are outlined in the following, whereas the purchaser is at discretion to issue alternate specifications as per networking needs.		Ensure the compliance of the requirements of the LAN Switch and Router as in the following sub-clauses.
	LAN Switch LAN switches may be used to terminate Ethernet interfaces from NEs at a transmission centre and to aggregate at uplink WAN ports towards a router. The LAN switch shall provide 10BaseT or Fast Ethernet interfaces towards NEs. The LAN switch for DCN shall be middle range LAN switch as per TEC GR No.: GR/LSW-01/03.SEP07. The middle range LAN switch (LAN SWITCH-1) may be used in case 16 ports supporting 10/100 Mbps is the requirement. Similarly, LAN switches may also be used at EMS location for connecting various servers, firewalls etc. The exact network design and architecture for a DCN is out of scope for this document.		Note and map the applications of the LAN switch as given in the GR clause. Note that it desirable that the vendor provide approved LAN switch.

	Router A router may be required to interconnect various transmission centres in a city and finally to connect to an IP/MPLS network for providing regional/national connectivity over MPLS-VPNs. In order to integrate existing NEs based on OSI management model, the router shall provide dual-stack (IP+OSI) i.e. - CLNP for Q3-based NEs and IP [OSPF/RIP] for TCP/IP-based NEs. Or else, the operator may choose to work at physical layer which makes the implementation transparent from higher layers. The router for DCN networking in a city may use Ethernet over SDH transport to connect to IP/MPLS network. However, other possibilities are not ruled out. It is suggested to use –48V (-40V-60V) DC operated low range routers as per TEC GR No.: TEC/GR/SA/TCP-01/03.MAR09 equipped with at least 2 Ethernet interfaces, one serial interface as LAN interfaces and 2 WAN Ports (which can be Nx64 Kbps or Ethernet). If the LAN ports are felt short of requirement, a LAN switch may be used, as above, to aggregate the transmission centers' management traffic on fewer Ethernet ports. The exact network design and architecture for a DCN is out of scope for this document.	Note and map the applications of the Router as given in the GR clause. Note that it desirable that the vendor provide approved Router.

TSTP for Ethernet over PDH (EoPDH)

Clause No	Clause Description	Test Procedure
1.0	**on** In the immediate future, Next generation SDH networks would carry much higher data traffic compared to TDM traffic. Most of the data traffic originate from some form of Ethernet port (3G BTS, Enterprise LAN etc.) and ends up with another Ethernet port located remotely (in RNC, Enterprise HQ etc.). To facilitate an efficient Ethernet transport over existing PDH interfaces going through SDH or Ethernet over Fiber Networks, it is proposed to add ITU-T standard G.8040 based Ethernet Over PDH(EoPDH) capabilities to the SDH NEs as envisaged in this GR. EoPDH works as a complementary Ethernet carrying standard to the already existing Ethernet Over SDH(EoS) suite of standards like GFP, VCAT and LCAS, with similar capabilities, but only with a new framing standardized in ITU-T G.8040 recommendation. The NG-SDH NE should support following EoPDH requirements as given below:-	Information only. No test is required.
1.1	The system shall support the total uplink bandwidth from EoPDH to be STM-4 equivalent.	Test case No. 1
1.2	The system shall support minimum of 32 VCGs.	Verify and note down the number of VCGs supported. The number of VCGs should be greater than or equal to 32.
1.3	Each VCG may be independently configured as EoSDH or EoPDH.	Ensure that any VCG can be configured as EoSDH or

		EoPDH.
1.4	The system shall support differential delay up to 64 ms.	Ensure that Differential delay up to 64ms is supported.
1.5	**EoPDH Mappings in SDH Mode** The system shall support following EoPDH mapping modes: AU-4/ VC12-E1-Xv, 1≤ X ≤ 16 AU-4/ VC3-E3-Xv, 1≤ X ≤ 8 AU-4/ VC3-DS3-Xv, 1≤ X ≤ 8 In the SDH mode, it shall be possible to configure each VCG port independently in one of the mapping modes as specified above. The VCGs can be configured subject to the total available bandwidth (STM4) and the maximum number of containers therein.	Verify the mapping of Ethernet over E1, E3 and DS3. No. of E1s can be from 1 to 16, E3s can be 1 to 8 and DS3s can be 1 to 8.
1.6	**Frame Format for PDH signals** The PDH signals shall support following Frame formats: E1 – PCM31CRC Multiframe format E3 – G.832 Frame format	Ensure that the Ethernet mapped E1 signals have PCM31CRC Multiframe format and E3 signals have G.832 Frame format.
1.7	Path protected and unprotected VC/VT may be mixed in a given virtual concatenation group up to the uplink bandwidth of the card.	Test case No. 2
1.8	**VCG Connections**	**Heading. No test is required.**
	• The system shall support bi-directional VCG.	Ensure that the VCGs are bi-directional.
	• In the EoPDH mode, the VLI byte of the E1/DS1/E3/DS3 frame within the virtually concatenated group shall be used for the virtual concatenation specific sequences and multi-frame indication as per the standards.	Verify the use of VLI byte in E1/E3/DS3 frame for VCAT specific sequences and MF indications.

	• The card shall support diverse routing of members within a virtually concatenated group. Diverse routing shall be supported at all the valid granularities of the members.	Test case No. 2
	• It shall be possible to enable and disable LCAS on a per VCG port basis.	Ensure that LCAS can be enabled or disabled on a per VCG basis.
1.9	**Non LCAS Mode of VCG**	**Heading. No test is required.**
	• It shall support addition/deletion of VCn's to/from a VCG port carrying traffic and during this a traffic outage will occur.	Test case No. 3
	• Any fault in one or many of the virtual containers of a VCG port would result in traffic outage till the fault is rectified.	Test case No. 3
	• Sequence numbers will be automatically provisioned by the hardware and the receive VCG will accept the sequence numbers received and re-sequence the data accordingly.	The above test case no. 3 shall ensure this.
1.10	**Link Capacity Adjustment Scheme (LCAS)**	**Heading. No test is required.**
	• The equipment shall support LCAS as per G.7043 for Virtual Concatenated PDH Signals.	Ensure that LCAS is supported as per G.7043
	• Addition/deletion of a member to /from VCG shall be hitless.	Test Case No. 4
	• Group ID (GID) shall be sent on every channel of a VCG.	The above test no. 4 shall ensure.
1.11	**Graceful handling of Signal Fail**	**Heading. No test is required.**

	A member of a VCG is said to be faulty/failed when alarms that affect virtual concatenation (LOM) are received on the member	Verify that VCG fails when LOM alarm is raised.
	• Fault detection shall be initiated after a LCAS Hold-off time of 0ms or 100ms or 3 sec. The default value shall be 100ms.	Verify that the fault detection is initiated after LCAS Hold-off time.
	• Any fault in a path would result in the virtual container being temporarily removed from the VCG datapath. This would result in a temporary traffic outage. The traffic shall automatically be restored with available bandwidth. After the recovery of the fault, the path shall be added automatically to the VCG and the complete bandwidth shall be restored.	Testing details are given in Test Case No. 4
	• Partial failure (at least one member in VCG is not failed) in receive direction shall not affect the traffic in the transmit direction	Test Case No. 5
	• Recovery from failure in the receive direction shall not affect the traffic in the transmit direction	Test Case No. 5
	• Partial failure in one direction should not affect the recovery of bandwidth after signal clear	The above test no. 5 shall ensure.
	• Addition or Deletion of a member to the VCG should be allowed during Partial or complete failure in one or both directions	Test Case No. 6
	• The addition of new member should result in bandwidth increase up to available after the addition process completes	Verify the feature.

1.12	**LCAS Interworking** VCG provisioned in LCAS mode shall interoperate with a remote VCG in non-LCAS mode according to G.7042/G.7043	Test Case No. 7
1.13	**Temporary removal of Non-Deskewable members from VCG**	**Heading. No test is required.**
	• In a VCG, excessive delay on one or few of the members can result in packet drops or the link going down completely. Depending on the application, it is sometimes preferred to have lesser bandwidth with less or zero packet drops over more bandwidth and lot of packet drops.	Verify the feature
	• In such scenario, LCAS detects the non-deskewable (MND) member and can be removed from the VCG.	
	• A Boolean parameter per VCG called "Remove Channels with MND" (Enable/Disable) will be provided to enable/disable the removal of members with non-deskewable delays.	
1.14	**Generic Framing Procedure** The equipment shall support GFP-F (Frame mapped mode), as per ITU-T G.7041.	Ensure that the GFP-F is as per ITU-T G.7041
1.15	**Fault Management**	**Heading. No test is required.**

<table>
<tr><td></td><td>PDH specific OMs
The EoPDH crossconnect shall support performance counters at the PDH level as per the table:<table><tr><th>PDH Granularity</th><th>Path PMs</th></tr><tr><td>E1</td><td>EB-P
BBE-P
ES-P
SES-P
UAS-P</td></tr><tr><td>E3</td><td>ES-P
SES-P
UAS-P</td></tr></table></td><td>Verify the Performance counters at the PDH level.

EB-P, BBE-P, ES-P, SES-P and UAS-P PM counters to be supported for E1.

ES-P, SES-P and UAS-P PM counters to be supported for E3.</td></tr>
<tr><td></td><td>VCG Port, GFP specific OMs</td><td>Heading. No test is required.</td></tr>
<tr><td></td><td>• Frames Received ; Frames Transmitted</td><td>Verify the availability of Frames Received and Frames Transmitted counters.</td></tr>
<tr><td></td><td>• Octets Received (Includes GFP headers for VCG ports in GFP Framing) ; Octets Transmitted (Includes GFP headers for VCG ports in GFP Framing)</td><td>Verify the availability of Octets Received and Octets Transmitted counters.</td></tr>
<tr><td></td><td>• Payload FCS Errors; Core Header CRC Errors ; Core Header Single Error Corrections ; Type Header CRC Errors ; Type Header Single Error Corrections</td><td>Verify the availability of FCS Errors, CRC Errors and Single Error Corrections counters.</td></tr>
<tr><td></td><td>• Performance Monitoring</td><td>Information only. No test is</td></tr>
</table>

		required.
	The intention is to use a monitoring strategy aligned with standard SDH practice of monitoring and binning PM's to indicate the health of the signal. Instead of BIP errors as the basic error events, the equipment shall use frame CRC/FCS errors. This shall be done on the frames received on VCG ports. Monitoring the health of the EPL circuit shall be done using SDH concepts of ES, SES and UAS. The following Performance Monitoring (PM) counters shall be supported on VCG Ports and PDH channels: Errored Seconds (ES) ; Severely Errored Seconds (SES) ; UnAvailable Seconds (UAS) **2.** All the PM/OM Counters shall binned intervals as 15 minutes ; 24 Hours (1 day)	
	Layer 2 Functionalities and capabilities	**Heading. No test is required.**
	Unless specified, there is no difference between the VCG and the front-panel ports for the Layer 2 functionality. When VLAN or a tag is referred to in the subsequent sections, it shall be treated either as Provider VLAN (in Q-in-Q mode) or as Customer VLAN (in Q mode). Explicit mention is made when there is a distinction.	Information only. No test is required.
1.16	**VLAN features** • The maximum number of L2EPs configurable per VBI by the user shall be 128.	Check the number of L2EPs and note down.
1.17	**DCN feature**	**Heading. No test is required.**
	• The equipment shall support DCN over broadcast ethernet interface.	Test Case No. 8

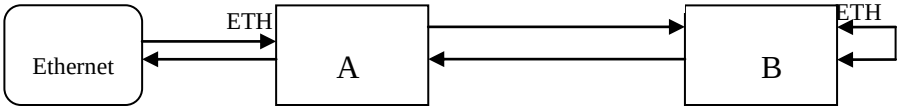
	• The equipment shall support subnetted IP-addresses with ARP.	The above test 10 shall ensure
1.18	**BPDU tunneling** On a per port, per BPDU mac address range 01-80-C2-00-00-00 To -80-C2-00-00-FF shall be configured to be tunnelled or dropped.	Test Case No. 9
1.19	**OAM Enhancement**	**Heading. No test is required.**
	FDV	**Heading. No test is required.**
	• Frame delay variation shall be supported for ELine services.	Verify the support of FDV for ELine services.
	• Oneway Frame delay variation shall be supportd using 1DM frames as defined in Y.1731.	Test Case No. 10
	• Measured oneway frame delays shall be available at the Remote MEP.	Test Case No. 10

Test Cases for Ethernet over PDH (EoPDH)

Test No 1	**Clause No. 1.1**	***Total uplink bandwidth***

Description: To test the STM-4 equivalent total uplink bandwidth from EoPDH.

Test Setup:



Test Procedure:

1. Make the setup as shown in the figure.
2. In EoPDH card of both the nodes A and B, consider three VCGs and select the VCG operating granularity as VCG_ E3.
3. Create 8 VCG_E3 cross connects in each VCG.
4. Total no. of cross connects in the NE should be 24 VCG_E3s which is STM4 equivalent.
5. Verify the traffic is up without any frame drops.

Expected Result:

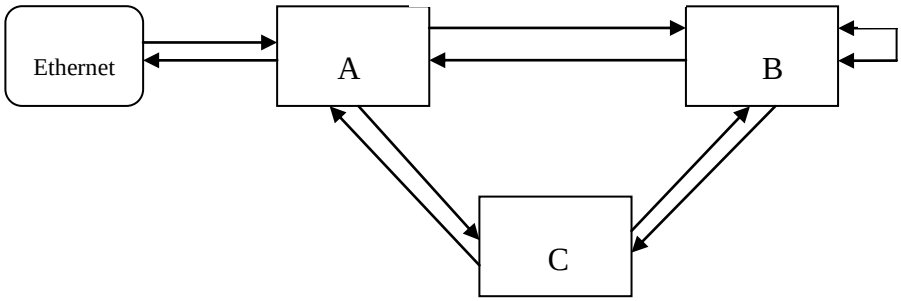
Traffic should flow without any frame drops and the uplink should be STM4 equivalent.

Result:

Test No 2	Clause No. 1.7 and 1.8	***Protected and unprotected VCs on same VCG***

Description: To test the provisioning of protected and unprotected VCs on the same VCG

Test Setup:



Test Procedure:

01. Make the setup as shown in the above figure.
02. Let Node A and Node B be a add/drop node and Node C be the pass-through node. Select the operating granularity as VCG_E1.
03. In Node A, provision 3 protected cross connect in VCG-101 and verify that cross connect provisioning is successful. Let Node A-Node C-Node B be the work path. Let protect path be Node A --- Node B.
04. In Node C, make pass-through cross connect.
05. In Node B provision 3 protected cross connect in VCG-101 and verify that cross connect provisioning is successful.
06. In Node A provision 2 unprotected cross connect in VCG-101. Let traffic path be Node A---Node B.
07. In Node B provision 2 unprotected cross connect in VCG-101.
08. Feed the traffic in Node A and put loop back in Node B. Verify that traffic is up.
09. Verify that both protected and un-protected traffic is up.
10. Remove the cross-connects which were provisioned on both the NEs. Now, on the VCG on NE A, provision 2 channels over the short path NE A -- NE B, and provision 3 channels to take the long path NE A --- NE C --- NE B. Ensure that the traffic is through. (Note: LCAS and

VCAT should be enabled for this sort of scenario)

11. Make identical cross connections at B also.
12. Now, pull both the fibers between NE A and NE B. This would cause the traffic to go down between the two NE, but because of diversely routed traffic, there would be some frame drops initially, but the traffic should not go down completely. The alarms partial loss of capacity on the recieve and transmit side would be raised against the particular VCG.
13. On restoring the fibers, the traffic should continue to flow normally, without any frame drops.

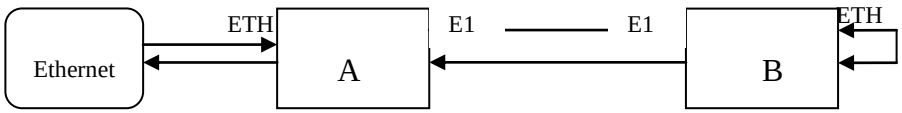
Expected Result: Protected and Un-protected VCs should exist on the same VCG. Diverse routing of traffic should be possible to avoid complete failure in traffic.

Result:

Test No 3	Clause No. 1.9	*Non-LCAS mode of VCG*

Description: To test the traffic outrage in non-LCAS mode when a member is added or deleted.

Test Setup:



Test Procedure:

1. Make the setup as shown in the above figure.
2. In both nodes, disable the LCAS on VCG 101. Select the operating granularity as VCG_E1.
3. In both nodes, provision six cross connect in VCG-101.
4. Pump the traffic in node A and loopback in node B.
5. In node A,in the same VCG add one more cross connect.Verify that the node A raise following alarms:-

   Rx Total Loss of Capacity alarm
   Link Down on ETH port
   Link Down on VCG port
   Link Integrity on ETH port if Link Integrity is enabled.Otherwise this will not occur.
6. Node B will raise following alarms:-

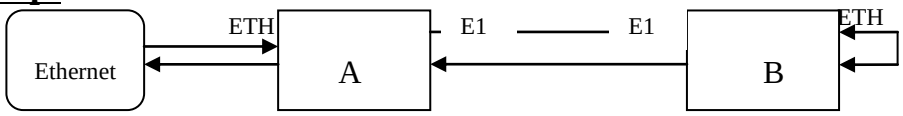
   Loss of Frame Delineation
   Link Down on VCG
   Link Down on ETH
   Link Integrity on ETH port if Link Integrity is enabled.Otherwise this will not occur.
7. Verify that traffic is down
8. In node B provision one more cross connect. Verify that traffic is up again.

Expected result: Traffic should go down when a member is added/deleted to/from VCG in Non-LCAS mode.
Result:

Test No 4	Clause No. 1.10	***Link Capacity Adjustment Scheme***

Description: To test the addition/deletion of a member to/from VCG is hitless.

Test Setup:



Test Procedure:

1. Make the setup as shown in the above figure.
2. In both nodes, enable LCAS on VCG 101. Make 5 cross connects on the same VCG with operating granularity as VCG_E1.
3. Ensure the traffic is up and there are no frame drops.
4. Add one more member in VCG-101 of Node A and verify that there is no hit in the already running traffic. Verify that there are no frame drops. The added member would still not be up as there is nothing on the other side.
5. Add one more cross connect in VCG-101 of Node B and verify that there is no hit in the already running traffic. Verify that there are no frame drops. Now, both the members which have been added in NE A and B, should be part of the VCG group and the LCAS control status should be proper.
6. Now in Node B,do LCAS unprovision the added cross connect and similarly do it in a Node A.Then delete the cross connect in both Node A and Node B and verify that there is no hit in the already running traffic. Verify that there are no frame drops.

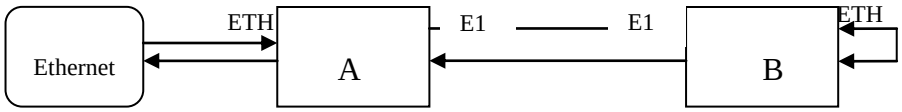
Expected result: LCAS to be supported and when enabled addition/deletion of VCs shouldn't bring the traffic down.

Result:

Test No. 5	Clause No. 1.11	***Partial Failure in one direction***

Description: To test the effect of partial failure in one direction in LCAS mode.

Test Setup:



Test Procedure:

1. Make the setup as shown in the figure.
2. Enable LCAS on VCG101.
3. Provision a single VCG_E1 cross connects for in VCG-101 of Node A.
4. Similarly make a cross connect at Node B.
5. Feed traffic from Ethernet tester on Node A and put a loop back on Node B. Verify that traffic is up without any frame drops.
6. At node A, Remove Transmit LCAS Provision.
7. Verify that Node A should report TX Partial Loss of Capacity LCAS.
8. Verify that Node B should report Rx Partial Loss of Capacity LCAS.
9. Add Transmit LCAS Provision.
10. Verify that after sometime alarms are cleared on both Node A and Node B.
11. Verify that during this process there is no hit in the traffic.

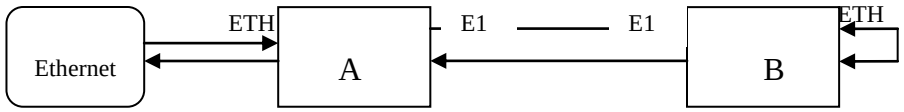
Expected result: Partial failure in one direction shall have no effect on the traffic in the other direction.

Result:

Test No. 6	Clause No. 1.11	***Addition or deletion of VCs during partial failure***

Description: To test the addition/deletion of VCs during partial failure.

Test Setup:



Test Procedure:

1. Make the test setup as shown in the above figure.
2. In both nodes, on VCG 101select operating granularity as VCG_E1.
3. Provision 3 cross connect in VCG-101 of Node A and node B.
4. Feed traffic from ethernet tester to Node A and put a loop back on Node B. Verify that traffic is up without any frame drops.
5. Remove Transmit LCAS Provision for a member in Node A.
6. Verify that Node A should report TX Partial Loss of Capacity LCAS.
7. Verify that Node B should report Rx Partial Loss of Capacity LCAS.
8. In this condition add one more cross connect in both Node A & Node B and Verify that traffic is up.
9. Delete the newly provisioned cross connect in both the nodes and Verify that traffic is up.

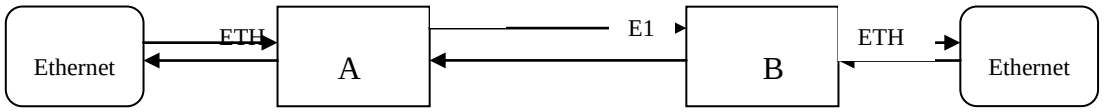
Expected result: Addition/Deletion of VCs should be possible during Partial failure of Tx/Rx.

Result:

Test No. 7	Clause No. 1.12	*LCAS Inter working*

Description: To test the Interoperability between LCAS and Non-LCAS nodes.

Test Setup:



Test Procedure:

1. Make the test set up as shown in the above figure.
2. Configure a VCG containing members, for instance 5 VCG_E1 with LCAS

le in A and with LCAS disable in B.

3. Control statement of NE A has to show Fixed as the other end is non

   LCAS receiver.

4. Pump the traffic from tester to NE A, traffic has to receive at at NE B

ut any frame drops.

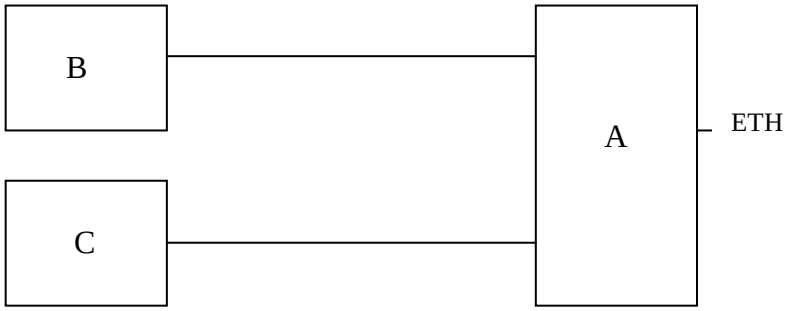
Expected result: Traffic should flow without any frame drops between a LCAS and a Non-LCAS node.

Result:

Test No. 8	Clause No. 1.17	DCN

Description: To test the DCN feature with EoPDH.

Test Setup:



Test Procedure:

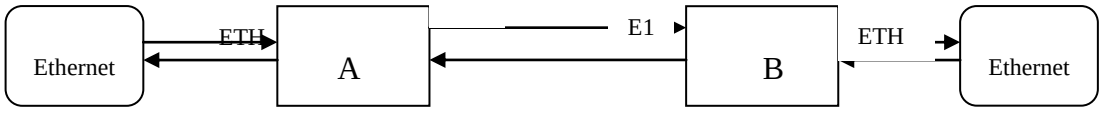
1. Make the setup as shown in the above figure.
2. Provision new management entry in the NE A.
3. Provide the CVLAN ID (CVLAN ID which will be a management VLAN ID and should be different from the data VLAN ID) into the management network entry.
4. Provide MAC address which will be unique for a management bridge.
5. Provide local IP address in the entry which will be with IP address and mask length corresponding to the subnet used in the network.
6. Select the ports which will be managed via ETH port in above config VCG1, VCG2 and ETH.
7. After completion of the provisioning, When packets come at the ETH port in management bridge it will send ARP request to all the ports which are in the management VLAN group except the incoming port. On the basis of ARP reply, ARP table will be updated with the entry of destination MAC address, IP address and port.

8. Ping NE A and NE B. It should be possible and now the NEs can be managed via ETH port of NE A.
Expected result: Node B and Node C should be accessible when disconnected from network via Node A.
Result:

Test No. 9	**Clause No. 1.18**	**BPDU Tunneling**

Description: To verify the BPDU tunneling feature.

Test Setup:



Test Procedure:

1. Change port type of ETH1 and VCG101 in node A and ETH1 and VCG228 in node B to .1q with APF as accept all, configure their Port VLAN IDs to be same, say 4000.
2. Add interfaces ETH1 and VCG101 to the ELAN service with CVID-4000, also add interfaces ETH1 and VCG228 with CVID 4000 to EVC on EoPDH-2.
3. Enable BPDU tunneling at the ETH port of node A.
4. Configure BPDU tunneling by selecting protocol action "tunnel" for protocols whose packets are to be tunneled, say 1:80:C2:00:00:03(MAC1).
5. Send untagged packets with DA as 01:80:C2:00:00:03 to ETH interface of node A, these should be received at ETH interface of node B.
6. Send untagged packets with DA as 01:80:C2:00:00:02 to ETH interface of node A, these should not be recived at node B, they should be dropped at ETH of node A.

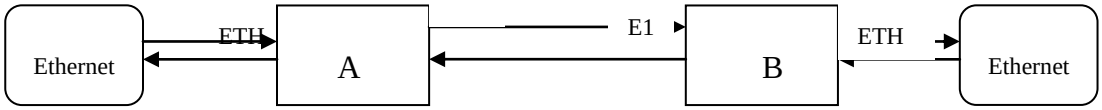
Expected result: BPDUs are to be tunneled without any drop and it should be configurable.

Result:

Test No. 10	Clause No. 1.19	Frame Delay Variation

Description: To test the support of one way Frame delay variation.

Test Setup:



Test Procedure:

1. Make the setup as shown in the figure.
2. Create Eline Service between ETH and VCG ports with granularity VCG_E1.
3. In Tx Delay measurement, the no. of frames to be sent should be 15 & priority should be 7 by default. The priority ranges from 0 to 7. The number of frames ranges from 2 to 15.
4. In Rx Delay measurement, the no. of 1DM frames to be expected should be 15 & priority should be 7 by default. The priority ranges from 0 to 7. The number of frames ranges from 2 to 15.
5. On the node where Rx delay should be measured, Enable Rx Delay Measurement with other parameters configured.
6. On the other node enable Tx delay Measurement with parameters configured. Priority should be same as that of Rx node.

Expected result: Frame delay variation is to be reported and one way delay should be available at the remote node.

Result:

5. Test Schedule /Observations / Records:

Check of STM-1 Optical Interface:

Limits: The limits of the optical parameters pertaining to the STM-4 optical interface shall differ with the application codes. Therefore, Table-2 of ITU-T Rec. G.957 may be referred to for the relevant application code.

Nominal Bit rates: Limits: 155.520 Mbit/s ± 4.6 ppm.

No. of Port	**Measured bit rate in bits/sec**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

A. Check of Optical parameters

a. Operating wavelengths:

Window	**Measured wavelength in nm**
1310 nm	MLM / SLM (Put a tick mark)
	Port 1 :
	Port 2 :
	Port 3 :
	Port 4 :

1550 nm	MLM / SLM (Put a tick mark)
	Port 1 :
	Port 2 :
	Port 3 :
	Port 4 :

b. Light source type:

No. of Port	**MLM / SLM**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

c. Spectral width:

No. of Port	**Measured width in nm**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

d. Side mode suppression ratio (SMSR): Limit: 30 dB for SLM Laser

No. of Port	**Measured in dB**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

e. Mean Launch power:

No. of Port	**Measured in dBm**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

f. Extinction ratio

No. of Port	**Measured in dB**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

g. Receiver Sensitivity

No. of Port	Measured results in dB
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

h. Receiver Reflectance

No. of Port	Measured results in dB
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

i. Eye mask

No. of Port	Results OK / Not OK
Port 1 :	OK / Not OK (Attach Printouts)
Port 2 :	OK / Not OK (Attach Printouts)
Port 3 :	OK / Not OK (Attach Printouts)
Port 4 :	OK / Not OK (Attach Printouts)

j. Check of Jitter

Jitter generation

No. of Ports	**Measured results in UIPP**	
	HP1+LP	**HP2+LP**
Port 1 :		
Port 2 :		
Port 3 :		
Port 4 :		

Jitter tolerance

No. of Ports	**Results OK / Not OK**
Port 1 :	OK / Not OK (Attach Printouts)
Port 2 :	OK / Not OK (Attach Printouts)
Port 3 :	OK / Not OK (Attach Printouts)
Port 4 :	OK / Not OK (Attach Printouts)

B. Check of STM-1 Electrical Signal

a. General characteristics:

Code used :

Nominal Bit rates:

No. of Port	Measured bit rate in bits/sec
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

b. Output pulse characteristics

Attach the print outs for the mask corresponding to binary 0 and binary 1 obtained by checking with the Digitizing Oscilloscope.

No. of Port	Binary 0	Binary 1
Port 1 :	Ok / Not Ok	Ok / Not Ok
Port 2 :	Ok / Not Ok	Ok / Not Ok
Port 3 :	Ok / Not Ok	Ok / Not Ok
Port 4 :	Ok / Not Ok	Ok / Not Ok

c. Return Loss at the output port measured across 75 ohm impedance shall be as below : (Limit : ≥ 15 dB)

Frequency Level = 0 dB	Port 1	Port 2	Port 3	Port 4
8 MHz				
20 MHz				
50 MHz				
100 MHz				
150 MHz				
200 MHz				
240 MHz				

d. Specification at the Input ports

Check of BER

Input	**BER at 0 ppm**	**BER at +20 ppm**	**BER at –20 ppm**

–48 V	OK / Not OK	OK / Not OK Maximum Offset acceptable =	OK / Not OK Maximum Offset acceptable =
–40 V	OK / Not OK	OK / Not OK Maximum Offset acceptable =	OK / Not OK Maximum Offset acceptable =
–60 V	OK / Not OK	OK / Not OK Maximum Offset acceptable =	OK / Not OK Maximum Offset acceptable =

Return Loss at the output port measured across 75 ohm impedance shall be as below : (Limit : ≥ 15 dB)

Frequency Level = 0 dB	Port 1	Port 2	Port 3	Port 4
8 MHz				
20 MHz				
50 MHz				

100 MHz				
150 MHz				
200 MHz				
240 MHz				

e. Check of Jitter parameters

Jitter generation

No. of Ports	**Measured results in UIPP**	
	HP1+LP	**HP2+LP**
Port 1 :		
Port 2 :		
Port 3 :		
Port 4 :		

Jitter tolerance

No. of Ports	Results OK / Not OK
Port 1 :	OK / Not OK (Attach Printouts)
Port 2 :	OK / Not OK (Attach Printouts)
Port 3 :	OK / Not OK (Attach Printouts)
Port 4 :	OK / Not OK (Attach Printouts)

C. Check of 2 Mbps Interface

a. General characteristics: Bit rate : Limits: 2048 ± 102 Hz

No. of Port	Measured bit rate in bits/sec
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

b. Check of Output pulse Characteristics:

No. of Port	Output Pulse
Port 1 :	Ok / Not Ok (attach print out)
Port 2 :	Ok / Not Ok (attach print out)
Port 3 :	Ok / Not Ok (attach print out)
Port 4 :	Ok / Not Ok (attach print out)

c. Output jitter at 2048 Kb/s :

Limits : 20 Hz to 100 KHz : ≤ 0.05 UI peak-to-peak

Filters	**Stream 1**	**Stream 2**	**Stream 3**	**Stream 4**
20 Hz to				

d. Check of BER:

Input voltage	**BER at 0 ppm**	**BER at +50 ppm**	**BER at –50 ppm**
–48 V	OK / Not OK	OK / Not OK Maximum Offset acceptable =	OK / Not OK Maximum Offset acceptable =
–40 V	OK / Not OK	OK / Not OK Maximum Offset acceptable =	OK / Not OK Maximum Offset acceptable =
–57 V	OK / Not OK	OK / Not OK Maximum Offset acceptable =	OK / Not OK Maximum Offset acceptable =

e. Check of Return Loss:

Frequency	**Limits**	**Stream 1**	**Stream 2**	**Stream 3**	**Stream 4**

51 KHz	≥ 12 dB				
60	≥ 12 dB				
75	≥ 12 dB				
100	≥ 12 dB				
105	≥ 18 dB				
200	≥ 18 dB				
500	≥ 18 dB				
1000	≥ 18 dB				
2000	≥ 18 dB				
2500	≥ 14 dB				
3072	≥ 14 dB				

f. Check of Input jitter acceptance : Also called Maximum Jitter Tolerance (MTJ)

	Stream 1	**Stream 2**	**Stream 3**	**Stream 4**
MTJ at the input port	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok

g. Mapping jitter:

Filter: 18 KHz to 100 KHz ≤ 0.075

Filters	Stream 1	Stream 2	Stream 3	Stream 4
18 KHz to				

h. Combined jitter:

Limits for 2Mb/s ± 50ppm,

20 Hz to 100 KHz : ≤ 0.4UI

18 KHz to 100 KHz : ≤ 0.075UI

	Port	Off Ppm	Filters							
			20 Hz to 100 KHz				18 KHz to 100 KHz			
			Single		Single		Single		Single	
		+50 -50								

		+50 -50								
		+50 -50								
		+50 -50								

D. 34 Mb/s Electrical interface

a. Code and bit rates: Code used is:

No. of Port	**Measured bit rate in bits/sec**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

b. Output Pulse Characteristics:

Attach the print outs for the mask. Ensure that the mask is as per figure 17/ITU-T rec. G.703 obtained by checking with the Digitizing Oscilloscope.

No. of port	Status of the mask
No.1	OK / Not OK
No.2	OK / Not OK
No.3	OK / Not OK
No.4	OK / Not OK

c. Check of BER

No. of port	**BER (nominal)**	**BER (+ 20 ppm)**	**BER (- 20 ppm)**
No.1	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok
No.2	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok
No.3	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok
No.4	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok

d. Return Loss at the Input ports

Return loss limits measured at input port across 75 ohm impedance shall be as below:

Frequency		Return loss
859.2 KHz to 1718.4 KHz	:	> 12 dB
1718.4 KHz to 34368 KHz	:	> 18 dB
34368 KHz to 51552 KHz	:	> 14 dB

Frequency	Return Loss (db)			
	Port 1	Port 2	Port 3	Port 4

850.0 KHz 5.0 MHz 10.0 MHz 15.0 MHz 20.0 MHz 25.0 MHz 30.0 MHz 34.368 MHz 40.0 MHz 45.0 MHz 50.0 MHz 51.552 MHz				

e. Output Jitter:

Limits: 100 Hz – 800 KHz ≤ 0.05 UI

Port No.	100 Hz – 800 KHz
No.1	
No.2	
No.3	

No.4	

f. Jitter tolerance at input ports:

No. of Ports	**Results OK / Not OK**
Port 1 :	OK / Not OK (Attach Printouts)
Port 2 :	OK / Not OK (Attach Printouts)
Port 3 :	OK / Not OK (Attach Printouts)
Port 4 :	OK / Not OK (Attach Printouts)

g. Jitter from Tributary mapping:

Port No.	10 KHz – 800 KHz Limit: ≤ 0.075 UI
No.1	
No.2	
No.3	
No.4	

h. Combined jitter and wander from tributary mapping and pointer adjustment:

Limits: 100 Hz – 800 KHz: ≤ 0.4 UI (for pointer sequence a, b and c)

100Hz– 800 KHz: ≤ 0.75 UI (for pointer sequence d)

10 KHz - 800 KHz: ≤ 0.075 UI

Pointer sequences	**Port 1**		**Port 2**	
	) KHz	**10 KHz to 800 K**	**) KHz**	**10 KHz to 800 K**

		Hz		**Hz**
a) Single of opposite polarity				
b) Regular with one double pointer				
c) Regular with one missing pointer				
d) Double pointer of opposite polarity				

Pointer sequences	**Port 3**		**Port 4**	
	) KHz	**10 KHz to 800 KHz**	**) KHz**	**10 KHz to 800 KHz**
a) Single of opposite pola				

rity				
b) Regular with one double pointer				
c) Regular with one missing pointer				
d) Double pointer of opposite polarity				

E. 44.736 Mb/s Electrical interfaces (DS-3)

a. Code and bit rates: Code used is: (B3ZS (bipolar with three-zero substitutions)

Limit: 44. 736 Mb/s+/- 895bits/s (+/-20ppm) 44. 736 Mb/s+/- 895bits/s (+/-20ppm)

No. of Port	**Measured bit rate in bits/sec**
Port 1 :	
Port 2 :	
Port 3 :	
Port 4 :	

b. Output Pulse Characteristics:

Attach the print outs for the mask. Ensure that the mask is as per figure 14/ITU-T rec. G.703 obtained by checking with the Digitizing Oscilloscope.

No. of port	Status of the mask
No.1	OK / Not OK
No.2	OK / Not OK
No.3	OK / Not OK
No.4	OK / Not OK

c. Check of BER

No. of port	**BER (nominal)**	**BER (+ 20 ppm)**	**BER (- 20 ppm)**
No.1	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok
No.2	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok
No.3	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok
No.4	Ok / Not Ok	Ok / Not Ok	Ok / Not Ok

d. Output Jitter:

Limits: 10 Hz – 400 KHz ≤ 5.0 UI

30 KHz – 400 KHz ≤ 0.1 UI

Port No.	10 Hz – 400 KHz ≤ 5.0 UI	30 KHz – 400 KHz ≤ 0.1 UI
No.1		
No.2		
No.3		
No.4		

e. Jitter tolerance at input ports:

Shall conform to Figure-9/G.824

No. of Ports	**Results OK / Not OK**
Port 1 :	OK / Not OK (Attach Printouts)
Port 2 :	OK / Not OK (Attach Printouts)
Port 3 :	OK / Not OK (Attach Printouts)
Port 4 :	OK / Not OK (Attach Printouts)

F. Check of Ethernet Ports

Run the RFC 2544 scripts at Fast Ethernet and Gigabit Ethernet ports for 64, 128, 256, 512, 1024, 1280 and 1518 bytes frame sizes and record the results.

===== End of the Document =====