Test Schedule and Test Procedure for FTTx based Broadband Access Applications using GPON Technology with Mini-OLT
(GR No.: TEC/GR/FA/PON-02/02-NOV-2018)

TSTP No. TSTP/TEC/GR/FA/PON-02/02-NOV-2018
(Supersedes previous TSTP)

(PROVISIONAL)

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A. INTRODUCTION

Introduction: The broadband access network architectures based on Fibre-to-the-Home/Building/Curb/Cab (FTTH/FTTB/ FTTC/FTTCab) commonly called FTTX architectures, using Gigabit-capable Passive Optical Network (GPON) technology with Mini-OLT conforming to TEC GR (Generic Requirements) No. GR/PON-02/02.NOV.2018 shall offer his system for type evaluation along with factory tests conducted by the manufacturers at their premises and a copy of Instruction and Maintenance Manual, after ensuring that his system is in compliance with this GR . The manufacture shall provide the physical layout of components & PCBs, terminations, bill of material, Installation & Maintenance Manual etc. along with the test results obtained during manufacturers' own factory testing.

Before start of the type testing, it shall ensure that :

- The manufacturer has a valid Infrastructure Approval from the competent authority for the product offered.
- The study of the factory test report, installation & maintenance manual, layout of components, PCBs, terminations & bill of material has been done & the product is in compliance of the GR.

All the necessary **set-ups & digital measuring instruments duly calibrated by an Authorised Lab. are to be provided by the manufacturer for testing.**

All the basic test facilities & measuring equipment as per the **'List of test instruments & Test Set-up'** enclosed, shall be provided by the manufacturer.

Note: <u>Though every care has been taken to cover all the parameters of the GR correctly in this Test Schedule, yet to avoid any inadvertent error/ misprint, the testing officer shall ensure that all the parameters of the GR have been tested & verified in accordance with the provisions of the GR.</u>

B. HISTORY SHEET

S.No.	Document No.	Test Schedule issue	Remarks
1.	Test Schedule & Test Procedure as per GR FTTx based Broadband Access Applications using Gigabit Passive Optical Network (GPON) Technology with mini-OLT (No. GR/PON-02/01.MAY.2013) TSTP (No. TSTP/ GR/PON-02/01.JUN.2013)	Issue - I (Provisional).JUNE.2013	-
2.	Test Schedule & Test Procedure as per GR FTTx based Broadband Access Applications using Gigabit Passive Optical Network (GPON) Technology with mini-OLT (No. GR/PON-02/02.NOV.2018) TSTP (No. TSTP/ GR/PON-02/02.NOV.2018)	Issue - II (Provisional) NOV.2018	Revised and Supersedes previous TSTPs

C. General information for type approval against GR/PO:

General details consist of vendor, equipment etc. as per the following:

SN	General Information	Details
1	Name of the Vendor	
2	Date of registration	
3	Name of the GR against which type approval sought	Mini-OLT based GPON
4	GR No.	TEC/GR/TX/PON-02/02.NOV.2018
5	TAC is against: GR/PO	
6	In case of PO, PO no (Undertaking in the case of TAC against PO*☺	
7	Details of equipment;	
	(a) Type of Equipment.	Mini-OLT/Splitter/ONT
	(b) Model No./Serial No	
8	Any other relevant Information:-	

Note:* Manufacturer shall give an undertaking stating that the PCB s and other hardware is same as he has quoted in the bid.

General Instruction:

1) Name of the Vendor:
2) Name of the technology:
3) TAC is against: GR/PO: TEC/GR/PON-02/02.NOV.2018
4) In case of PO, PO no:
5) Date of registration:
6) Date of Commence of tests;
   - Place of testing :

9) Details of equipment;
   i) FTTH application   :
   a) OLT   :
   b) No of ONT per PON   :
   c) Details of Sub racks   :

   - Size of the Sub rack   :
   - Type of PCB guide used: Built in embossed type PCB guides / Metallic PCB guides riveted type/ Non metallic removable PCB guides
   - In case of Non metallic removable PCB guides, manufacturer shall give the details of material used
     Comments:

   ❖ Please inspect the Sub rack and record the following information;

- Max. No. of PCB that can be loaded in the sub rack:
  OLT Data Box:
  Video Overlay:
  Other modules:

- The space between any two PCB is sufficient for the purpose of
  - Air Circulation/heat dissipation   **Yes/No**

  - Smooth flow of PCB within the Sub rack without colliding/touching the adjacent PCB   **Yes/No**

  - Locking arrangements of PCB is provisioned. If yes, whether the Screwing to the body of Sub rack/ Clips at the top and bottom of the PCB/Any other arrangement
                                                                        Yes/No

- Are the Top and bottom plates of Sub rack are of sufficient strength and do not sag / bend when slightly pressed from the center of these plates, if so please indicate
                                                                        Yes/No

- Whether the Sub rack has got the front cover to avoid the ingress of dust.
                                                                        Yes/No

- Whether care has been taken for the EMI and EMC induction or not. If yes what sort of arrangement has been engineered by the manufacturer?
                                                                        Yes/No
- Please check the detailed arrangements for fixing the Sub rack to the full/main rack (It should preferably be the screwing arrangements, with minimum four undetectable screws).   **Yes/No**

- Please check the material of the Sub rack, in case it is mild steel, check that the proper enameling has been done or not.   **Yes/No**

Details of Rack:

Dimension of full size:
Model /version of full rack if any   :
Details of the Rack as stated in this clause are   : **Yes/No**
If no, please ensure that the manufacturer is essentially amending the his manuals to provide these details; listed in the manuals
No of sub racks a Full Rack can accommodate   :

How many sub rack a manufacturer proposes to :
Accommodate in a full rack
Please ensure that the full rack has sufficient strength, so that it does not get twisted while erecting.   **Yes/No**

Please ensure that the top and base plates of the Full Rack is sufficiently thick and have proper arrangements i.e holes etc are there to mount the rack on floor.   **Yes/No**

Please ensure that there is a sufficient space for running the Optical fiber cables/optical patch cord/ electrical cables etc. **Yes/No**

OLT Details:
Name of the PCB   **Sr No,**

  1)

  2)

  3)

  4)

  5)

  6)

  7)

  8)

  9)

  10)

  11)

ONT Details:

Optical Network Termination   **Sr No,**

  1)

  2)

  3)

  4)

  5)

  6)

ONT's connected to Other PON

  1)

  2)

  3)

  4)

Undertaking in the case of TAC against PO: Manufacturer shall give an undertaking stating that the PCB s and other hardware is same as he has quoted in the bid.

Connectors: Type of optical used in the system   : SC/APC, SC/UPC and LC/APC

Make   :
Model no   :

In the case connector used are other than FC/PC, ensure that the suitable adapters are provided by the manufacturer.

Types of Electrical connectors used with the equipment:

Make   :   F-Type RF
Model no   :

Dispersion: **18 ps /nm km**
Fiber Loss/Km: 0.25 **dB**

D. Testing team: *(to be filled by testing team)*

S. no.	Name	Designation	Organization	Signature
1.				
2.				
3.				

E. List of the test instruments with their make and model

S.N.	Name of the instrument	Make /Model
1	Ethernet Analyzer	
2	Optical Spectrum Analyzer	
3	Optical Power Meter	
4	PON Power Meter	
5	Optical Laser Source	
6	Optical Return Loss Meter	
7	Optical Attenuators	
8	POTS Hand sets	
9	FAX Machine	
10	WiFi Adapter	
11	Desk Top PCs and Laptop	

12	TV with IPTV Set Top Box	
13	Millimeter	

F. Equipment Configuration:

a) Mini-OLT configuration:

S.No.	Item	Details	Remarks
1.	Number of PON cards		
2.	Number of SNI Interface		
(i)	10GBE (Optical)		
(ii)	10GBE (Electrical)		
(iii)	1GBE (Optical)		
(iv)	1GBE (Electrical)		
3.	Management Interface		
(i)	Ethernet Port (RJ45)		
(ii)	Serial Port		
4.	PON Interface		
(i)	Number of PON Interfaces Supported		
(ii)	PON with Class B+ Optics		
(iii)	PON with Class C+ Optics		

b) ONT Configurations:

S.N.	Item	Details	Remarks
1	ONT1(Type as per TEC GR)		
(i)	ANI Port		
(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		
2.	ONT2 (Type as per TEC GR)		
(i)	ANI Port		

(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		
3.	ONT3 (Type as per TEC GR)		
(i)	ANI Port		
(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		
4	ONT4 (Type as per TEC GR)		
(i)	ANI Port		
(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		
5.	ONT5 (Type as per TEC GR)		
(i)	ANI Port		
(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		
6.	ONT6 (Type as per TEC GR)		
(i)	ANI Port		
(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		

7.	ONT7(Type as per TEC GR)		
(i)	ANI Port		
(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		
8.	ONT8 (Type as per TEC GR)		
(i)	ANI Port		
(ii)	UNI Ethernet Port		
(iii)	UNI POTS Port		
(iv)	USB Interface		
(v)	Wi-Fi Support		
(vi)	RF Support		

(c). Type of Connectors:

S.No.	Item	Details	**Remarks**
1.	Type of optical used in the system	SC/APC, SC/UPC and LC/APC	
(i)	Make		
(ii)	Model no		
2.	Type of Electrical connector used with the equipment	SC/APC, SC/UPC and LC/APC	
(i)	Make	F-Type RF	
(ii)	Model no		

Note: In the case connector used are other than FC/PC, ensure that the suitable adapters are
 provided by the manufacturer.

G. System Manuals

1. Maintenance manuals

2. Installation manual

3. Repair manual

4. User Manual

H. Clause-wise Test Type and Test No.
(a).Test Setup for testing of Mini-OLT based solution:

Lab Setup for GPON Solution
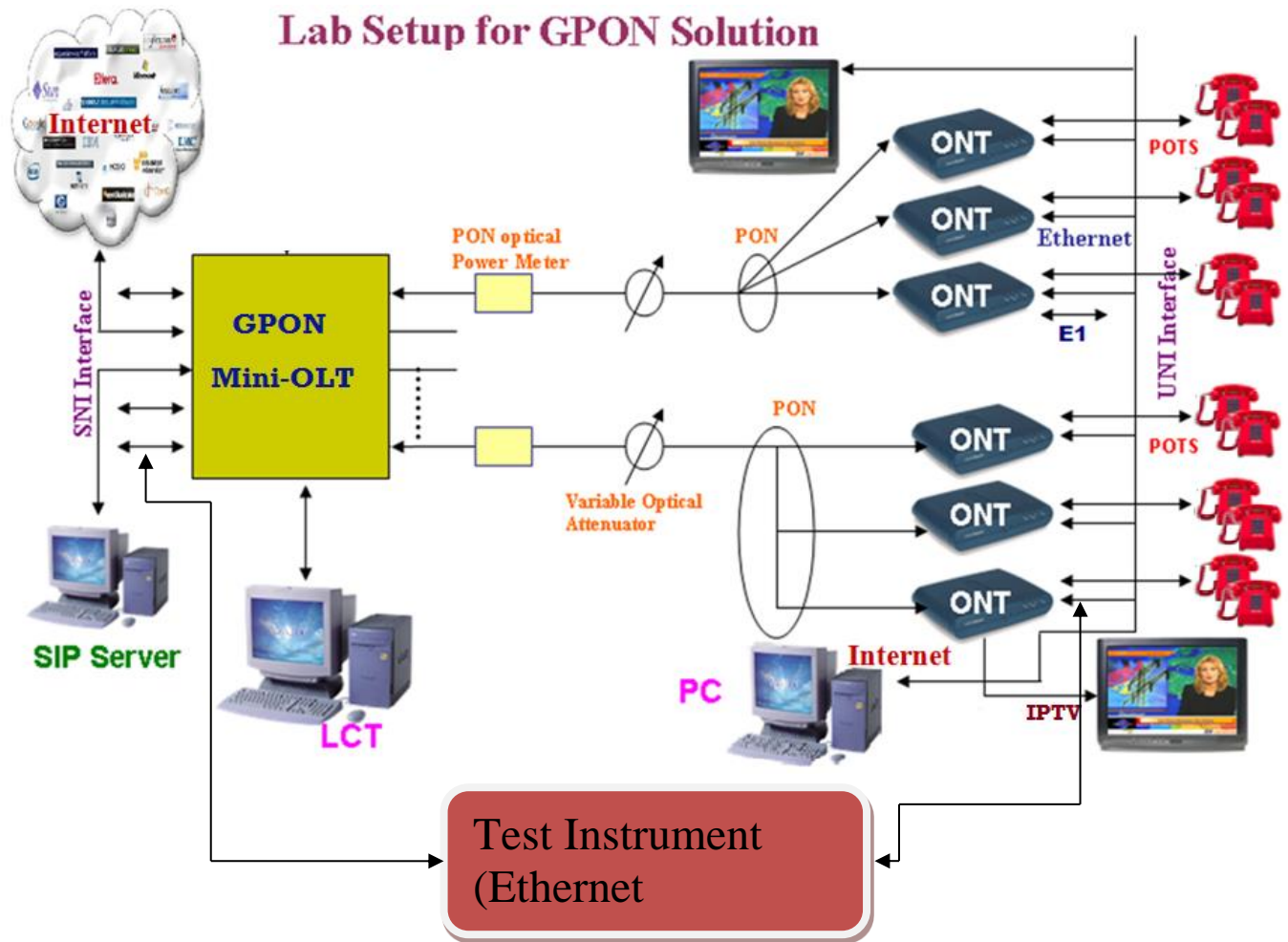
(b). Connections to be created while testing Mini-OLT based GPON Equipment:

1. Protection Provisioning for the ONTs supporting Protection feature

2. Ethernet connections:

   (i)   Internet HSI (High Speed Internet)

   (ii) Internet PPoE (Internet with Residential Gateway)

   (iii) VBES connections for Bandwidth provisioning

3. IPTV Service Connections on Ethernet Ports

4. IP Phone service connection on Ethernet ports

5. Wi-Fi Provisioning

6. POTS services on RJ45 ports

Sl NO	Clause No	Clause	Type of test	Compliance
			Physical Check / Declaration / Documentation / Report from Accredited Test Lab / Functional verification / Information / Lab Test (Test Reference)	**Complied / Not Complied / Submitted / Not Submitted / Not Applicable (Indicate Annexure No for Test Results)**
1		**Chapter 1: Technical Requirements**	Declaration -refer Annexure-II	
2	1.0	**Introduction**	Information - refer Annexure-II	
3	2.0	**An introduction to GPON constituents**	Lab test- refer to test under clause 2.0, Annexure-II	
4	2.1	**Functional components of GPON**	Information - refer Annexure-II	
5	2.1.1	ONU/ONT shall support the following services: • High speed data/Internet. • VOIP through POTS. • E1 through TDM over IP External gateway. • IP Video • WiFi support as IEEE 802.11b/g/n/ac	Lab test- refer to test under clause 2.1, Annexure-II	
6	2.1.2	Mini-OLT shall provide the aggregation and switching functionality between the core network and PON interfaces. 1. Check no. of PON interfaces (towards ONU/ONT) : 8 2. Check no. of service interfaces (towards core networks) : 2x10GbE and 4x1GbE	Physical Check – refer Annexure-II	
7	2.1.3	**Optical Splitter** During type approval testing split options up to N=16 shall at least be demonstrated. There shall be various options provided to purchaser such as: • m: N where m=1 or 2 and • N=4, 8, 16, 32, 64, 128 and may be more	Declaration -refer Annexure-II	
8	2.1.4	**Fiber plant for PON** Ensure that Fibers used between Mini-OLT and ONU/ONT shall be ITU-T Rec G.652. Special fiber e.g. ITU-T Rec G.657 may also be used for FTTB/FTTH intra-building, campus etc. applications.	Declaration -refer Annexure-II	

9	2.2	**TDM lines and voice transport options** 1. Layer2 control protocol between ONU/ONT and Mini-OLT shall be Ethernet over GEM. 2. TDM support shall be provided through TDM over packet (TDMoP) option. TDMoP support shall be relevant to E1 lines. 3. The voice traffic shall be terminated at Mini-OLT across IP over Ethernet interfaces with(S signaling and ITU-T Rec G.711 framing) creating a simple path to an all networks with soft-switches, as needed. An external SIP/H.248↔V5.2 gateway may be used interfacing PSTN switches subject to purchaser's requirements.	Fubnctional verification-refer Annexure-II	
10	2.3	**Topological requirements** Ensure that optical section of a local access network system shall be passive and its architecture is capable of simultaneously supporting a mix of p2p or p2mp application. Actual architecture required shall be decided by the purchaser.	Information-refer Annexure-II	
11	2.3.1	FTTX architecture: An introduction:	Declaration -refer Annexure-II	
12	2.4	**Equipment interfaces in FTTB/FTTH/FTTC/FTTCab/FTTM architectures:**	Declaration-refer Annexure-II	
13	2.4.1	GPON equipment shall provide three types of interfaces • User-Network interface (UNI) • Service-Node-Interface (SNI) • PON interface (IFPON	Physical Check-refer Annexure-II	
14	2.4.2	**A broad overview of Services in various FTTX architectures** FTTB for residential application: shall support the following services: 1. Asymmetric broadband services (Internet, digital broadcast TV services, Video on demand, file download etc.) over direct Ethernet, over copper or through VDSL2. 2. Symmetric broadband services (e.g. content broadcast, e-mail, file exchange, distance learning, telemedicine, on line gaming etc.) over direct Ethernet, over copper or through VDSL2. FTTB for business application: shall support the following services: 1. Asymmetric broadband services (e.g. Internet, digital broadcast TV services, Video on demand, file download etc.) over direct Ethernet. 2. Symmetric broadband services (e.g. group software, content broadcast, e-mail, file exchange etc.) over direct Ethernet, over copper or through VDSL2. POTS through VOIP. TDMOP services. FTTH applications: shall support the following services: 1. Asymmetric broadband services (e.g. Internet, digital broadcast TV services, Video on demand, file download	Functional verification -refer Annexure-II	

		etc.) over fiber.		
		2. Symmetric broadband services (e.g. content broadcast, e-mail, file exchange, distance learning, telemedicine, on line gaming etc) over fiber, POTS through VOIP.		
15	2.4.3	**PON interface (IFPON) at the reference points S/R and R/S.** The interface at reference points S/R and R/S in figure 3 is designated as IFPON. This is a PON-specific interface that shall support all the protocol elements necessary to allow transmission between Mini-OLT and ONU/ONTs.	Physical Verification-refer Annexure-II	
16	2.5	**Important parametric definitions and functional requirements of GPON system.**	Declaration -refer Annexure-II	
17	a	The GPON system shall support a Logical Reach up to 60 Km. At least a physical reach of 20 Km shall be demonstrated.	Lab test- refer to test under clause 2.5, Annexure-II	
18	b	The maximum differential logical reach shall be 20 Km as per GPON standard G.984.X.	Lab test- refer to test under clause 2.5, Annexure-II	
19	c	Power supply failure/EMS server breakdown/bugs in the software shall not affect current tributary connection map.	Functional verification -refer Annexure-II	
20	2.5.1	**Bit rate options of GPON system.**	Declaration refer Annexure-II	
21	a	The GPON system shall support a bit rate of 2488.32Mbps in the downstream Mini-OLT-ONU/ONT and 1244.16Mbps in the upstream ONT/ONU- Mini-OLT directions.	Functional verification -refer Annexure-II	
22	b	The BER should not be worse than 1×10^{-10} for the extreme case of optical path attenuation and dispersion conditions.	Declaration -refer Annexure-II	
23	3.0	**Specifications for GPON system constituents for various topologies:**	Information - refer Annexure-II	
24	3.1	**Equipment categorization:** On the basis of target applications, there shall be following types of ONU/ONT: Type 1. Home-ONT (H-ONT) for FTTH applications. Type 2. Residential-ONU (R-ONU) for FTTCab/FTTC applications. Type 3. MDU-ONU (M-ONU) for FTTB applications in MDU. Type 4. Business-ONT (B-ONT) for FTTH applications. Type 5. Mobile backhaul-ONT (M-ONT) for FTTM applications. **Protection requirements due to fiber cuts:** 1. No support for protection (used mainly for residential applications) 2. In case of business as well as high density residential applications, the purchaser may opt for configurable protection as fully–protected, partially protected or unprotected.	Information -refe Annexure-II	
25	3.2	**Physical interface requirements at UNI:**		

26	1	**Type 1:** H-ONT for residential broadband service delivery. Service support shall be there for voice, video and data. POTS - Minimum One. 10/100/1000 BaseT Ethernet interface (to inter-connect IP phones, STB, PC etc., through a home Ethernet bridge or Router mode with inbuilt Residential Gate Way functionality) -Minimum one. Dying gasp feature (If required by purchaser). Inbuilt IEEE 802.11b/g/n/ac WiFi interface in the home(Optional) USB 2.0/3.0 Interface(optional).	Functional verification - refer,Annexure-II	
27	2	**Type2**: Residential-ONU (R-ONU) for FTTCab/FTTC applications The ONU for FTTCab/FTTC architecture shall provide VDSL2 interface numbers of homes/users shall be high in the deployment distance from target user may be 500m-1000m.The interface support shall be provided for: i. 10/100/1000 Ethernet Interface– Minimum 16. ii. ADSL2+/VDSL2 interface –Minimum 16 iii. G.Fast (ITU-T rec G.9700 & G.9701) / G.hn(ITU-T rec G.9960 & G.9961) interface. (If required by purchaser) iv. Dying gasp feature (If required by purchaser). v. The users shall install an appropriate NT at their premises.	Functional verification -refer Annexure-II	
28	3	**Type 3**: MDU-ONU (M-ONU) for FTTB applications in MDU. The M-ONU for FTTB architectures shall provide interfaces to cater to residential as well as business requirements in Multi-Dwelling Unit (MDU). M-ONU is usually installed in the basement of the MDU. Direct Ethernet access to ONU (up to 100Mb/s) over copper-pairs can be used, if user location is within ~100 meter reach of ONU in an MDU/MTU. ADSL2+/VDSL2 based access may be used for longer distances. The users shall install an appropriate NT at their premises A typical distance from target users may be 100-150m. The interface support shall be provided for: i. POTS-minimum 24 ii. 10/100/1000BaseT Ethernet interfaces – Minimum 24 iii. Inbuilt IEEE 802.11b/g/n/ac WiFi interface in the home(Optional) iv. ADSL2+/VDSL2 interfaces- Minimum 24. v. G.Fast (ITU-T rec G.9700 & G.9701) / G.hn(ITU-T rec G.9960 & G.9961) interface. (If required by purchaser) vi. Dying gasp feature (If required by purchaser). vii. The users shall install an appropriate NT at their premises.	Functional verification -refer Annexure-II	
29	4	**Type 4**: Business-ONT (B-ONT) for FTTH applications.	Functional	

		i. POTS – Minimum One ii. E1 line (for PBX interconnection etc.). The support for E1 shall be meant for transportapplications of TDM to Mini-OLT. The system shall support E1 Interface – Minimum One iii. 10/100/1000 BaseT Ethernet interface (to inter-connect IP phones, STB, PC etc., through a home Ethernet bridge or Router mode with inbuilt Residential Gate Way functionality) – Minimum Two iv. IEEE 802.11b/g/n/ac WiFi interface (inbuilt implementation) in the home – Minimum One v. Dying gasp feature (If required by purchaser). vi. USB 2.0/3.0 Interface(Optional)	verification -refer Annexure-II	
30	5	**Type 5**: Mobile backhaul-ONT (M-ONT) for FTTM applications. i. 10/100/1000BaseT Ethernet interfaces – Minimum Four Port ii. PON ports for Uplink- Two iii. Dying gasp feature (If required by purchaser) iv. USB 2.0/3.0 Interface(optional). v. The system shall support 1588v2 protocol for synchronisation.	Functional verification -refer Annexure-II	
31	3.3	**ONU and ONT equipment architecture** ONU/ONT may comprise of the basic module providing optical interface on the PON side and some sub-modules providing various UNI interfaces on the user side through DSLAM etc.	Physical Check - refer Annexure-II	
32	3.3.1	**Functional requirements of ONU/ONT at UNI**	Declaration-refer Annexure-II	
33	1	**Isolation of subscriber traffic to ensure user privacy for ONU.** ONU shall have capability to prevent MAC address spoofing. it shall be possible to limit the number of MAC/IP addresses per port and to bind the MAC/IP addresses to a port. There shall be no layer 2 connectivity between users at ONU. Subscriber (peer to peer communication shall be allowed only through MINI-OLT.	Lab Test - Refer Test under clause3.3.3(1) at Annexure-II	
34	2	**Layer 2 bridging support for various ONU/ ONT.** • Type 1. Home-ONT (H-ONT) for FTTH applications. 64 MAC addresses, 16 VLAN. • Type 2. Residential-ONU (R-ONU) for FTTCab/FTTC applications. 1K MAC addresses, 4096 VLAN. • Type 3. MDU-ONU (M-ONU) for FTTB applications in MDU. 1K MAC addresses, 4096 VLAN . • Type 4. Business-ONT (B-ONT) for FTTH applications. 256 MAC addresses, 64 VLAN. The following capabilities shall be supported at UNI for all 'types': i. Flow control per 802.3x	Lab Test - Refer Test Item 2 at Annexure-II	

		ii. IGMPv2/3 snooping – applicable for ONU only, optional for ONT, iii. IGMP filtering - applicable for ONU only, optional for ONT, iv. 128 multicast groups - applicable for ONU only, optional for ONT. Note: Flow control shall be supported by both ONU and ONT. The others shall be as per the requirements of the purchaser.		
35	3	Bandwidth management, congestion control and QoS	Lab Test - Refer Test Item 3 at Annexure-II	
36	4	**Dynamic Bandwidth adjustment (DBA)** • piggy-back DBRu mode 0 shall be supported • Idle GEM DBA shal be supported • Concurrent support of idle GEM and piggy-back DBRu mode 0 shall be supported • T-CONT Type 1 and T-CONT type 4	Lab Test - Refer Test Item 4 at Annexeure-II	
37	5	**Security** • User name and password based authentication. • Optional support of 802.1x authenticator functionality (port based) • MAC address limitation per port. • AES (key size of 128 bit) support (optional) per port-id with operator disable/enable capability. • Operator disable/enable shall be done in-band PLOAM message (Encrypt Port-Id) and there is only one key per ONT/ONU. • For higher security, ONT/ONU must support run-time regeneration of the AES key and encryption using the new key, while carrying the live traffic.	Lab Test - Refer Test Item 6 at Annexure-II	
38	6	ONT Ethernet port shall be configurable to accept the following frames: • Customer VLAN tagged frames. • Priority tagged frames. • Untagged frames. • 802.1P mode.	Lab Test - Refer Test Item 7 at Annexeure-II	
39	7	There shall be FEC RS (255,239) support with operator disable/enable capability in both upstream and downstream direction.	Lab Test - Refer Test Item 9 at Annexeure-II	
40	3.3.2	**'Triple-play' related requirements for ONU**	Declaration-refer Annexure-II	
41	a	**Channel zapping time** The GR envisages distributed channel-change activation at ONU by means of IGMPv2/3 messages. The GR assumes an average 6 seconds time between channel-swapping by a user as a design measure. To achieve the same, the ONU shall be able to scale up to @N*10 swaps/minute (where N = No. of users at ONU). Besides it shall keep the time taken for the multicast join low enough to enable the customer to perceive a channel change time of less than a second.	Functional verification -refer Annexure-II	
42	b	**Channel-change activation** Channel	Functional	

		change decision shall be taken at ONU to achieve the targets as at sub-clause a) above. Further, ONU shall support two stage of multicasting for Broadcast TV. Normally, the ONU shall be downloading a group of channels commonly seen in the served-area. Other 'niche' channels shall be available in Metro Core. For a 'niche' channel, ONU shall send an IGMP join to Mini- OLT, if demanded by at least one user.	verification -refer Annexure-II	
43	c	**DHCP option 82 (IETF RFC 3046)** For DHCP based access for entertainment & gaming services, the ONU shall support DHCP option 82 for line identification.	Functional verification -refer Annexure-II	
44	3.4	**Mini-OLT Specifications**	Declaration-refer Annexure-II	
45	a	a. Hardware capability 1. Number of PON interfaces in the box: Mini-OLT shall support single PON/IF card which may be integrated with network side interface card. 2. Number of PON interfaces supported in the box: The Mini-OLT shall support 4/8/16 PON interfaces. 3. Number of interfaces towards the Core network: An Mini-OLT shall have the provision to terminate the following interfaces: (i) For 4 PON interface configuration: A minimum of 2 x GigE and 1 x 10GE LAN interfaces shall be supported towards the core network to cater to the different service providers links. Ratio of uplink access should be 1:1. (ii) For 8 PON interface configuration: A minimum of 4 x GigE and 2 x 10GE LAN interfaces shall be supported towards the core network to cater to the different service providers links. Ratio of uplink access should be 1:1. (iii) For 16 PON interface configuration: A minimum of 4 x GigE and 4 x 10GE LAN interfaces shall be supported towards the core network to cater to the different service providers links. Ratio of uplink access should be 1:1.	Phisical Check- refer Annexure-II	
46	b	Functional and architectural requirements • Mini-OLT shall transparently support SIP/H.248 signaling. • External SIP/H.248→Media gateways can be used to connectivity to PSTN switches Protection requirements • The protection mechanism for the PON line should be mandatorily provided. • 1+1 or 1:1 redundancy may also be provisioned for uplink connectivity. The redundancy shall be as per Purchaser's requirements.	Lab Test - Refer Test Item b) at Annexure- II	
47	c	c) Features and capabilities. • The Mini-OLT shall have local status monitoring	Lab Test - Refer Test Item c) at	

		• The Mini-OLT shall supports LED status indication per Mini-OLT port • Power: Indicates power on/off status • Fail: Indicates internal device failure status • Alarm: Indicate alarm status	Annexure-II	
48	d	Dynamic Bandwidth Allocation (DBA). • Maximum bandwidth limiting : 100Mbps for FE port & 400Mbps for 1G port • Minimum guaranteed bandwidth: 512 Kbps • Two or more level (preferred four) classes of classification • Piggy-back DBRu report mode 0 • Idle GEM DBA • Concurrent support of idle GEM and piggy-back DBRu mode 0 support • T-CONT Type 1 and T-CONT type 4.	Lab Test - Refer Test Item d) at Annexure-II	
49	e	Layer 2 management and QoS support. • Switch fabric in Mini-OLT shall be able to handle full wired speed throughputs • MAC learning shall be supported at Mini-OLT • Port-id-based VLAN shall be supported at Mini-OLT • VLAN stacking towards the network at the Mini-OLT shall be supported	Lab Test - Refer Test Item e) at Annexure-II	
50	f	Support for MAC address limiting • The operator shall be able to set the maximum number of MAC addresses from an ONT UNI at the Mini-OLT • The number shall be operator programmable. When MAC address limit is reached, subsequent MAC addresses from that specific ONT UNI will not be learned	Lab Test - Refer Test Item f) at Annexure-II	
51	g	Supports learning and aging time configuration at Mini-OLT • The operator shall be able to enable/disable MAC address learning function and configure the MAC learning aging time • VLAN and Port-id mapping • The Mini-OLT shall have a function to store the corresponding relationship of user ID, VLAN tag value and port-id number	Declaration-refer Annexure-II	
52	h	VLAN function The Mini-OLT shall support the following VLAN operation • VLAN insertion in ingress process • VLAN removal in egress process • VLAN stacking per 802.1ad	Declaration-refer Annexure-II	
53	i	Filtering functions at Mini-OLT • Filtering by destination MAC address and protocol type • Filtering by destination MAC address • Filtering by source MAC address • Filtering of 802.1x packets • Support of ONT/ONU Ethernet port authentication	Declaration-refer Annexure-II	
54	j	Support for packet classification functions. - Support of IGMP proxy for ONU. - Classification based on VLAN ID	Declaration-refer Annexure-II	

		- Classification based on 802.1p bit - The OLT chassis should be able to configure up to 4K VLAN. However VLAN 0, 1, 2, 3 and 4095 are reserved and not used in the OLT system. - VLAN forwarding /filtering database should be based on IVL (Independent VLAN Learning)". Note: Purchaser shall communicate Number of Port-Id/Alloc.-Id per ONT/ONU to be supported by GPON link.		
55	4.0	**Network requirements**	Declaration-refer Annexure-II	
56	4.1 a	The transmission methodology should be bidirectional by the use of wavelength division multiplexing (WDM) technique on a single fiber compliant with ITU-T Rec. G.652	Declaration-refer Annexure-II	
57	b	Bidirectional transmission shall be accomplished using WDM technique on a single-fiber	Declaration-refer Annexure-II	
58	c	Wavelength in the range 1260-1360nm shall be used for upstream. There shall be option to purchaser for use of 1550nm for overlay RF video applications	Declaration-refer Annexure-II	
59	d	The PON system shall support a 1:128, 1:64, 1:32, 1:16, 1:8, and 1:4 split options per PON interface on Mini-OLT. The exact requirements for optical interfaces for 1xN, 2xN splitter shall be specified by the purchaser based on the optical power-budget calculations	Declaration-refer Annexure-II	
60	4.1.1	**Optical splitter specifications** Optical Splitter shall comply Optical splitter specifications as per GR No. TEC/GR/TX/OPT-001/APR 2012.	Functional verification -refer Annexure-II	
61	4.1.2	**Ethernet interfaces at SNI of Mini-OLT:** The following Ethernet interface options shall be supported. Actual interface type shall be communicated by purchaser. 1. 1000BaseSX (50µ multi-mode) interface Supported/ Not Supported 2. 1000BaseLX (10µ single-mode @1310nm) interface Supported/ Not Supported 3. 1000BaseZX (10µ single-mode @1550nm) interface Supported/ Not Supported 4. 10GBase LAN interface as per IEEE 802.3ae. The specifications for these interfaces shall comply with relevant IEEE standards The different GbE interfaces and 10GBase LAN interfaces may implemented through the use of SFP/SFP+ and XFP .	Functional verification -refer Annexure-II	
62	5.0	**Configuration schemes:** From the view point of administration of access network, the protection architecture of GPON is considered to enhance the reliability of the access networks. However, protection shall be as an optional mechanism because its implementation depends on the realization of economical systems. These protection schemes shall be optional to the purchaser requirement.	Declaration-refer Annexure-II	

63	5.1	**Protection on the Mini-OLT SNI section:** There shall be support of multiple Ethernet service network interfaces (SNI) from each Mini-OLT. For redundancy, the Mini-OLT shall support IEEE 802.3ad Ethernet link aggregation and RSTP IEEE 802.1w on those interfaces	Functional verification -refer Annexure-II	
64	5.2	**Possible switching types for PON protection** The following two types of protection switching shall be provisioned 1. Automatic switching: - It is triggered by fault detection, such as loss of signal, loss of frame, signals degrade (BER becomes worse than the predetermined threshold). 2. Forced switching: - This one is activated by administrative events, such as fiber rerouting, fiber replacement, etc. Both types should be possible in the GPON system, if required, even though they are optional functions. The switching mechanism is generally realized by the OAM function; therefore, the required OAM information field should be reserved in the OAM frame.	Functional verification - refer,Annexure-II	
65	5.3	Synchronization requirements are required for Mobile Backhaul applications. To deliver high bandwidth to mobile operators, accurate synchronization and timing is required in the G-PON network. For 2G operators, E1 interfaces have been used for synchronization. However, for 3G/4G wireless additional synchronization schemes need to be provided through IEEE1588v2 Precision Time Protocol (PTP). **Synchronizing the ONTs:** All ONU/ONTs shall operate synchronously with the PON clock transmitted by the OLT. Mini-OLT shall serve as the master timing source. The following interfaces shall be optionally available as specified by the purchaser at the Mini-OLT for synchronization. : - IEEE1588v2 Transparent Clock Over PON or- SyncE	Functional verification -refer Annexure-II	
66	6.0	**Performance requirements:** The equipment shall be tested for error performance as follows **In laboratory:** In the case E1 service is offered, BER performance over simulated hop shall be tested better than 1x10-10 for 24 hours over an emulated E1(TDMoP) in an end to end configuration. IETF RFC 2544 conformance/performance shall be tested for end-to-end Ethernet service **In field:** In the case E1 service is offered, BER	Functional verification - refer,Annexure-II	

		performance over simulated hop shall be tested better than 1x10-10 for 24 hours over an emulated E1(TDMoP) in an end to end configuration. IETF RFC 2544 conformance/performance shall be tested for end-to-end Ethernet service		
67	7.0	**Maintenance, performance monitoring & supervisory signals** The maintenance signals philosophy shall be as per ITU-T Rec. G.984.x.	Declaration-refer Annexure-II	
68	7.1	**Alarms:** The alarms and consequent actions shall be possible to monitor via EMS & LCT of the equipment shall be as per ITU-T G.984 series Recs.	Declaration-refer Annexure-II	
69	8.0	**Mechanical standard requirements**	Declaration-refer Annexure-II	
70	a	ONT should be designed to support wall mounting installation	Phisical Check-refer Annexure-II	
71	b	The Mini-OLT equipment shall be housed in the standard mechanical ETSI upto 2U box.	Phisical Check-refer Annexure-II	
72	c	There shall be proper covers on the mechanical box to avoid the ingress of dust	Phisical Check-refer Annexure-II	
73	9.0	**Minimum equipment required for Type Approval.** Fully loaded pre-wired equipment with input output ports with min 4 ONT/ONU, 1 Mini-OLT and 1 EMS/LCT are required for type approval.	Declaration-refer Annexure-II	
74	10.0	**Field trial** The equipment shall be subjected to field trial for a minimum of 4 weeks with working traffic. The equipment shall be loaded with maximum possible live-traffic & the balance may be loaded with simulated traffic to assess the performance of the equipment. The manufacturer/supplier shall ensure that the equipment meets the field requirements of the purchaser.	Information- refer Annexure-II	
75		**Chapter 2: General Requirements**	Declaration-refer Annexure-II	
76	1.0	**Reference Documents**	Documentation - refer Annexure-II	
77	1.1	Whatever that has not been specifically stated in this document, shall deem to be as per relevant latest ITU-T Recommendations.	Documentation - refer Annexure-II	
78	1.2	Relevant ITU-T Recommendations & other specifications are given in the GR.	Documentation - refer Annexure-II	
79	1.3	All references to TEC GRs & other recommendations imply for their latest issues	Documentation - refer Annexure-II	
80	2.0	**Engineering Requirements**	Declaration-refer Annexure-II	
81	2.1	The equipment shall be fully solid state and adopt state-of-art technology.	Declaration-refer Annexure-II	
82	2.2	The equipment shall be compact and composite in construction and light- weight the manufacturers shall furnish actual dimensions and weight of the equipment.	Declaration-refer Annexure-II	

83	2.3	All connectors shall be reliable and of standard type (CACT approved).	Declaration-refer Annexure-II	
84	2.4	All connectors and the cable used shall be low loss type and suitably shielded (CACT approved).	Declaration-refer Annexure-II	
85	2.5	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: • Fan failure is reported through LCT/NMS. • Fans are DC operated. • MTBF is better than 80000 hours.	Declaration-refer Annexure-II	
86	2.6	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 TEC document: QM-333(March 2010) - "Specifications for environmental testing of electronics equipments for transmission and switching use".	Declaration-refer Annexure-II	
87	2.7	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.	Declaration-refer Annexure-II	
88	2.8	Each terminal block and individual tags shall number suitably with clear identification code and shall correspond to the associated wiring drawing.	Declaration-refer Annexure-II	
89	2.9	All controls, switches, indicators etc shall be clearly marked to show their circuit diagrams and functions.	Phisical Check- refer Annexure-II	
90	2.10	Facility to mount fixed attenuator, if required shall be provided in the receive chain of the system.	Phisical Check- refer Annexure-II	
91	3.0	**Operational Requirements**	Declaration-refer Annexure-II	
92	3.1	The equipment shall be designed for continuous operation.	Functional verification -refer Annexure-II	
93	3.2	The equipment shall be able to perform satisfactorily without any degradation at an altitude up to 4000 meters above mean-sea-level. A self certificate from the manufacturer will be acceptable.	Declaration-refer Annexure-II	
94	3.3	The equipment shall be able to work without any degradation in saline atmosphere near coastal areas and should be protected against corrosion.	Declaration-refer Annexure-II	
95	3.4	Visual indication to show power ON/OFF status shall be provided.	Phisical Check- refer Annexure-II	
96	3.5	Wherever the Visual indications are provided, Green color for healthy and Red color for unhealthy conditions would be provided. Some color may be used for non–urgent alarms.	Phisical Check- refer Annexure-II	
97	4.0	**Quality Requirements**	Declaration-refer Annexure-II	
98	4.1	The MTBF value for GPON system is ……………………hours. The MTTR value for GPON system is ……………………hours.	Declaration-refer Annexure-II	

		The above values are calculated as per guidelines of BSNL-QA document: QM-115.		
99	4.2	4The equipment shall be manufactured in accordance with international quality management system ISO 9001:2000 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted. And the equipment shall meet the latest BSNL QA Guidelines indicated in Manuals QM 118 {Quality and Reliability in product Design.}, QM 205 {Guidelines for Standard of Workmanship for Printed Boards}, QM 206 {Guidelines for Standard of Workmanship for Printed Board Assemblies}, QM 210 {Guidelines for Standard of Workmanship for Surface Mounted Devices} and QM 301{Transmission Equipment General Documentation}.	Declaration-refer Annexure-II	
100	4.3	The equipment shall conform to the requirements for environment as specified in BSNL-QA document: QM-333 (issue: 2-1998) - "Specification for environmental testing of electronic equipment for transmission and switching use".	Declaration-refer Annexure-II	
101	5.0	**Maintenance Requirements**	Declaration-refer Annexure-II	
102	5.1	Maintenance philosophy is to replace faulty units/subsystems after quick on-line analysis through monitoring sockets, alarm indications and Built-in Test Equipment. The actual repair will be undertaken at centralized repair centers. The corrective measures at site shall involve replacement of faulty units/sub-systems.	Declaration-refer Annexure-II	
103	5.2	The equipment shall have easy access for servicing and maintenance.	Phisical Check-refer Annexure-II	
104	5.3	Suitable alarms shall be provided for identification of faults in the system and faulty units.	Functional Verification-refer Annexure-II	
105	5.4	Suitable potential free contacts (preferably)/or any other suitable method shall be provided for extension of audio/visual alarms.	Phisical Check-refer Annexure-II	
106	5.5	Rating and types of fuses used are to be indicated.	Phisical Check-refer Annexure-II	
107	6.0	**Power Supply**	Declaration-refer Annexure-II	
108	6.1	**Power supply requirements for various GPON constituents:**	Declaration-refer Annexure-II	
109	a	**Powering requirements:** ONU/ONT The primary power source shall be 160-270Vac, 50+/-5Hz for the following: • Type 1. Home-ONT (H-ONT) for FTTH applications. • Type 4. Business-ONT (B-ONT) for FTTH applications • Type 5. Mobile backhaul-ONT (M-ONT) for FTTM applications • Type 3. MDU-ONU (M-ONU) for FTTB applications in MDU The ONT shall be designed to have protection of power	Phisical Check-refer Annexure-II	

		transient, power-surge and power blowouts. However, • In case of DC operation, the adaptor for AC→DC conversion shall be internal to the device. • The power rating shall be clearly marked on the device. • The power backup requirement for ONT is left to the purchaser's discretion.		
110	b	**Powering requirements:** Cabinet/Curb ONU (C-ONU) at Remote Office The nominal power supply shall be –48V DC with a variation in the range from -40V to -60V for R-ONU for FTTCab applications (when installed at Remote Office e.g. DLC/RSU/RLU locations).The equipment shall operate over this range without any degradation in performance. • The equipment shall be adequately protected in case of voltage variation beyond the range as specified above and also against input reverse polarity. • The power consumption shall be minimal. The actual power rating/ consumption to be furnished by the manufacturer on the equipment.	Phisical Check-refer Annexure-II	
111	c	**Powering requirements:** Cabinet/Curb ONU (C-ONU) at Curb (installed at street-cabinets etc.) The primary power source shall be 160-270Vac, 50+/-5Hz for this case. The ONU shall be designed to have protection of power transient, power-surge and power blowouts. However, - In case of DC operation, the adaptor for AC↔DC conversion shall be provided. The adaptor can be external or internal to the device. - The power rating shall be clearly marked on the device. - The power backup requirement for R-ONU is left to the purchaser's discretion. - The ONU shall provide external 4-6 hours battery backup (to be specified by purchaser for the exact backup duration) to withstand commercial power outages. This assumes 0.5 average traffic in erlangs for POTS and 4-6 hours average usage time for 10/100/1000Base interface with 30% activity factor. ▫ The battery shall have a minimum life of 2 years. The replacement of the battery shall not cause any service interruption. The backup system should have a low voltage cut-off at battery voltage below 10.5V to prevent overdraw. ▫ The system shall be equipped to test, monitor and report (through EMS and LCT) the following: Ø Battery present or not (assessed by voltage of the battery) Ø Battery useful or not (assessed by a short periodic discharge/charge test) Ø Low capacity (means going to shutdown soon).	Phisical Check-refer Annexure-II	
112	d	**Powering requirements:** Mini-OLT and related equipment in CO	Phisical Check-refer Annexure-II	

		Nominal power supply is –48V DC with a variation in the range from -40V to -60V. The equipment shall operate over this range without any degradation in performance. - The equipment shall be adequately protected in case of voltage variation beyond the range as specified above and also against input reverse polarity. - The derived DC voltages in the equipment shall have protection against over-voltage, short-circuit and overload. - The power consumption shall be minimal. The actual power rating/ consumption to be furnished by the manufacturer on the equipment. - The OLT system shall be provided with at least two power feeds – centralized power supply or distributed on-board power supply as follows: The Mini-OLT shall have the option of power source operating at 230V AC -15% to +10%, 50±5 Hz for this case. The Mini-OLT shall be designed to have protection of power transient, power-surge and power blowouts. However, - The power rating shall be clearly marked on the Mini-OLT. - The power backup requirement for Mini-OLT is left to the purchaser's discretion. ▫ The Mini-OLT shall provide external 4-6 hours battery backup (to be specified by purchaser for the exact backup duration) to withstand commercial power outages. ▫ The battery shall have a minimum life of 2 years. The replacement of the battery shall not cause any service interruption. The backup system should have a low voltage cut-off at battery voltage below 10.5V to prevent overdraw. ▫ The Mini-OLT should also be provided with the feature of power monitoring and automatic shutdown to safe guard the system, before the power backup goes below the cutoff level. The system shall also be equipped to test, monitor and report (through EMS and LCT) the following: Ø Battery present or not (assessed by voltage of the battery) Ø Battery useful or not (assessed by a short periodic discharge/charge test) Ø Low capacity (means going to shutdown soon).		
113	7.0	**Accessories**	Declaration -refer Annexure-II	
114	7.1	The supplier shall provide complete set of: • All the necessary 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	Declaration-refer Annexure-II	

		site. • Special tools, extender-boards, extender-cables and accessories essential for installation, operation and maintenance of the equipment shall be clearly indicated and supplied along with the equipment.		
115	8.0	**Documentation** Technical literature in English language only shall be accepted. **Installation spares, operation and maintenance manual:** It should cover the following: • Safety measures to be observed in handling the equipment; • Precautions for installation, operation and maintenance; • Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance, troubleshooting and sub-assembly replacement; • Illustration of internal and external mechanical parts. **Repair manual:** It should cover the following: • List of replaceable parts used including their sources and the approving authority. • Detailed ordering information for all the replaceable parts shall be listed in the manual to facilitate recording of spares. • Procedure for trouble-shooting and sub-assembly replacement shall be provided. Test fixture and accessories required for repair shall also be indicated. Systematic trouble shooting chart (fault-tree) shall be given for the probable faults with their remedial actions.	Documantation-refer Annexure-II	
116	9.0	**Optical access port** • The optical access ports should be designed to protect themselves against the entry of dust when they are not occupied by an external fiber-optic connection. • The optical access port shall be so positioned on the card as to be easy- to- clean by the user as well as for operation/handling purposes.	refer Annexure-II	
117		**Chapter 3: Safety Requirements**	Declaration-refer Annexure-II	
118	1.0	**Operating personnel safety requirements**	Declaration-refer Annexure-II	
119	1.1	The equipment shall conform to IS 13252 part 1: 2010+Amd 2013+Amd 2015 "Information Technology Equipment – Safety- Part 1: General Requirements" [equivalent to IEC 60950-1:2005+A1:2009+A2:2013 "Information Technology Equipment –Safety- Part 1: General Requirements"]. The Manufacturer/supplier shall submit a certificate in respect of compliance to these requirements.	Report from Accredited Test Lab-refer Annexure-II	
120	1.2	The laser product shall meet the optical safety requirement as per IEC-60825-1. The equipment shall meet the optical safety requirement as per ALSD/ APR procedure of ITU-T Rec. G.664 (latest edition) on Class B laser. The equipment shall have visual warning and controls ensuring danger-free operation.	Report from Accredited Test Lab-refer Annexure-II	

121	1.3	The equipment shall follow proper construction practice to minimize unintended radiation due to leakage from any gap or monitoring points. All unused ports and monitoring points should be terminated. The power flux density shall not exceed 1 mW/cm2 at a distance of 2.5 cms.	Report from Accredited Test Lab-refer Annexure-II	
122	1.4	Protection against short circuit/open circuit in the accessible points shall be provided. All switches/controls on front panel shall have suitable safeguards against accidental operations. There shall be a provision for the terminal for grounding the equipment.	Phisical Check-refer Annexure-II	
123	1.5	The optical access ports should be designed to protect themselves against the entry of dust when they are not occupied by an external fibre-optic connection. The optical access port shall be so positioned on the card as to be easy- to- clean by the user as well as for operation/handling purposes.	Phisical Check-refer Annexure-II	
124	1.6	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.	Functional verification -refer Annexure-II	
125		**Chapter 4: EMC Requirements**	Declaration-refer Annexure-II	
126	1.0	**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.	Declaration-refer Annexure-II	
127	a	Conducted and radiated emission *(applicable to telecom equipment)*:	Report from Accredited Test Lab-refer Annexure-II	
128	b	Immunity to Electrostatic discharge:	Report from Accredited Test Lab-refer Annexure-II	
129	c	Immunity to radiated RF:	Report from Accredited Test Lab-refer Annexure-II	
130	d	Immunity to fast transients (burst):	Report from Accredited Test Lab-refer Annexure-II	
131	e	Immunity to surges:	Report from Accredited Test Lab-refer Annexure-II	
132	f	Immunity to conducted disturbance induced by Radio frequency fields:	Report from Accredited Test	

			Lab-refer Annexure-II	
133	g	Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any):	Report from Accredited Test Lab-refer Annexure-II	
134		**Chapter 5: Part-I:EMS Requirements**	Declaration-refer Annexure-II	
135	1.0	**General operation and functional requirements.**	Declaration-refer Annexure-II	
136	1	Management system compliance with ITU G.984.x series	Declaration-refer Annexure-II	
137	2	Access network management system	Declaration-refer Annexure-II	
138	3	Management Menu functionality	Declaration-refer Annexure-II	
139	4	Configuration of Equipment, Error detection threshold, Display of color coded graphical fault, System status, alarm logging, performance data	Functional verification -refer Annexure-II	
140	5	Management privilege control, EMS security control, NE Configuration, Database management	Functional verification -refer Annexure-II	
141	6	Generation of reports and security log	Functional verification -refer Annexure-II	
142	7	Drill down up to module level in each NE	Declaration-refer Annexure-II	
143	8	Drill down up to card and port level configuration	Declaration-refer Annexure-II	
144	9	EMS data backup	Functional verification -refer Annexure-II	
145	10	Visual presentation of NE and alarm and status display	Functional verification -refer Annexure-II	
146	11	NE out of service and in service, Restart of NE from the EMS	Functional verification -refer Annexure-II	
147	12	Systematic Health Monitoring	Functional verification -refer Annexure-II	
148	13	Configuration of network element like creating, viewing and editing	Functional verification -refer Annexure-II	
149	14	Soft copy of EMS on a CD	Functional verification -refer Annexure-II	
150	15	Setup/procedure to software download	Declaration-refer Annexure-II	
151	16	Calendar management	Declaration-refer Annexure-II	
152	17	Messaging system	Declaration-refer	

			Annexure-II	
153	18	Response time of command/query	Declaration-refer Annexure-II	
154	19	Interface details	Declaration-refer Annexure-II	
155	20	Infrastructure requirement for EMS	Declaration-refer Annexure-II	
156	21	Critical components and units of EMS	Declaration-refer Annexure-II	
157	22	Installation and commissioning of the EMS	refer Annexure-II	
158	23	Validation of components and features of EMS by purchaser	Declaration-refer Annexure-II	
159	2.0	**EMS architecture & server hardware specification**	Declaration-refer Annexure-II	
160	1	Architecture	Information-refer Annexure-II	
161	2	Scalability aspects	Declaration-refer Annexure-II	
162	3	EMS server specifications	Phisical Check-refer Annexure-II	
163	4	Application server specification	Phisical Check-refer Annexure-II	
164	5	Database server specification	Phisical Check-refer Annexure-II	
165	6	Firewall server [optional to purchaser's requirement]	Phisical Check-refer Annexure-II	
166	7	Specification for LCT/workstation	Phisical Check-refer Annexure-II	
167		**Chapter 5: Part-II:FCAPS Requirements**		
168	1.0	**Network**	Declaration-refer Annexure-II	
169	1.1	**General Functions:** The Centralized EMS system and LCT for single system supports the management functionality including the following: • Configuration Management • Fault Management • Performance Management • Software Management • Security Management • Inventory Management	Declaration-refer Annexure-II	
170	1.1.1	Configuration management	Functional verification -refer Annexure-II	
171	1.1.2	Fault management	Functional verification -refer Annexure-II	
172	1.1.3	Performance management	Functional verification -refer Annexure-II	
173	1.1.4	Security management	Functional verification -refer	

|			Annexure-II	
			Annexure-II	
174	1.1.5	Inventory management	Functional verification -refer Annexure-II	
175	1.1.6	Software management	Functional verification -refer Annexure-II	
176	1.1.7	Software download	Functional verification -refer Annexure-II	
177	1.1.8	Management interface details	Phisical Check- refer Annexure-II	
178	1.1.9	Southbound management interface	Functional verification -refer Annexure-II	
179	1.1.1 0	Northbound management interface	Functional verification -refer Annexure-II	
180	1.1.1 1	Local management interface	Functional verification -refer Annexure-II	
181	1.1.1 2	User interface	Functional verification -refer Annexure-II	
182	1.2	**Additional functional reqirements**	Declaration- refer Annexure-II	
183	a	**ONT/ONU requirements:**	Declaraton-refer Annexure-II	
184	1.2.1	ONUs/ONTs shall perform the following tests/monitor to the battery to be reported through NMS and LCT	Declaration-refer Annexure-II	
185	1	Battery / Power monitoring status	Declaration- refer Annexure-II	
186	2	Status reporting of ONU/ONT	Functional verification -refer Annexure-II	
187	1.2.2	Status reporting - ONU/ ONT ID - PON port link status - UNI access port link status - Loop back test status in case of ONU - Loop-back time-out status in case of ONU - Power supply status - Vendor code - Model number.	Phisical Check- refer Annexure-II	
188	1.2.3	ONT shall also support the following: - Vendor code and model number in EEPROM. - Remote download firmware upgrade. - Auto negotiation or manual configuration of 10M/100Mbps and half-duplex or full-duplex on ONT's user port. - UNI port MDI-MDIX auto-detection. - Maximum frame size 1522 bytes	Phisical Check- refer Annexure-II	

		- **LED status indication** a. **Power**. Indicates power on/off status b. **Voice**. To show that there is at least 1 call active on the ONT, and prevent service interruption? Can also be defined as ONT sees off-hook signal from one phone. - Voice-signaling: ONT has registered with soft-switch c. LEDs to E1 services for B-ONT d. **Operation**. Indicates PON fiber link is normal and OAM channel is operational e. Signal that voice/data NW is received f. **Test**. Indicates ONT is in loopback test status by one or a combination of LEDs. g. **UNI connection**. Indicates ONT UNI access port link is normal h. **Data.** Indicates ONT UNI access port activity i. **Full duplex**. Indicates ONT UNI access port at full-duplex mode j. **Speed**. Indicates 10/100/1000M speed selection (as applicable) The system shall support OMCI as per ITU-T Rec. G.984x GPON standard for all OAM features between ONT/ONU and Mini-OLT for interoperability.		
189	1.3	**Mini-OLT Requirements:**	Declaration-refer Annexure-II	
190	1	One Craft Terminal at Mini-OLT	Phisical Check-refer Annexure-II	
191	2	In-Band Management connection for EMS	Functional verification -refer Annexure-II	
192	3	Out-Band Management connection for EMS	Functional verification -refer Annexure-II	
193	4	Support for Alarms output and control	Functional verification -refer Annexure-II	
194	5	Line Rate, Security, and Performance	Functional verification -refer Annexure-II	
195	6	Line rate	Functional verification -refer Annexure-II	
196	7	AES (key size of 128 bit) support per port-id	Functional verification -refer Annexure-II	
197	8	FEC support	Functional verification -refer Annexure-II	
198	9	Network Diagnostics and Healthy check	Functional verification -refer Annexure-II	

CHAPTER 1: TECHNICAL REQUIREMENTS

Clause 1.0: Introduction

A Passive Optical Network (PON), in general, consists of Optical Line Termination (OLT) which is named as Mini-OLT system installed generally at the Central Office (CO) and a set of associated Optical Network Units (ONU)/Optical Network Terminations (ONT) installed at various locations in the network (as detailed later) with a passive Optical Distribution Network (ODN) comprised of optical fibres and passive splitters/couplers interconnecting them. The placement of Mini-OLT may be centralised or distributed to a Remote Office (RO), building basement etc. In such a manner, the Service providers may extend the PON services beyond the reach possible with existing CO.
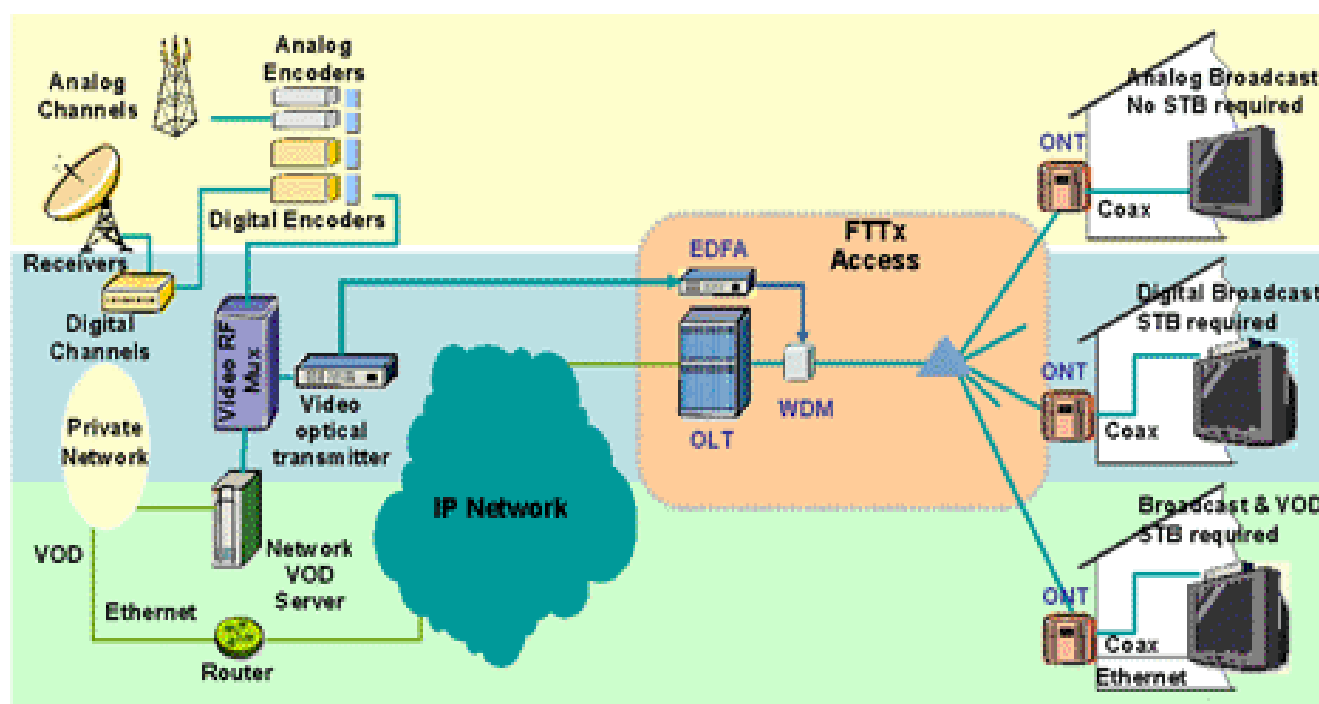
Clause 2.0: An introduction to GPON constituents

- Point to Point connectivity with ONT to Mini-OLT.
- Point to Multipoint connectivity.
- Maximum bandwidth of GPON system.

Test Setup:
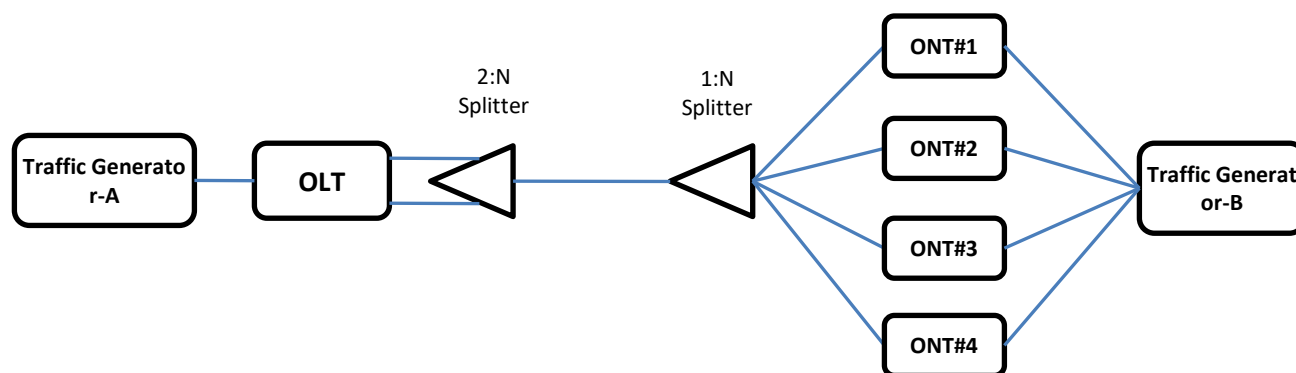
Test procedure:

Establish the test connection as shown in Figure.

1. Point to multipoint connectivity with ONT to Mini-OLT.
   1) Create bi-directional test packet streams on traffic generator A and B for all ONTs.
   2) Send the traffic and verify point to point connectivity through packet forwarding.

2. Point to Point connectivity between ONTs.
   1) Create bi-directional test packet streams on traffic generator B for between ONT#1 and ONT#4.
   2) Configure the port-bridge feature on the Mini-OLT
   3) Send the traffic and verify P2P connectivity through packet forwarding.

3. Mixed test (P2MP, P2P)
   1) Create bi-directional test packet streams on traffic generator A and B for ONT#2 and ONT#3.
   2) Create bi-directional test packet streams on traffic generator B for between ONT#1 and ONT#4.
   3) Configure the port-bridge feature on the Mini-OLT.
   4) Send the traffic and verify P2MP and P2P connectivity.

4. Maximum bandwidth of GPON system
   1) Create bi-directional test packet streams on traffic generator A and B for from ONT#1 to ONT#3.
   2) Create bi-directional test packet streams on traffic generator B for from ONT#1 to ONT#3.
   3) Send the traffic then verify the maximum bandwidth of GPON system.

Results:

1. Point to Point connectivity with ONT to Mini-OLT.
   - Traffic generator A and B will receive all the packet streams.

2. Point to Multipoint connectivity between ONTs.
   - Traffic generator B link up with ONT#1 and ONT#2 will receive all the packet streams.

3. Mixed test (P2MP, P2P)
   - Traffic generator A and B will receive the all the packet streams.

4. Maximum bandwidth of GPON system
   - Measure the maximum bandwidth of GPON system.

Clause 2.1: Functional components of GPON

Clause 2.1.1: ONU/ONT shall support the following services:

- High speed data/Internet.
- VOIP through POTS.
- E1 through TDM over IP External gateway.
- IP Video
- WiFi support as IEEE 802.11b/g/n/ac

Test Setup:
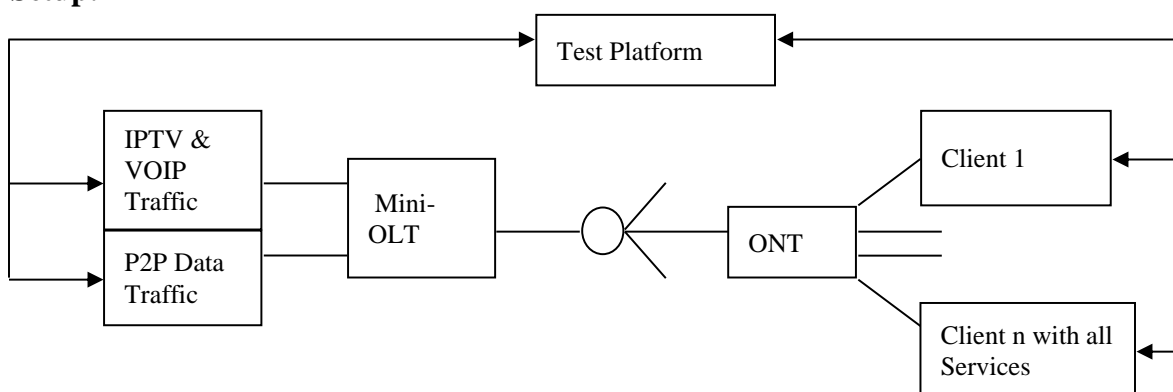
High speed data/Internet:

Configure the Mini-OLT for Internet connectivity through one of the SNI interface and make the connections for Ethernet traffic as untagged packet connection on the Ethernet port at any of the ONT.

Now verify for the Internet access through configured ports.

Verify system supports the VOIP service:

Configure the system to support the voice service either through the SIP server connected to Mini-OLT SNI or some other mean to through media gate way or soft switch and configure the voice services at the concern ONT as well. Allocate the phone numbers for Phone1 and Phone2. Phone1 and Phone2 communicate with each other and check for the voice quality.

BER Performance of 2 Mb/s

For ONT (Type 4)

Ports	Port #01	Port #02	Port #03	Port #04

Error Count	0	0	0	0
BER	-	-	-	-

IP video

Verify Basic IPTV Functionality

S. No.	ONU/ONT No.	Test Results		
		Pass	**Fail**	**Not Supported**
	1	-		
	2	-		
	3	-		
	4	-		

Verify IPTV Latency (IGMP Join and leave Latency)

Join & Leave Latency combined 2 to 3Secs.

- Wi-Fi support as per IEEE 802.11b/g/n/ac (Support for IEEE 802.11b/g/n/ac with in-built implementation)   **Yes/No**

USB interface support

Configure the ONT and connect the power pack to the ONT via USB port.
Configure PM Monitoring on the Power Pack via LCT.
Check the performance reports.

Result-   **OK / NOT OK**

ONU user interface may also have **G.Fast (**ITU-T rec G.9700 & G.9701)/ G.hn (ITU-T rec G.9960 & G.9961) interface. (If required by purchaser)

Comments: **Yes/No**

Clause 2.1.2: Mini-OLT shall provide the aggregation and switching functionality between the core network and PON interfaces.

1. Check no. of PON interfaces (towards ONU/ONT)   : 8
2. Check no. of service interfaces (towards core networks) : 2x10GbE and 4x1GbE

Clause 2.1.3: **Optical Splitter**
During type approval testing split options up to N=16 shall at least be demonstrated.
There shall be various options provided to purchaser such as:

- m: N where m=1 or 2 and
- N=4, 8, 16, 32, 64, 128 and may be more

Clause 2.1.4: Fiber plant for PON

Ensure that Fibers used between Mini-OLT and ONU/ONT shall be ITU-T Rec G.652. Special fiber e.g. ITU-T Rec G.657 may also be used for FTTB/FTTH intra-building, campus etc. applications.

Clause 2.2: TDM lines and voice transport options

1. Layer2 control protocol between ONU/ONT and Mini-OLT shall be Ethernet over GEM.
2. TDM support shall be provided through TDM over packet (TDMoP) option. TDMoP support shall be relevant to E1 lines.
3. The voice traffic shall be terminated at Mini-OLT across IP over Ethernet interfaces with(S signaling and ITU-T Rec G.711 framing) creating a simple path to an all networks with soft-switches, as needed. An external SIP/H.248↔V5.2 gateway may be used interfacing PSTN switches subject to purchaser's requirements.

Comments: Support of all above.   **Yes/No**

Clause 2.3: Topological requirements

Ensure that optical section of a local access network system shall be passive and its architecture is capable of simultaneously supporting a mix of p2p or p2mp application. Actual architecture required shall be decided by the purchaser.

Clause 2.3.1: FTTX architecture: An introduction: No test required.

Clause 2.4: Equipment interfaces in FTTB/FTTH/FTTC/FTTCab/FTTM architectures:

Clause 2.4.1: GPON equipment shall provide three types of interfaces
- User-Network interface (UNI)
- Service-Node-Interface (SNI)
- PON interface (IFPON)

SNI: - Mini-OLT shall support SNI towards core networks. SNI depends on services provided by the service provider. SNI provides various Gigabit Ethernet and /or 10GbE interfaces. The purchaser may convey specific interface requirement as well as quantity of interfaces.

Interface	PON 1	PON 2	PON 3	PON 4	PON 5	PON 6	PON 7	PON 8
Spec.	0-5 dBm	0-5 dBm	0-5 dBm	0-5 dBm	0-5 dBm	0-5 dBm	0-5 dBm	0-5 dBm
Measured Value dBm								
Interface	SNI 10G	SNI 10G	SNI 1G	SNI 1G	SNI 1G	SNI 1G		
Spec.								

Measured Value dBm								

RFC 2544 Test at 1GbE/10GB port: - RFC 2544 testing is generally carried out automatically by the instrument and it helps ensure repeatable results through the measurement of *Throughput, Latency, Frame loss and Back to back frame*. Automation also provides ease of use for field technicians by enabling accurate, efficient measurements and results through a clear and simple pass/fail indication.

Tests results are attached in annexure.

IFPON: ONU shall provide (IFPON) interface towards Mini-OLT for GPON transport. Mini-OLT also provides (IFPON) interfaces towards ONU for GPON transport. They are PON specific interfaces that shall support all the protocol elements necessary to allow transmission between Mini-OLT and ONU/ONT.

Clause 2.4.2: A broad overview of Services in various FTTX architectures

FTTB for residential application: shall support the following services:
1. Asymmetric broadband services (Internet, digital broadcast TV services, Video on demand, file download etc.) over direct Ethernet, over copper or through VDSL2.

   Comments: Direct Ethernet……   **Yes/No**

2. Symmetric broadband services (e.g. content broadcast, e-mail, file exchange, distance learning, telemedicine, on line gaming etc.) over direct Ethernet, over copper or through VDSL2.

   Comments: Direct Ethernet……   **Yes/No**

3. POTS through VOIP.

   Comments: VOIP through POTS……   **Yes/No**

 FTTB for business application: shall support the following services:
1. Asymmetric broadband services (e.g. Internet, digital broadcast TV services, Video on demand, file download etc.) over direct Ethernet.

   Comments: Direct Ethernet……   **Yes/No**

2. Symmetric broadband services (e.g. group software, content broadcast, e-mail, file exchange etc.) over direct Ethernet, over copper or through VDSL2. POTS through VOIP. TDMOP services.

   Comments: Direct Ethernet and VOIP through POTS……   **Yes/No**

 FTTH applications: shall support the following services:

1. Asymmetric broadband services (e.g. Internet, digital broadcast TV services, Video on demand, file download etc.) over fiber.

   Comments: Direct Ethernet……   **Yes/No**

2. Symmetric broadband services (e.g. content broadcast, e-mail, file exchange, distance learning, telemedicine, on line gaming etc) over fiber, POTS through VOIP.

   Comments: Direct Ethernet and VOIP through POTS……   **Yes/No**

Note 1: The above services descriptions are indicative of possibilities and not for exact specification. The purchaser shall indicate the requirement of interfaces.

Note 2: IPTV shall be supported for the residential deployment as option to the purchaser.
                                                                                 Yes/No
Note 3: The service interface for E1 shall be TDM over packet.   **Yes/No**

Clause 2.5: Important parametric definitions and functional requirements of GPON system.

a. The GPON system shall support a Logical Reach up to 60 Km. At least a physical reach of 20 Km shall be demonstrated.

   Comments: Distance up to 60Km is demonstrated   **Yes/No**

b. The maximum differential logical reach shall be 20 Km as per GPON standard G.984.X.

   Comments: Maximum differential logical reach of 20 Km demonstrated.   **Yes/No**

c. Power supply failure/EMS server breakdown/bugs in the software shall not affect current tributary connection map.

   Comments: **Yes/No**

Definitions and explanation of important parameters of a GPON system

Requirement:
- The GPON system shall support a logical reach up to 60 km. At least a minimum logical reach of 20km.
- The maximum differential logical reach shall be 20kms as per GPON standards G.984.x
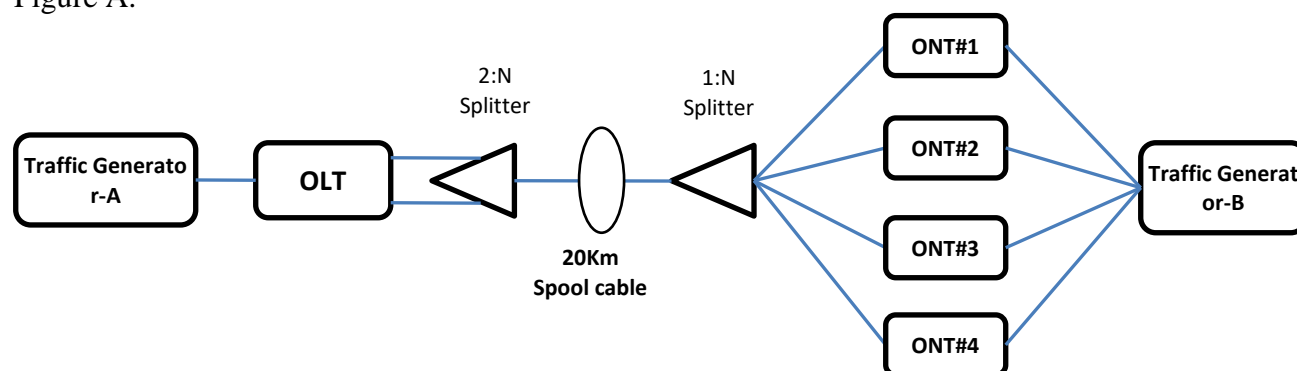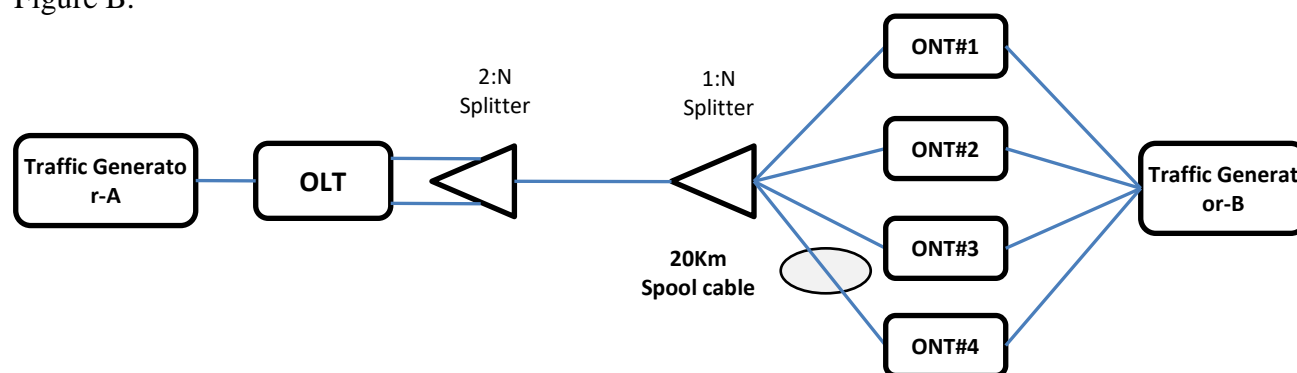
Test Setup:

Figure A.

Figure B.

Test procedure:
1. Maximum logical reach.
   - Establish the test connection as shown in Figure A.
   - Verify activation status of all ONTs.
   - Verify each ONT's distance through Mini-OLT command or EMS.
   - Create bi-directional test packet streams on traffic generator A and B for all ONTs
   - Send the traffic then verify forwarding status upstream and downstream

2. The maximum differential logical reach.
   - Establish the test connection as shown in Figure B.
   - Verify activation status of all ONTs.
   - Verify each ONT's distance through Mini-OLT command or EMS.
   - Create bi-directional test packet streams on Traffic generator A and B for all ONTs
   - Send the traffic then verify Upstream and downstream bandwidth

Result:
1. Maximum logical reach 60 Km.
   - All of ONTs activated normally.
   - Traffic generator A and B received all the packet streams.
2. The maximum differential logical reach 20 Km.
   - All of ONTs activated normally.
   - Traffic generator A and B received all the packet streams.

Clause 2.5.1: Bit rate options of GPON system.

    a. The GPON system shall support a bit rate of 2488.32Mbps in the downstream Mini-OLT-ONU/ONT and 1244.16Mbps in the upstream ONT/ONU- Mini-OLT directions.

        Yes/No

    b. The BER should not be worse than $1x\,10^{-10}$ for the extreme case of optical path attenuation and dispersion conditions.   **Yes/No**

Clause 3.0: **Specifications for GPON system constituents for various topologies:**

Clause 3.1: Equipment categorization**:**
        On the basis of target applications, there shall be following types of ONU/ONT:

Type 1. Home-ONT (H-ONT) for FTTH applications.   **Yes/No**

Type 2. Residential-ONU (R-ONU) for FTTCab/FTTC applications.   **Yes/No**

Type 3. MDU-ONU (M-ONU) for FTTB applications in MDU.   **Yes/No**

Type 4. Business-ONT (B-ONT) for FTTH applications.   **Yes/No**

Type 5. Mobile backhaul-ONT (M-ONT) for FTTM applications.   **Yes/No**

Protection requirements due to fiber cuts:
1. No support for protection (used mainly for residential applications)
2. In case of business as well as high density residential applications, the purchaser may opt for configurable protection as fully–protected, partially protected or unprotected.

   Comments: **Type- A, Type-B And Type-C Protection Supported.**

Clause 3.2   Physical interface requirements at UNI:

Clause 3.2.1 Type 1: H-ONT for residential broadband service delivery**.**
        Service support shall be there for voice, video and data.

1. **POTS**   **Yes/No**
Verify system supports the VOIP service: Configure the system to support the voice service (ONT) and allocate numbers for Phone1 and Phone2. Phone1 and Phone2 communicate with each other and check for the voice quality.

2. **10/100/1000 BaseT Ethernet interface.**   **Yes/No**
RFC 2544 Test at 10/100BaseT ports: - RFC 2544 testing is generally carried out automatically by the instrument and it helps ensure repeatable results through the measurement of *Throughput, Latency, Frame loss and Back to back frame*. Automation also provides ease of use for field technicians by enabling accurate, efficient measurements and results through a clear and simple pass/fail indication.

3. **Dying gasp feature (If required by purchaser)**   **Yes/No**

4. Inbuilt IEEE 802.11b/g/n/ac(optional)	**Yes/No**
5. USB 2.0/3.0 interface(Optional)	**Yes/No**

Clause 3.2.2 Type2: Residential-ONU (R-ONU) for FTTCab/FTTC applications

The ONU for FTTCab/FTTC architecture shall provide VDSL2 interface numbers of homes/users shall be high in the deployment distance from target user may be 500m-1000m.The interface support shall be provided for:

1. 10/100/1000 Ethernet Interface– Minimum 16.   **Yes/No**
2. ADSL2+/VDSL2 interface –Minimum 16   **Yes/No**
3. G.Fast (ITU-T rec G.9700 & G.9701) / G.hn(ITU-T rec G.9960 & G.9961) interface. (If required by purchaser)   **Yes/No**
4. Dying gasp feature (If required by purchaser).   **Yes/No**

Clause3.2.3 Type 3: MDU-ONU (M-ONU) for FTTB applications in MDU.

The M-ONU for FTTB architectures shall provide interfaces to cater to residential as well as business requirements in Multi-Dwelling Unit (MDU). M-ONU is usually installed in the basement of the MDU. Direct Ethernet access to ONU (up to 100Mb/s) over copper-pairs can be used, if user location is within ~100 meter reach of ONU in an MDU/MTU. ADSL2+/VDSL2 based access may be used for longer distances. The users shall install an appropriate NT at their premises

A typical distance from target users may be 100-150m. The interface support shall be provided for:

1. POTS-minimum 24   **Yes/No**
2. 10/100/1000BaseT Ethernet interfaces – Minimum 24   **Yes/No**
3. IEEE 802.11b/g/n WiFi interface (inbuilt implementation) – Minimum One   **Yes/No**
4. ADSL2+/VDSL2 interfaces- Minimum 24.   **Yes/No**
5. G.Fast (ITU-T rec G.9700 & G.9701) / G.hn(ITU-T rec G.9960 & G.9961) interface. (If required by purchaser)   **Yes/No**
6. Dying gasp feature (If required by purchaser).   **Yes/No**

Clause 3.2.4 Type 4: Business-ONT (B-ONT) for FTTH applications.

1. POTS (purchaser shall indicate the exact number of ports).   **Yes/No**
2. E1 line (for PBX interconnection etc.) the support for E1 shall be meant for transport application of TDM to Mini-OLT.   **Yes/No**
3. 10/100BaseT Ethernet interface to interconnect VOIP phones, STB, PC etc.   **Yes/No**
4. IEEE 802.11g Wi Fi interface in the home (in-built/internal implementation).   **Yes/No**
5. USB 2.0/3.0 interface   **Yes/No**
6. Dying gasp feature (If required by purchaser).   **Yes/No**

Clause 3.2.5 Type 5: Mobile backhaul-ONT (M-ONT) for FTTM applications.
   1. 10/100BaseT Ethernet interface to interconnect VOIP phones, STB, PC etc. **Yes/No**
   2. USB 2.0/3.0 interface   **Yes/No**

3. Dying gasp feature (If required by purchaser).   **Yes/No**
4. The system shall support IEEE 1588v2 protocol for synchronization.   **Yes/No**

Note1: - The system shall be designed considering 100Mbps throughput per 10/100BaseX Ethernet UNI port and 400Mbps up/down for 10/100/1000BaseX Ethernet UNI port.

Note2: -PON access shall support STB in the home network offering different video channels of IPTV on different TV sets.

Clause 3.3:   ONU and ONT equipment architecture
ONU/ONT may comprise of the basic module providing optical interface on the PON side and some sub-modules providing various UNI interfaces on the user side through DSLAM etc.

Clause 3.3.1: Functional requirements of ONU/ONT at UNI

Test Setup:
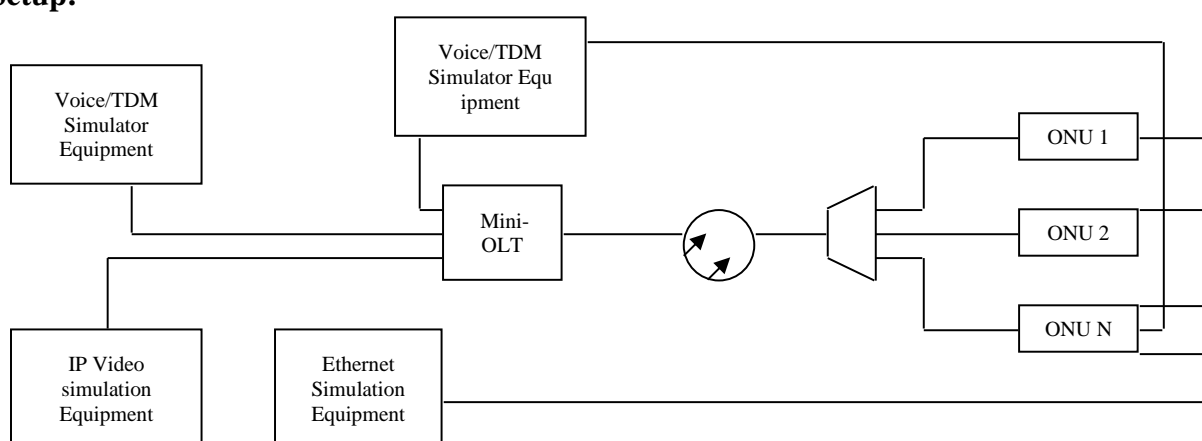
1. **Isolation of subscriber traffic to ensure user privacy for ONU.   (ONU Not Offered)**
    ONU shall have capability to prevent MAC address spoofing. it shall be possible to limit the number of MAC/IP addresses per port and to bind the MAC/IP addresses to a port. There shall be no layer 2 connectivity between users at ONU. Subscriber (peer to peer communication shall be allowed only through MINI-OLT.

Test: **Verify the anti-MAC spoofing function of the system:** Configure the data service of the system, and set up the service channel. Enable the anti-MAC spoofing function. Initiate DHCP dial up or PPP dial up on the PC. Query the dynamically bound MAC address. Use the packet transmitting tool (Through MAC spoofing s/w) to change the original MAC address to initiate dial up.

Comments: **Yes/No**

2. **Layer 2 bridging support for various ONU/ ONT.**
    -   Type 1. Home-ONT (H-ONT) for FTTH applications.
                64 MAC addresses, 16 VLAN.
    -   Type 2. Residential-ONU (R-ONU) for FTTCab/FTTC applications.
                1K MAC addresses, 4096 VLAN[2].
    -   Type 3. MDU-ONU (M-ONU) for FTTB applications in MDU.

1K MAC addresses, 4096 VLAN[1].

- Type 4. Business-ONT (B-ONT) for FTTH applications.
  256 MAC addresses, 64 VLAN.

The following capabilities shall be supported at UNI for all 'types':

i. Flow control per 802.3x
ii. IGMPv2/3 snooping – applicable for ONU only, optional for ONT,
iii. IGMP filtering - applicable for ONU only, optional for ONT,
iv. 128 multicast groups - applicable for ONU only, optional for ONT.

Note: Flow control shall be supported by both ONU and ONT. The others shall be as per the requirements of the purchaser.

- Type 1 Home-ONT (H-ONT) for FTTH applications
  64 MAC addresses, 16 VLAN **Yes/No**
- Type 4 Business-ONT (B-ONT) for FTTH applications.
  256 MAC addresses, 64 VLAN **Yes/No**

Test:

- To test of VLAN and MAC support for the referred ONT, configure the Ethernet traffic between MINI-OLT and ONT through SNI and UNI interface.
- Now create the respective number of VLAN and corresponding number of MAC_IDs at UNI of the particular ONT.
- Now generate the Ethernet traffic on all VID streams and from all MAC sources respectively, now check received traffic at SNI side.

3. **Bandwidth management, congestion control and QoS** **Yes/No**

4. **Dynamic Bandwidth adjustment (DBA)**
   - piggy-back DBRu mode 0 shall be supported **Yes/No**
   - Idle GEM DBA shal be supported **Yes/No**
   - Concurrent support of idle GEM and piggy-back DBRu mode 0 shall be supported
     Yes/No
   - T-CONT Type 1 and T-CONT type 4 **Yes/No**

Test: Generate the traffic with the different test cases as specified above with the help of N2X analyzer and check for the compliance.

Comments:
Yes/No

5. **Security**
   - User name and password based authentication. **Yes/No**
   - Optional support of 802.1x authenticator functionality (port based) **Yes/No**
   - MAC address limitation per port. **Yes/No**
   - AES (key size of 128 bit) support (optional) per port-id with operator disable/enable capability. **Yes/No**

---

[1]Available VLAN may be lesser than 4096 depending upon implementation

- Operator disable/enable shall be done in-band PLOAM message (Encrypt Port-Id) and there is only one key per ONT/ONU. **Yes/No**
- For higher security, ONT/ONU must support run-time regeneration of the AES key and encryption using the new key, while carrying the live traffic. **Yes/No**

Note: The above mentioned security shall be supported by multi-subscriber ONT/ONU.

6. ONT Ethernet port shall be configurable to accept the following frames:
   - Customer VLAN tagged frames. **Yes/No**
   - Priority tagged frames. **Yes/No**
   - Untagged frames. **Yes/No**
   - 802.1P mode. **Yes/No**

7. There shall be FEC RS (255,239) support with operator disable/enable capability in both upstream and downstream direction. **Yes/No**

Comments:

Line Testing
- In FTTCab/FTTC and FTTB architectures, the ONU shall allow pre-qualification testing of the 2-wire line from the central location through software.
- The output of the pre-qualification testing shall at least be the maximum upstream and downstream bit rate possible over the line.

Comments: Offered / Not offered

Testing of GPON System in support of clause No. 3.3.1:

Test Item 2: Layer2 Bridge Support for ONT's

Requirement:
- 64 MAC address and 16 VLAN

Test Setup:
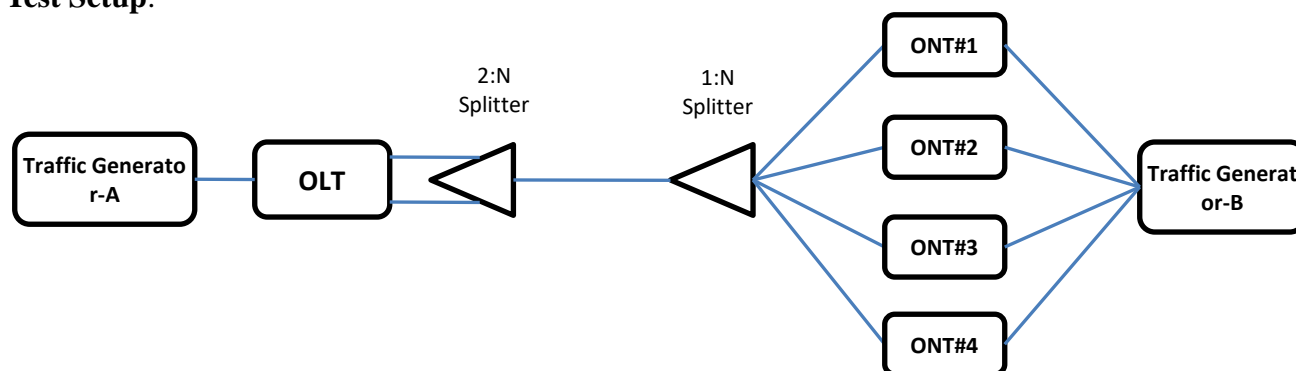
Test procedure:
Connect MINI-OLT, ONT and traffic generator as the above figure.

1. 64 MAC address

- Create 64 bi-direction traffic streams on the Traffic Generator A and B for each ONT.
- Send the traffic streams.
- Verify all of streams forward normally.

2. 16 VLANs
   - Create 16 VLAN ids on the ONT through OMCI from MINI-OLT
   - Create traffic streams with 17 VLAN ids on the Traffic Generator.
   - Send the traffic streams.
   - Verify traffic generator A and B receive only 16 VLAN streams normally.

Result:
1. 64 MAC address
   - All of 64 streams forwarded successfully.
2. 16 VLANs
   -16 streams of 17 streams forwarded, and the rest is not forwarded.

Test Item 3: Bandwidth Management & Congestion Control:

Requirement:

- Mapping 802.1p priority into priority queue

Test Setup:
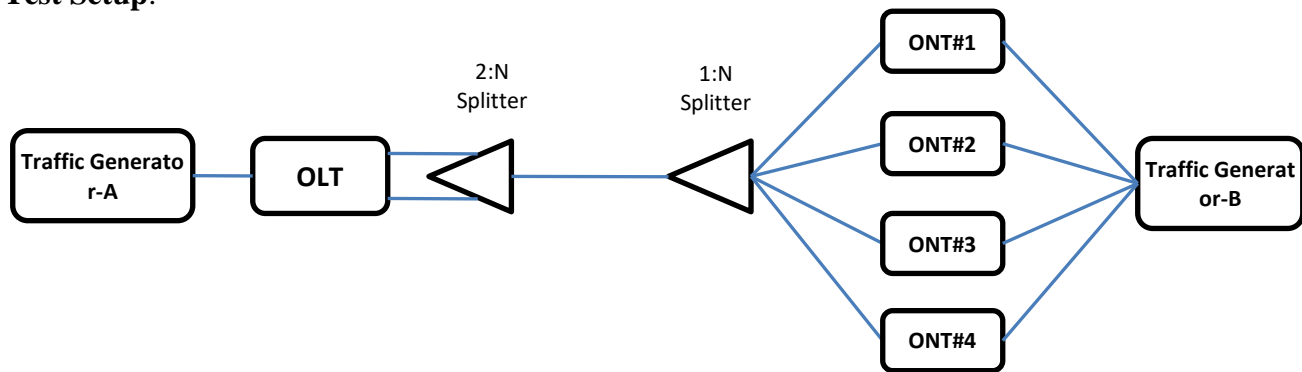
Test procedure:
Connect MINI-OLT, ONT and traffic generator as the above figure.

1. 802.1p priority based SPQ scheduling
   - Allocate T-CONT for 50Mbps to each ONT via OMCI.
   - Create 4 streams as below on traffic Generator-B for all of ONTs.
     - Stream#1 : Traffic Stream 1(25M)
     - Stream#1 : Traffic Stream 3(25M)
     - Stream#1 : Traffic Stream 5(25M)
     - Stream#1 : Traffic Stream 7(25M)
   - Send the traffic then verify whether Traffic Stream5 and Traffic Stream7 are guaranteed.

2. 802.1p priority based WRR scheduling

- Allocate T-CONT for 50Mbps to each ONT via OMCI.
- Create 4 streams as below on traffic Generator-B for all of ONTs.
    - Stream#1 : Traffic Stream 1(25M)
    - Stream#1 : Traffic Stream 3(25M)
    - Stream#1 : Traffic Stream 5(25M)
    - Stream#1 : Traffic Stream 7(25M)
- Send the traffic then verify whether each flow should be forward according to the provisioned weight value of WRR scheduler.

Result:

i. 802.1p priority based SPQ scheduling
    -Each ONT transport 4 upstream traffic to the 100Mbps rate included TRAFFIC STREAM 5, 7.

ii. 802.1p priority based WRR scheduling
    -Each traffic stream forward according to the provisioned weight value of WRR scheduler.

Test Item 4: Dynamic Bandwidth Adjustment/Allocation:

Requirement:

- T-CONT Type1 to T-CONT type4 shall be supported.

Test Setup:
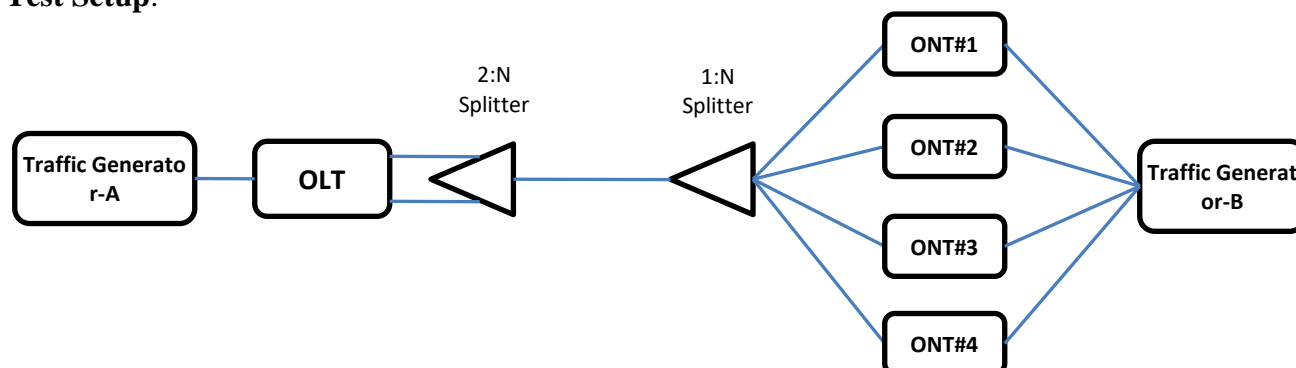
Test procedure:

Connect Mini-OLT, ONT and traffic generator as the above figure.

1) T-CONT Type 1
    - Establish the test connection as shown in Figure A.
    - Configure the bandwidth for the all of ONTs as below.
        - For ONT#1 : fixed B/W 10M
        - For ONT#2 : fixed B/W 10M
        - For ONT#3 : fixed B/W 10M
        - For ONT#4 : fixed B/W 10M
    - Create bi-directional test packet streams as below for all of ONTs.
        - ONT#1: 100Mbps unicast stream
        - ONT#2: 100Mbps unicast stream
        - ONT#3: 100Mbps unicast stream

- ◼ ONT#4: 100Mbps unicast stream
- Send the test streams to upstream direction for ONT#1 then verify below.
    - ◼ Mini-OLT should receive only 10Mbps rates from ONT#1
- Send the test streams to upstream direction for ONT#1 and ONT#2
    - ◼ Mini-OLT should receive only 10Mbps rates from ONT#1
    - ◼ Mini-OLT should receive only 10Mbps rates from ONT#2
- Send the test streams to upstream direction for all of ONTs then verify below
    - ◼ Mini-OLT should receive only 10Mbps rates from ONT#1
    - ◼ Mini-OLT should receive only 10Mbps rates from ONT#2
    - ◼ Mini-OLT should receive only 10Mbps rates from ONT#3
    - ◼ Mini-OLT should receive only 10Mbps rates from ONT#4

2) T-CONT Type 2
- Establish the test connection as shown in Figure A. And for congestion, add the one dummy ONT.
- Configure the bandwidth for the all of ONTs as below.
    - ◼ For ONT#1 : Assured B/W 100M, Max B/W 100M
    - ◼ For ONT#2 : Assured B/W 100M, Max B/W 100M
    - ◼ For ONT#3 : Assured B/W 0, Max B/W unlimited
    - ◼ For ONT#4 : Assured B/W 0, Max B/W unlimited
    - ◼ For Dummy ONT : fixed B/W 90%
- Create bi-directional test packet streams as below for all of ONTs.
    - ◼ ONT#1: 100Mbps unicast stream
    - ◼ ONT#2: 100Mbps unicast stream
    - ◼ ONT#3: 100Mbps unicast stream
    - ◼ ONT#4: 100Mbps unicast stream
- Send the test streams to upstream direction for all of ONTs then verify below
    - ◼ Mini-OLT should receive only 100Mbps rates from ONT#1
    - ◼ Mini-OLT should receive only 100Mbps rates from ONT#2
    - ◼ Mini-OLT should receive surplus B/W from ONT#3
    - ◼ Mini-OLT should receive surplus B/W from ONT#4

3) T-CONT Type 3
- Establish the test connection as shown in Figure A. And for congestion, add the one dummy ONT.
- Configure the bandwidth for the all of ONTs as below.
    - ◼ For ONT#1 : Assured B/W 100M, Max B/W 1G
    - ◼ For ONT#2 : Assured B/W 0, Max B/W 1G
    - ◼ For ONT#3 : Assured B/W 0, Max B/W 1G
    - ◼ For ONT#4 : Assured B/W 0, Max B/W 1G
    - ◼ For Dummy ONT : fixed B/W 90%
- Create bi-directional test packet streams as below for all of ONTs.
    - ◼ ONT#1: 100Mbps unicast stream
    - ◼ ONT#2: 100Mbps unicast stream
    - ◼ ONT#3: 100Mbps unicast stream
    - ◼ ONT#4: 100Mbps unicast stream
- Send the test streams to upstream direction for all of ONTs then verify below
    - ◼ The test packet stream from ONT#1 should be assured and other ONTs should be forward

ed as much as surplus B/W.

4) T-CONT Type 4
- Establish the test connection as shown in Figure A.
- Configure the bandwidth for the all of ONTs as below.
  - For ONT#1 : Max B/W 50M
  - For ONT#2 : Max B/W 60M
  - For ONT#3 : Max B/W 70M
  - For ONT#4 : Max B/W 80M
- Create bi-directional test packet streams as below for all of ONTs.
  - ONT#1: 100Mbps unicast stream
  - ONT#2: 100Mbps unicast stream
  - ONT#3: 100Mbps unicast stream
  - ONT#4: 100Mbps unicast stream
- Send the test streams to upstream direction for all of ONTs then verify below
  - Mini-OLT should receive only 50Mbps rates from ONT#1
  - Mini-OLT should receive only 60Mbps rates from ONT#2
  - Mini-OLT should receive only 70Mbps rates from ONT#3
  - Mini-OLT should receive only 80Mbps rates from ONT#4

Result:
1) T-CONT Type 1
   -The expected results are attached in annexure.
2) T-CONT Type 2
   - The expected results are attached in annexure.
3) T-CONT Type 3
   - The expected results are attached in annexure.
4) T-CONT Type 4
   - The expected results are attached in annexure.

Test Item 6: Security:

Requirement:
- MAC address limitation per port
- AES (key-size of 128bit) support
- Username and password based authentication

Test Setup:
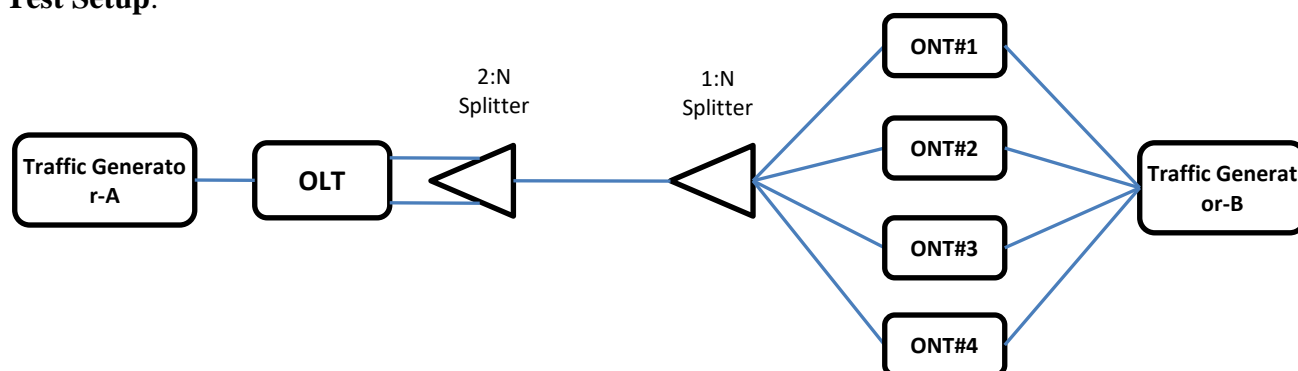
Test procedure:
Connect Mini-OLT, ONT and traffic generator as the above figure.

1. MAC Address Limitation per port
   - Configure max-host as bellow.
     - ONT#1 : max-host number is 1
     - ONT#2 : max-host number is 2
     - ONT#3 : max-host number is 3
     - ONT#4 : max-host number is 4
   - Create 5 traffic streams for each ONT on Traffic Generator-B.
   - Send the traffic then verify whether traffic streams forwarded according as max-host value of each ONT.
2. AES support
   - Configure enable/disable of AES encryption on the ONT via OMCI.
   - Configure run-time regeneration of AES key feature.
   - Create bi-directional test packet streams on traffic generator A and B for all ONTs
   - Send the traffic streams and verify all of streams forward normally.
   - Verify the AES feature of ONT through ONT's console.
   - Verify whether the key change every frequency through ONT's console.

3. Username and password based authentication.
   - Configure the traffic generator-A as a PPPoE server.
   - Configure the traffic generator-B as a PPPoE client (included username and password)
   - Verity username and password based authentication using PPPoE emulator.

Result:
1. MAC Address Limitation per port
   -All of streams forwarded according as max-host value of each ONT.
2. AES support
   -The AES feature worked normally.
3. Username and password based authentication.
   -The PPPoE session worked normally.

Test Item 7: ONT Ethernet port shall be configurable to accept the following frames:

Requirement:
ONT Ethernet port shall be configurable to accept the following frames.
   - Customer VLAN tagged frames
   - Priority tagged frames
   - Untagged frames
   - 802.1p mode

Test Setup:
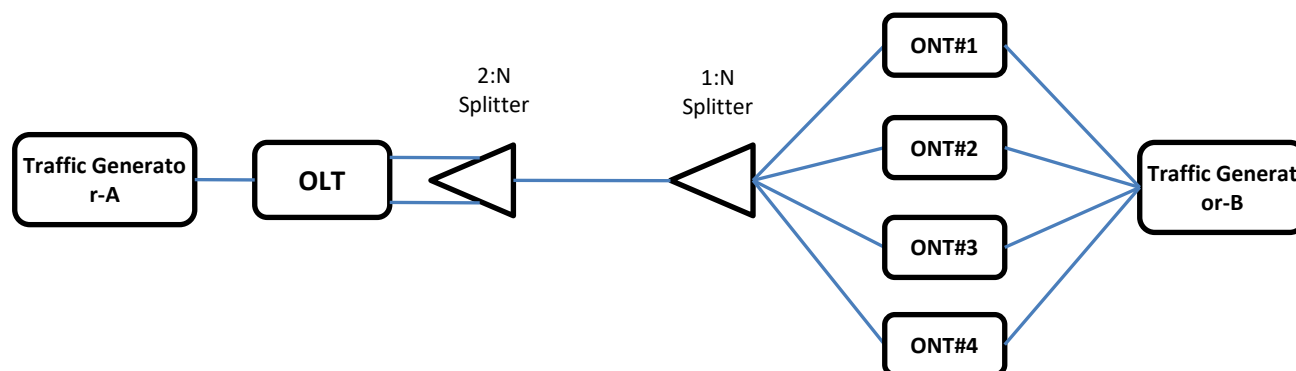
Test procedure:

Establish the test connection as shown in Figure.
1. Customer VLAN tagged frames.
   - Configure ONT's UNI port for customer VLAN ID (VLAN10) for all ONTs at MINI-OLT
   - Create two test traffic streams on traffic generator B for each ONT as below.
   - Flow#1: tagged frame with customer VLAN ID (VLAN10)
   - Flow#2: tagged frame with different customer VLAN ID (VLAN20)
   - Send the traffic then verify behavior of VLAN function.

2. Priority tagged frames.
   - Configure ONT's UNI port for VLAN10 for all ONTs at Mini-OLT
   - Create four test packet streams on traffic generator B for each ONT as below.
     - Flow#1: tagged (VLAN10) frame with Traffic Stream 1
     - Flow#2: tagged (VLAN10) frame with Traffic Stream 2
     - Flow#3: tagged (VLAN10) frame with Traffic Stream 3
     - Flow#4: tagged (VLAN10) frame with Traffic Stream 4
     - Flow#5: tagged (VLAN10) frame with Traffic Stream 5
     - Flow#6: tagged (VLAN10) frame with Traffic Stream 6
     - Flow#7: tagged (VLAN10) frame with Traffic Stream 7
   - Send the traffic then verify behavior of VLAN function and QoS scheduler.

3. Untagged frames
   - Configure ONT's UNI port to untagged mode for all ONTs at Mini-OLT
   - Create untagged test packet streams on traffic generator B for each ONT as below
   - Send the traffic then verify behavior of VLAN function

4. 802.1p mode
   - Configure ONT's UNI port for VLAN10 for all ONTs at Mini-OLT
   - Create four test packet streams on traffic generator B for each ONT as below.
     - Flow#1: tagged (VLAN10) frame with Traffic Stream 1
     - Flow#2: tagged (VLAN10) frame with Traffic Stream 2
     - Flow#3: tagged (VLAN10) frame with Traffic Stream 3
     - Flow#4: tagged (VLAN10) frame with Traffic Stream 4
     - Flow#5: tagged (VLAN10) frame with Traffic Stream 5
     - Flow#6: tagged (VLAN10) frame with Traffic Stream 6
     - Flow#7: tagged (VLAN10) frame with Traffic Stream 7
   - Send the traffic then verify behavior of VLAN function and QoS scheduler.

Result:
1. Customer VLAN tagged frames.
   - Traffic generator A received the flow#1
   - Traffic generator A not received the flow#2
2. Priority tagged frames.
   - Traffic generator A received all streams
3. Untagged frames
   - Traffic generator A received all streams
4. 802.1p mode
   - Traffic generator A received all streams.

Test Item 8: Testing not required for ONT the feature is for ONU.

Test Item 9: FEC Support:

There shall be support for RS (255,239) FEC with operator enable/disable capability in both upstream and downstream directions.

Requirement:
There shall be support for RS (255,239) FEC with operator enable/disable capability in both upstream and downstream directions.

Test Setup:
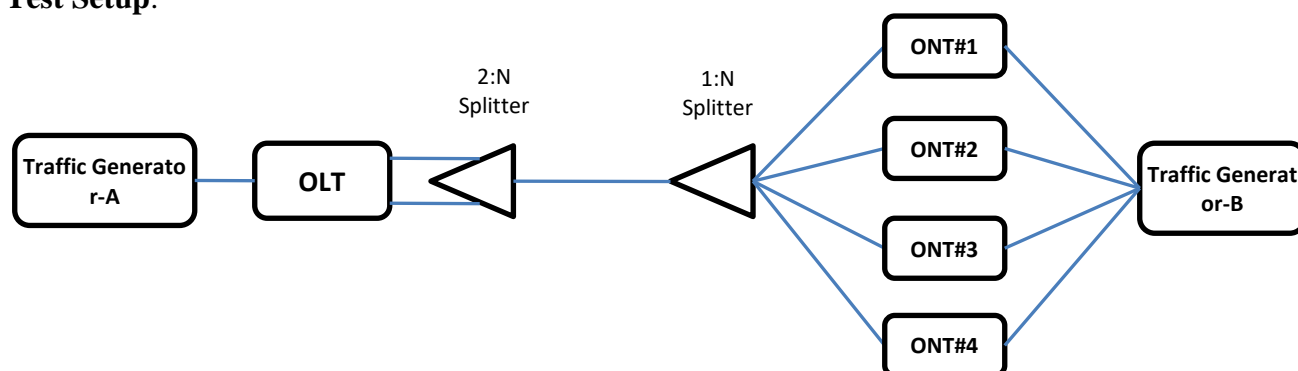
Test procedure:
- Establish the test connection as shown in Figure.
- Create bi-direction test traffic streams on traffic generator A and B for all of ONTs
- Connect the dynamic attenuator to the space between two splitters.
- Attenuate the optical power of Mini-OLT until coming BIP error.
- Enable FEC feature for both upstream and downstream.(For increase optical link budget)
- Verify decrease the BIP error.

Result:
- FEC enable and disable feature is available in both down and up stream.
- After FEC enable, BIP decreased.

Clause 3.4 Mini-OLT Specifications

a) Hardware capability
1. Number of PON interfaces in the box:
Mini-OLT shall support single PON/IF card which may be integrated with network side interface card.

Comments: **Yes/No**

2. Number of PON interfaces supported in the box:
The Mini-OLT shall support 4/8/16 PON interfaces.

Comments: **Yes/No**

3. Number of interfaces towards the Core network:
An Mini-OLT shall have the provision to terminate the following interfaces:

(i) **For 4 PON interface configuration:** A minimum of 2 x GigE and 1 x 10GE LAN interfaces shall be supported towards the core network to cater to the different service providers links. Ratio of uplink access should be 1:1.
(ii) **For 8 PON interface configuration:** A minimum of 4 x GigE and 2 x 10GE LAN interfaces shall be supported towards the core network to cater to the different service providers links. Ratio of uplink access should be 1:1.
(iii) For 16 PON interface configuration: A minimum of 4 x GigE and 4 x 10GE LAN interfaces shall be supported towards the core network to cater to the different service providers links. Ratio of uplink access should be 1:1.

Comments: **Yes/No**

b) Functional and architectural requirements
• Mini-OLT shall transparently support SIP/H.248 signaling. **Yes/No**
• External SIP/H.248→Media gateways can be used to connectivity to PSTN switches

Comments: **Yes/No**

Protection requirements
• The protection mechanism for the PON line should be mandatorily provided.

• 1+1 or 1:1 redundancy may also be provisioned for uplink connectivity. The redundancy shall be as per Purchaser's requirements.

Comments: **Yes/No**

c) Features and capabilities.

• The Mini-OLT shall have local status monitoring **Yes/No**

• The Mini-OLT shall supports LED status indication per Mini-OLT port **Yes/No**

• **Power:** Indicates power on/off status **Yes/No**

• **Fail:** Indicates internal device failure status **Yes/No**

• **Alarm:** Indicate alarm status **Yes/No**

d) Dynamic Bandwidth Allocation (DBA).
- Maximum bandwidth limiting :   100Mbps for FE port & 400Mbps for 1G port
- Minimum guaranteed bandwidth: 512 Kbps
- Two or more level (preferred four) classes of classification   **Yes/No**
- Piggy-back DBRu report mode 0   **Yes/No**
- Idle GEM DBA   **Yes/No**
- Concurrent support of idle GEM and piggy-back DBRu mode 0 support
      Yes/No
- T-CONT Type 1 and T-CONT type 4.   **Yes/No**

e) Layer 2 management and QoS support.
- Switch fabric in Mini-OLT shall be able to handle full wired speed throughputs
      Yes/No
- MAC learning shall be supported at Mini-OLT   **Yes/No**
- Port-id-based VLAN shall be supported at Mini-OLT   **Yes/No**
- VLAN stacking towards the network at the Mini-OLT shall be supported
      Yes/No

f) Support for MAC address limiting
- The operator shall be able to set the maximum number of MAC addresses from an ONT UNI at the Mini-OLT   **Yes/No**
- The number shall be operator programmable. When MAC address limit is reached, subsequent MAC addresses from that specific ONT UNI will not be learned
      Yes/No

g) Supports learning and aging time configuration at Mini-OLT
- The operator shall be able to enable/disable MAC address learning function and configure the MAC learning aging time   **Yes/No**
- VLAN and Port-id mapping   **Yes/No**
- The Mini-OLT shall have a function to store the corresponding relationship of user ID, VLAN tag value and port-id number   **Yes/No**

h) VLAN function
  The Mini-OLT shall support the following VLAN operation
- VLAN insertion in ingress process   **Yes/No**
- VLAN removal in egress process   **Yes/No**
- VLAN stacking per 802.1ad   **Yes/No**

i) Filtering functions at Mini-OLT
- Filtering by destination MAC address and protocol type   **Yes/No**
- Filtering by destination MAC address   **Yes/No**
- Filtering by source MAC address   **Yes/No**
- Filtering of 802.1x packets   **Yes/No**
- Support of ONT/ONU Ethernet port authentication   **Yes/No**

j) Support for packet classification functions.
- Support of IGMP proxy for ONU.
-     Classification based on VLAN ID
-     Classification based on 802.1p bit

- The OLT chassis should be able to configure up to 4K VLAN. However VLAN 0, 1, 2, 3 and 4095 are reserved and not used in the OLT system.
- VLAN forwarding /filtering database should be based on IVL   (Independent VLAN Learning)".

Comment   Yes/NO

Note: Number of port-id Alloc-id per ONT/ONU to be supported by GPON link shall be communicated by the purchaser.

Testing of GPON System in support of clause No. 3.4:

Test Item a): Hardware capability stated as above.

Test Item b): Functional and Architecture Requirement:

Requirement: Functional and architectural requirement:
1) Mini-OLT shall transparently support SIP/H.248 signaling. External SIP/H.248 -> media g ateway can be used for connectivity to PSTN switches.
2) 1+1 redundancy is required for uplink connectivity. In case the system controller card failu re does not affect the traffic, 1+1 redundancy for this card is not required.

Test Setup:

Figure A.
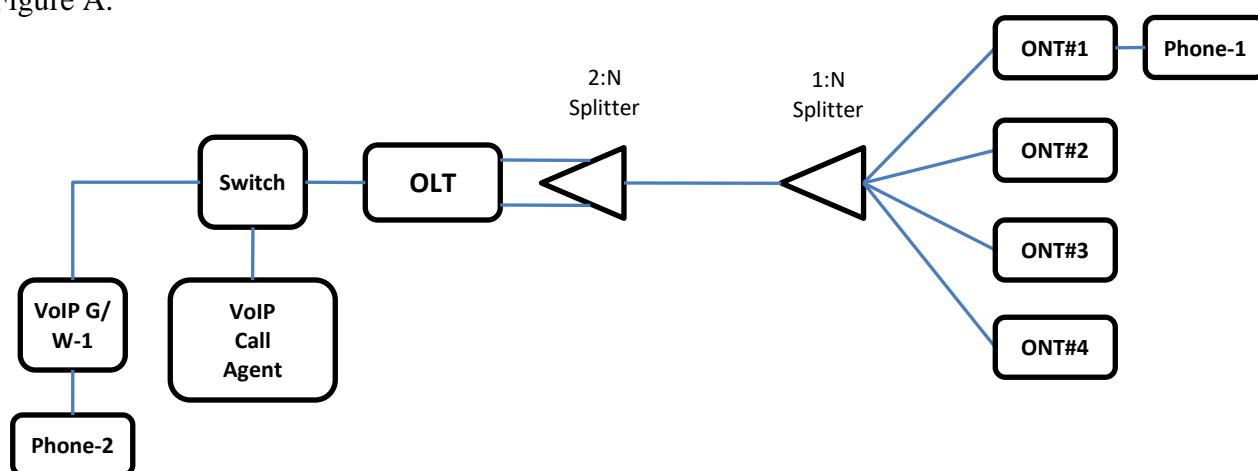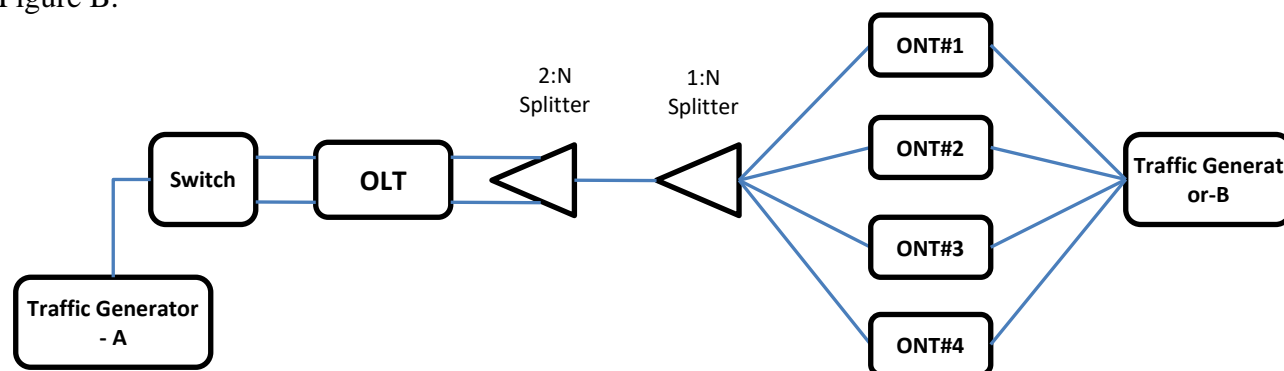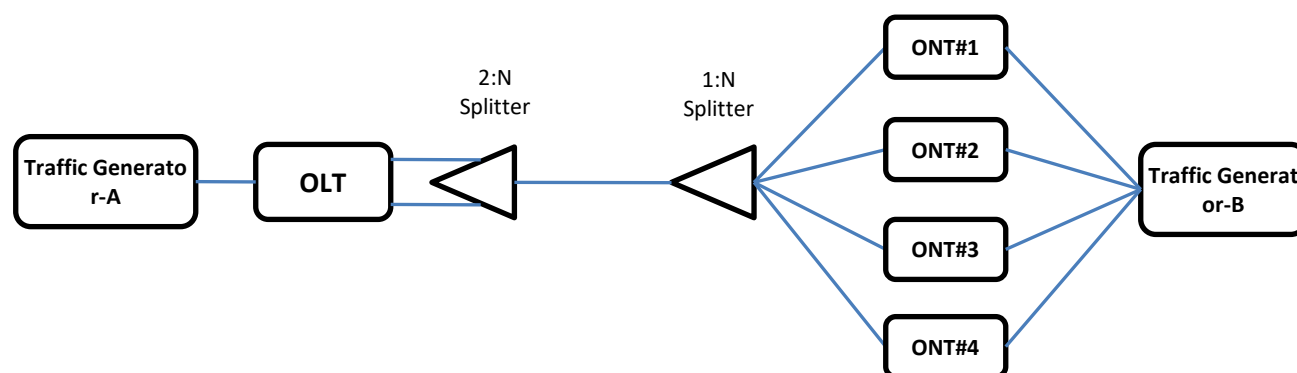
Figure B.

Figure C.

Test procedure:
1. Support SIP/H.248 signaling
    1) Establish the test connection as shown in Figure A.
    2) Proceed to the following steps for SIP and H.248 separately.
    - Register all of VoIP G/Ws to VoIP call agent.
    - Make a call from Phone-1 to Phone-2.
    - Verify the call session works normally.

2. 1+1 redundancy test for uplink port
    1) Establish the test connection as shown in Figure B.
    2) Connect 2 links between switch and Mini-OLT (each link of Mini-OLT are different uplink port).
    3) Configure LACP to switch and Mini-OLT then check LACP status.
    4) Create test packet streams on traffic generator A and B.
    5) Send the test packet streams and remove one of link between switch and MINI-OLT.
    6) Verify the test packet streams forward normally through the remainder link.

Result:
    1. The call session worked normally
    2. After change of topology, all of test packet streams forwarded normally.

Test Item c): Functional and Architecture Requirement:

Requirement: Features and capability
    - The Mini-OLT shall have local status monitoring
    - The Mini-OLT shall supports LED status indication per Mini-OLT port
    - Power: Indicates power on/off status
    - Fail: Indicates internal device failure status
    - Alarm: Indicate alarm status

Test Setup:
    Test setup is not needed for this clause.

Test procedure:
1. Power LED
    - Verify the power LED of Mini-OLT with the naked eYes/No.
2. Fail LED
    - Verify the fail LED of Mini-OLT with the naked eYes/No.

3. Alarm LED
   - Verify the alarm LED of Mini-OLT with the naked eYes/No.

Result:
   - The Mini-OLT supported the LED as above.

Test Item d): Dynamic Bandwidth Allocation:

Requirement:
   Dynamic Bandwidth Allocation (DBA)
   - Maximum bandwidth limiting
   - Minimum guaranteed bandwidth
   - Two or more level(preferred four) classes of classification
   - Type of T-CONT

Test Setup:
 Figure A.
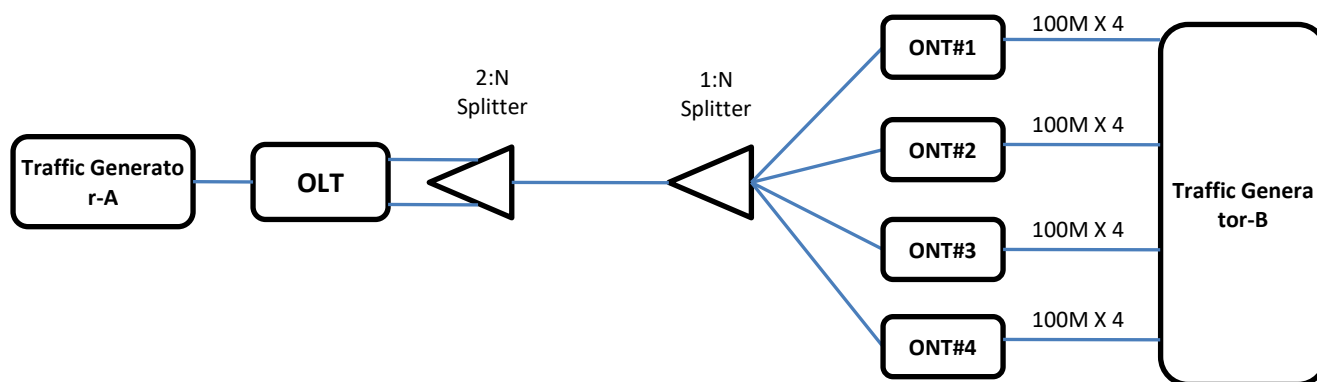
Test procedure:

1. Two or more level (preferred four) classes of classification.
   - Establish the test connection as shown in Figure A.
   - Create bi-direction test packet streams on traffic generator A and B as below.
     ■ Upstream test packet streams for traffic generator B
     ■ UNI#1 : IP-precedence 7
     ■ UNI#2 : IP-precedence 5
     ■ UNI#3 : IP-precedence 3
     ■ UNI#4 : IP-precedence 1
   - Assign the IP-precedence to Mini-OLT's queue as below.
     ■ IP-precedence 7 : Queue 3
     ■ IP-precedence 5 : Queue 2
     ■ IP-precedence 3 : Queue 1
     ■ IP-precedence 1 : Queue 0

- Send the test traffic streams and proceed to the following steps.
  - Deny queue 0
  - Deny queue 1
  - Deny queue 2
  - Deny queue 3
- Verify each class works normally.

Result:
1. Two or more level (preferred four) classes of classification.
   - Deny policy for the queues worked normally.

Test Item e): Layer 2 Management and QoS Support:

Requirement:

Layer 2 management and QoS support
- Switch fabric in Mini-OLT shall be able to handle full wired speed throughputs.
- MAC learning shall be supported at Mini-OLT
- Port-id-based VLAN shall be supported at Mini-OLT
- VLAN stacking towards the network at the Mini-OLT shall be supported

Test Setup:

Figure A.
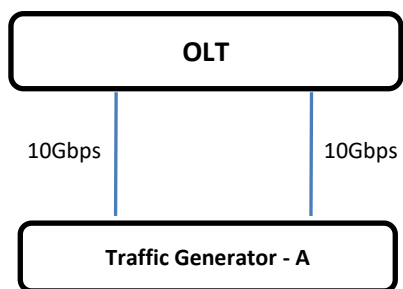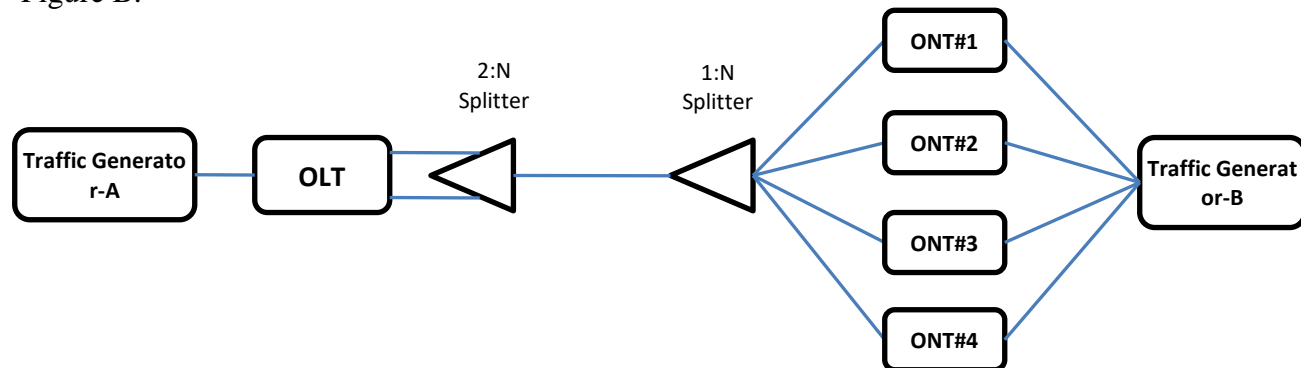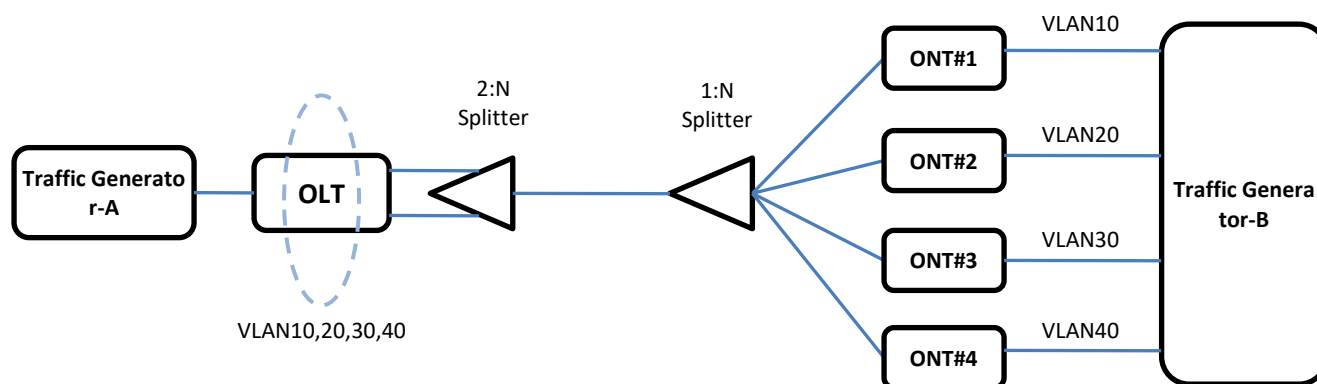
Figure B.

Figure C.

Figure D.
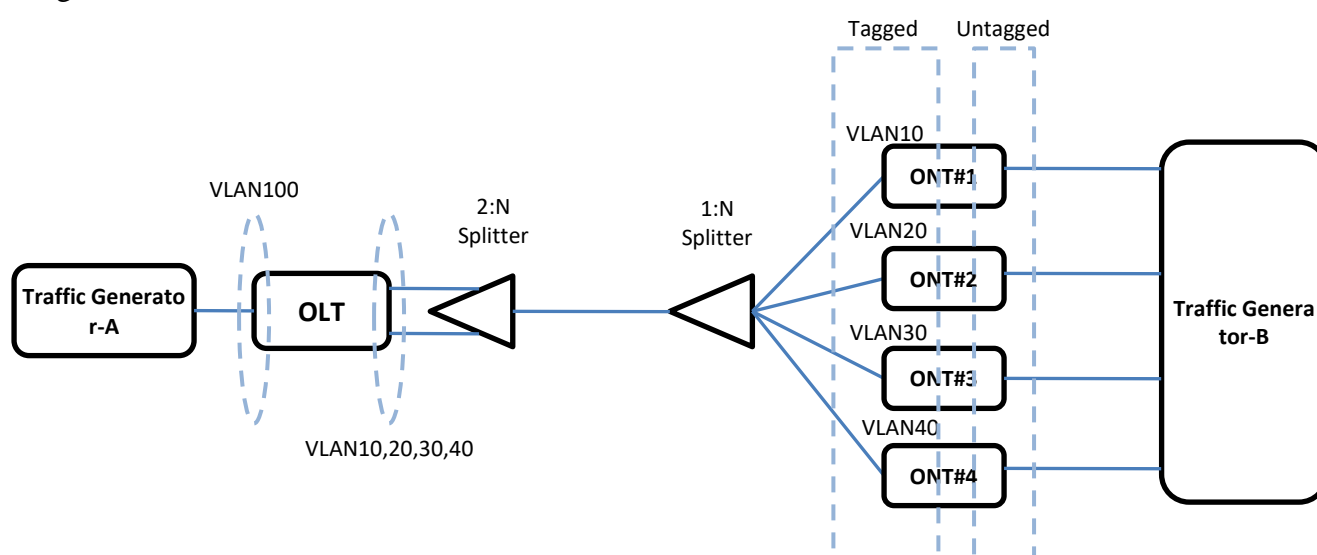
Test procedure:

1. MAC learning shall be supported at Mini-OLT
   - Establish the test connection as shown in Figure B.
   - Create bi-direction test packet streams on traffic generator A and B.
   - Send the test packet stream then verify MAC table of Mini-OLT.
   - Stop the test packet stream then verify MAC table of Mini-OLT after MAC aging time.

2. Port-id-based VLAN shall be supported at Mini-OLT
   - Establish the test connection as shown in Figure C.
   - Configure VLAN feature for both ONTs and Mini-OLT as shown in Figure C.
   - Create bi-direction test packet streams on traffic generator A and B as below.
     - ONT#1 : VID 10, tagged packet for unicast
     - ONT#2 : VID 20, tagged packet for unicast
     - ONT#3 : VID 30, tagged packet for unicast
     - ONT#4 : VID 40, tagged packet for unicast
   - Send the test packet streams then verify whether all test packet streams are forward normally .

3. VLAN stacking towards the network at the Mini-OLT shall be supported
   - Establish the test connection as shown in Figure D.
   - Configure VLAN feature for both ONTs and Mini-OLT as shown in Figure D.
   - Create test packet streams on traffic generator B as below.
     - ONT#1 : untagged frame
     - ONT#2 : untagged frame
     - ONT#3 : untagged frame
     - ONT#4 : untagged frame
   - Create test packet streams on traffic generator A as below.
     - ONT#1 : VID 10 tagged packet
     - ONT#2 : VID 20 tagged packet
     - ONT#3 : VID 30 tagged packet
     - ONT#4 : VID 40 tagged packet
   - Send the traffic then proceed to the following steps.
     - Traffic generator A receive double tagged frame
     - Traffic generator B receive untagged frame.

Result:
1. MAC learning supported at Mini-OLT
   - The MINI-OLT learned the MAC address and removed it after MAC aging time.
2. Port-id-based VLAN supported at Mini-OLT
   - All test packet streams are forwarded normally according to reserve VLAN ID.
3. VLAN stacking towards the network at the Mini-OLT supported
   - Traffic generator A received double tagged frame
   - Traffic generator B received untagged frame.

Test Item f): Support for MAC address limiting:

Requirement:

- MAC address limitation per port

Test Setup:
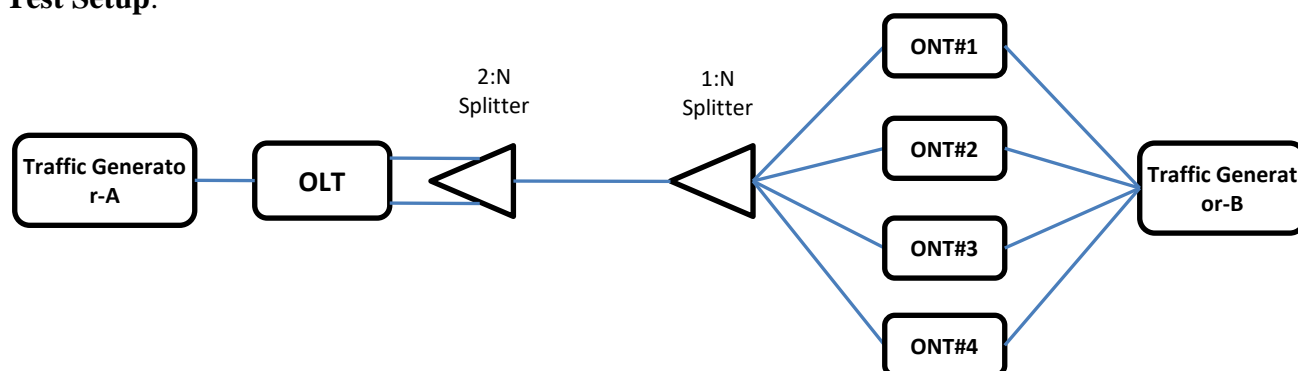
Test procedure:
  Connect Mini-OLT, ONT and traffic generator as the above figure.

  4. MAC Address Limitation per port
       - Configure max-host as bellow.
           ■ ONT#1 : max-host number is 1
           ■ ONT#2 : max-host number is 2
           ■ ONT#3 : max-host number is 3
           ■ ONT#4 : max-host number is 4
       - Create 5 traffic streams for each ONT on Traffic Generator-B.
       - Send the traffic then verify whether traffic streams forwarded according as max-host value of each ONT.

Result:
       1. MAC Address Limitation per port
          -All of streams forwarded according as max-host value of each ONT.

Clause 4.0: Network requirements

Clause 4.1: Passive optical network
  a) The transmission methodology should be bidirectional by the use of wavelength division multiplexing (WDM) technique on a single fiber compliant with ITU-T Rec. G.652
                                                                        Yes/No
  b) Bidirectional transmission shall be accomplished using WDM technique on a single-fiber
                                                                        Yes/No
  c) Wavelength in the range 1260-1360nm shall be used for upstream. There shall be *option* to purchaser for use of 1550nm for overlay RF video applications   **Yes/No**

  d) The PON system shall support a 1:128, 1:64, 1:32, 1:16, 1:8, and 1:4 split options per PON interface on Mini-OLT. The exact requirements for optical interfaces for 1xN, 2xN splitter shall be specified by the purchaser based on the optical power-budget calculations

  Comments: **Yes/No**

Passive optical splitter bank must include 1xN, 2xN (with 1 & 2 representing number of input ports and 'N' several output ports). The fiber types used in the manufacturing of Passive Optical Splitter, connectors shall be compliant with ITU-T Rec. G.652. The overall lowest possible maximum insertion loss (dB) for a splitter to be taken from generic requirements for optical splitter for passive optical network technology NO. TEC/GR/TX/OPT-001/01/APR-12.

a) 1xN Symmetrical splitter – optical splitter specifications, refer generic requirements for optical splitter for passive optical network technology NO. TEC/GR/TX/OPT-001/01/APR-12.
                                                                        Yes/No

b) 2xN Symmetrical splitter - optical splitter specifications, refer generic requirements for optical splitter for passive optical network technology NO. TEC/GR/TX/OPT-001/01/APR-12.
                                                                        Yes/No

c) Connector and adaptor specifications, refer generic requirements for optical splitter for passive optical network technology NO. TEC/GR/TX/OPT-001/01/APR-12. **Yes/No**

Insertion loss: -Make the test set up as shown in the figure below. Program the Optical Spectrum Analyzer for power measurement. First take the reference without the splitter and record the reading. Now insert the Optical splitter and connect the output of the splitter to the spectrum Analyzer. Take the reading at the crest of the spectral wave and record the level, the difference of two readings i.e the reference and the actual level of the spectral pulse and that shall be the Channel Insertion Loss. Insertion loss should be measured for 1310nm, 1490nm and 1550nm wavelengths individually. The overall lowest possible maximum insertion loss (dB) for a 1:32 splitter is 17.1dB Record the readings in the following tables
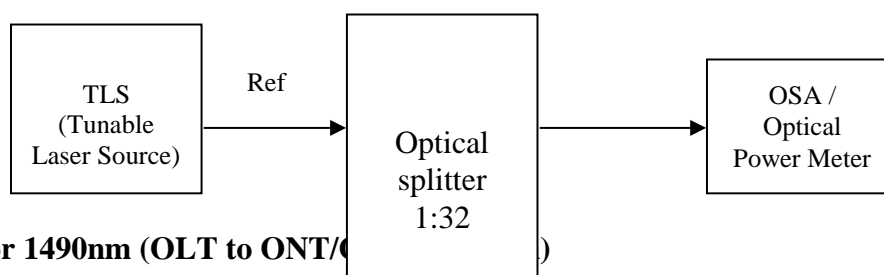
Insertion loss for 1490nm (OLT to ONT/(   ))

Individual Port Insertion Loss(PON)							
Measurement	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 9	Port 10	Port 11	Port 12	Port 13	Port 14	Port 15	Port 16
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 17	Port 18	Port 19	Port 20	Port 21	Port 22	Port 23	Port 24
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 25	Port 26	Port 27	Port 28	Port 29	Port 30	Port 31	Port 32
Reference (dBm)								
Actual reading								
Insertion Loss								

Insertion loss for 1550nm (OLT to ONT/ONU direction)

Individual Port Insertion Loss(PON)							
Measurement	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8
Reference (dBm)								
Actual reading								
Insertion Loss								

Measurement	Port 9	Port 10	Port 11	Port 12	Port 13	Port 14	Port 15	Port 16
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 17	Port 18	Port 19	Port 20	Port 21	Port 22	Port 23	Port 24
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 25	Port 26	Port 27	Port 28	Port 29	Port 30	Port 31	Port 32
Reference (dBm)								
Actual reading								
Insertion Loss								

Insertion loss for 1310nm (ONT/ONU to OLT direction)

Individual Port Insertion Loss(PON)								
Measurement	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 9	Port 10	Port 11	Port 12	Port 13	Port 14	Port 15	Port 16
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 17	Port 18	Port 19	Port 20	Port 21	Port 22	Port 23	Port 24
Reference (dBm)								
Actual reading								
Insertion Loss								
Measurement	Port 25	Port 26	Port 27	Port 28	Port 29	Port 30	Port 31	Port 32
Reference (dBm)								
Actual reading								
Insertion Loss								

Directivity: -
Directivity is the ratio of the optical power launched into an input port to the optical power returning to any other input port. Directivity has been referred to as near-end isolation or near-end crosstalk. Directivity should be > 55dB.

Directivity for 1310nm (ONT/ONU to OLT direction)

Individual Port Directivity (PON)								
Measurement	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8
Reference i/p								
Actual reading at adjacent port								
Directivity								
Measurement	Port 9	Port 10	Port 11	Port 12	Port 13	Port 14	Port 15	Port 16
Reference i/p								
Actual reading at adjacent port								
Directivity								
Measurement	Port 17	Port 18	Port 19	Port 20	Port 21	Port 22	Port 23	Port 24
Reference i/p								
Actual reading at adjacent port								
Directivity								
Measurement	Port 25	Port 26	Port 27	Port 28	Port 29	Port 30	Port 31	Port 32
Reference i/p								
Actual reading at adjacent port								
Directivity								

Directivity for 1550nm (ONT/ONU to OLT direction)   Better than 55dB

Uniformity: -
Uniformity is a measure of how evenly the power is distributed between the output ports of the splitter. It is defined as the difference between the highest and the lowest insertion loss between all of the splitter output ports, expressed in dB. Uniformity is a typical value across the entire bandpass. Maximum uniformity for 1:32 splitter is 1.3 dB.
Uniformity= (highest insertion loss - lowest insertion loss)   **1.00 dB**   **OK / NOT OK**

Clause 4.1.2: Ethernet interfaces at SNI of Mini-OLT:
The following Ethernet interface options shall be supported. Actual interface type shall be communicated by purchaser.
1. 1000BaseSX (50μ multi-mode) interface   **Supported/ Not Supported**
2. 1000BaseLX (10μ single-mode @1310nm) interface   **Supported/ Not Supported**
3. 1000BaseZX (10μ single-mode @1550nm) interface   **Supported/ Not Supported**
4. 10GBase LAN interface as per IEEE 802.3ae.   **Supported/ Not Supported**

The specifications for these interfaces shall comply with
comply with relevant IEEE standard.   **Yes/No**

The different GbE interfaces and 10GBase LAN interfaces may implemented through the use of SFP/SFP+/XFP. **Yes/No**

Clause 5.0: Configuration schemes:

From the view point of administration of access network, the protection architecture of GPON is considered to enhance the reliability of the access networks. However, protection shall be as an optional mechanism because its implementation depends on the realization of economical systems. These protection schemes shall be optional to the purchaser requirement.

The configuration system used is: **Type-B or C protection**

Comments: **Yes/No**

Clause 5.1: Protection on the Mini-OLT SNI section:

There shall be support of multiple Ethernet service network interfaces (SNI) from each Mini-OLT. For redundancy, the Mini-OLT shall support IEEE 802.3ad Ethernet link aggregation and RSTP IEEE 802.1w on those interfaces

Comments: **Yes/No**

Clause 5.2: Possible switching types for PON protection

The following two types of protection switching shall be provisioned
1. Automatic switching: - It is triggered by fault detection, such as loss of signal, loss of frame, signals degrade (BER becomes worse than the predetermined threshold).
2. Forced switching: - This one is activated by administrative events, such as fiber rerouting, fiber replacement, etc.

Both types should be possible in the GPON system, if required, even though they are optional functions**.** The switching mechanism is generally realized by the OAM function; therefore, the required OAM information field should be reserved in the OAM frame.

Testing of Type 'B' Protection:

Test Architecture:
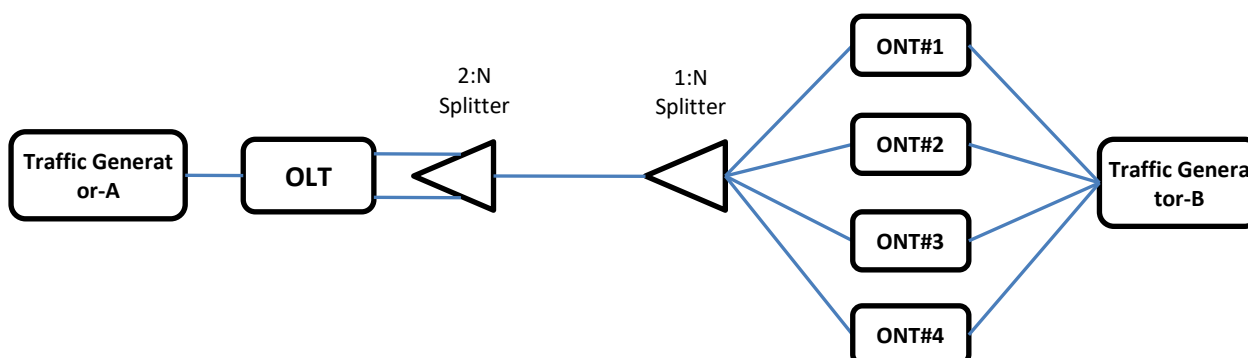
Test procedure:

1. Connect OLT, ONT and traffic generator as the above figure.
2. Create VBES or HSI connection on any one or all the ONTs.
3. Generate the traffic from Traffic generator and measure the same at other side.
4. To test automatic protection switching, configure the protection scheme accordingly.
5. Remove the working fiber and check the switching of ONTs to other PON which is configured for PON protection.
6. After the ONTs are ranged on other PON check the service restoration automatically.
7. For Force switching configure the protection scheme accordingly.
8. Repeat test cases step 5 & 6.

Test Result:

Traffic should restore after the ONTs switch over to other PON in either case.

Testing of Type 'C' Protection:

Test Architecture:
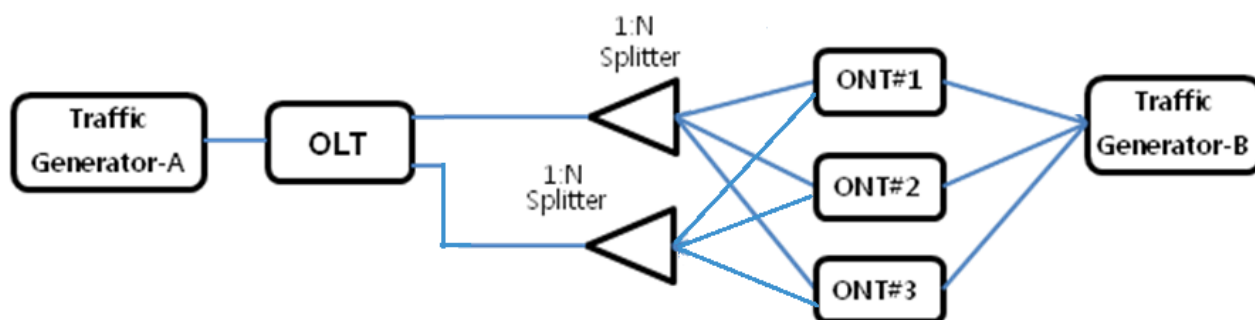
Test procedure:

1. Connect OLT, ONT and traffic generator as the above figure. In this case one or more ONT's with Two PON ports need to be connected in the network.
2. Create VBES or HSI connection on the ONT with two PON ports.
3. Generate the traffic from Traffic generator and measure the same at other side.
4. To test automatic protection switching, configure the protection scheme accordingly.
5. Remove the working fiber at ONT end and check the switching of same ONT to other PON which is configured for PON protection.
6. After the ONT is ranged on other PON check the service restoration automatically.
7. For Force switching configure the protection scheme accordingly.
8. Repeat test cases step 5 & 6.

Test Result:

Traffic should restore after the ONTs switch over to other PON in either case.

Comments: **Yes/No**

Clause 6.0: Performance requirements:
The equipment shall be tested for error performance as follows

In laboratory: In the case E1 service is offered, BER performance over simulated hop shall be tested better than   1x10-10 for 24 hours over an emulated E1(TDMoP) in an end to end configuration. IETF RFC 2544 conformance/performance shall be tested for end-to-end Ethernet service
Comments: **Yes/No**

In field: In the case E1 service is offered, BER performance over simulated hop shall be tested better than   1x10-10 for 24 hours over an emulated E1(TDMoP) in an end to end configuration. IETF RFC 2544 conformance/performance shall be tested for end-to-end Ethernet service

Comments: **Yes/No**

Clause 7.1: Alarms:
The alarms and consequent actions shall be possible to monitor via EMS & LCT of the equipment shall be as per ITU-T G.984 series Recs.
Comments: **Yes/No**

Clause 8.0: Mechanical standard requirements

    a) ONT should be designed to support wall mounting installation   **Yes/No**

    b) The Mini-OLT equipment shall be housed in the standard mechanical ETSI   upto 2U box.

                                                                                                 Yes/No
    c) There shall be proper covers on the mechanical box to avoid the ingress of dust

Clause 9.0: Minimum equipment required for Type Approval.

Fully loaded pre-wired equipment with input output ports with min 4 ONT/ONU, 1 Mini-OLT and 1 EMS/LCT are required for type approval.   **Yes/No**

CHAPTER 2: GENERAL REQUIREMENT

Clause 1.0: Reference Documents

Clause 1.1: Whatever that has not been specifically stated in this document, shall deem to be as per relevant latest ITU-T Recommendations. **Yes/No**

Clause 1.2: Relevant ITU-T Recommendations & other specifications are given in the GR.
Yes / No

Clause 1.3: All references to TEC GRs & other recommendations imply for their latest issues
Yes / No

Clause 2.0: Engineering Requirements

Clause 2.1: The equipment shall be fully solid state and adopt state-of-art technology.
Yes / No

Clause 2.2: The equipment shall be compact and composite in construction and light- weight the manufacturers shall furnish actual dimensions and weight of the equipment. **Yes / No**

Clause 2.3: All connectors shall be reliable and of standard type (CACT approved). **Yes / No**

Clause 2.4: All connectors and the cable used shall be low loss type and suitably shielded (CACT approved). **Yes / No**

Clause 2.5: 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:
- Fan failure is reported through LCT/NMS. **Yes / No**
- Fans are DC operated. **Yes / No**
- MTBF is better than 80000 hours. **Yes / No**

Comments: **Yes / No**

Clause 2.6: 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 TEC document: QM-333(March 2010) - "Specifications for environmental testing of electronics equipments for transmission and switching use"
Yes / No

Clause 2.7: 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.
Yes / No

Clause 2.8: Each terminal block and individual tags shall number suitably with clear identification code and shall correspond to the associated wiring drawing. **Yes / No**

Clause 2.9: All controls, switches, indicators etc shall be clearly marked to show their circuit diagrams and functions. **Yes / No**

Clause 2.10: Facility to mount fixed attenuator, if required shall be provided in the receive chain of the system. **Yes / No**

Clause 3.0: Operational Requirements

Clause 3.1: The equipment shall be designed for continuous operation.   **Yes / No**

Clause 3.2: The equipment shall be able to perform satisfactorily without any degradation at an altitude up to 4000 meters above mean-sea-level. A self certificate from the manufacturer will be acceptable.   **Yes / No**

Clause 3.3: The equipment shall be able to work without any degradation in saline atmosphere near coastal areas and should be protected against corrosion   **Yes / No**

Clause 3.4: Visual indication to show power ON/OFF status shall be provided.   **Yes / No**

Clause 3.5: Wherever the Visual indications are provided, Green color for healthy and Red color for unhealthy conditions would be provided. Some color may be used for non–urgent alarms.
                    Yes / No

Clause 4.0: Quality Requirements

Clause 4.1: The MTBF value for GPON system is …………………….hours.
                    The MTTR value for GPON system is …………………….hours.

The above values are calculated as per guidelines of BSNL-QA document: QM-115.

Clause 4.2: The equipment shall be manufactured in accordance with international quality management system ISO 9001:2000 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted. And the equipment shall meet the latest BSNL QA Guidelines indicated in Manuals QM 118 {Quality and Reliability in product Design.}, QM 205 {Guidelines for Standard of Workmanship for Printed Boards}, QM 206 {Guidelines for Standard of Workmanship for Printed Board Assemblies}, QM 210 {Guidelines for Standard of Workmanship for Surface Mounted Devices} and QM 301{Transmission Equipment General Documentation}..
                    Yes / No

Clause 4.3: The equipment shall conform to the requirements for environment as specified in TEC document: QM-333 (March 2010) - "Specification for environmental testing of electronic equipment for transmission and switching use".

Test results taken during environmental testing are attached in annexure.

Clause 5.0: Maintenance Requirements

Clause 5.1: Maintenance philosophy is to replace faulty units/subsystems after quick on-line analysis through monitoring sockets, alarm indications and Built-in Test Equipment. The actual repair will be undertaken at centralized repair centers. The corrective measures at site shall involve replacement of faulty units/sub-systems.   **Yes / No**

Clause 5.2: The equipment shall have easy access for servicing and maintenance.
                    Yes / No

Clause 5.3: Suitable alarms shall be provided for identification of faults in the system and faulty units.
Yes / No

Clause 5.4: Suitable potential free contacts (preferably)/or any other suitable method shall be provided for extension of audio/visual alarms. **Yes / No**

Clause 5.5: Rating and types of fuses used are to be indicated. **Yes / No**

Clause 6.0: Power Supply

Clause 6.1: Power supply requirements for various GPON constituents:
  a. **Powering requirements: ONU/ONT**
      The primary power source shall be 160-270Vac, 50+/-5Hz for the following:

  - **Type 1.** Home-ONT (**H-ONT**) for FTTH applications.
  - **Type 4.** Business-ONT (**B-ONT**) for FTTH applications
  - **Type 5.** Mobile backhaul-ONT (**M-ONT**) for FTTM applications
  - **Type 3.** MDU-ONU (**M-ONU**) for FTTB applications in MDU

  The ONT shall be designed to have protection of power transient, power-surge and power blowouts. However,
  - In case of DC operation, the adaptor *for* AC→DC conversion shall be internal to the device. **Yes / No**
  - The power rating shall be clearly marked on the device. **Yes / No**
  - The power backup requirement for ONT is left to the purchaser's discretion.
    Yes / No

  b. **Powering requirements: Cabinet/Curb ONU (C-ONU) at Remote Office**

  The nominal power supply shall be –48V DC with a variation in the range from -40V to -60V for R-ONU for FTTCab applications (when installed at Remote Office e.g. DLC/RSU/RLU locations).The equipment shall operate over this range without any degradation in performance.

Symbol	Parameter	Conditions	Min	Typical	Max
Vin	Input voltage		-40V	-48V	-60V
Iin	Conditions input current	Vin = - 48 V O/p at max. load			

  - The equipment shall be adequately protected in case of voltage variation beyond the range as specified above and also against input reverse polarity.
    The input over voltage and under voltage indication is given by the Bay Top module.

I/P Voltage (V)	Condition	LED Status
V<= - 40 V	Under voltage	RED
V>= - 60 V	Over voltage	RED
V = - 48 V	Typical	GREEN

  - The power consumption shall be minimal. The actual power rating/ consumption to be furnished by the manufacturer on the equipment.

The power consumed by ONT (Type….) is =   Watt
The power consumed by ONT (Type….) is =   Watt
The power consumed by ONT (Type….) is =   Watt
The power consumed by ONT (Type….) is =   Watt
The power consumed by ONT (Type….) is =   Watt
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The power consumed by ONT (Type….) is =   Watt
The power consumed by ONT (Type….) is =   Watt

- The derived DC voltages in the equipment shall have protection against over-voltage, short-circuit and overload. **Yes / No**

c. **Powering requirements: Cabinet/Curb ONU (C-ONU) at Curb (installed at street-cabinets etc.)**

The primary power source shall be 160-270Vac, 50+/-5Hz for this case. The ONU shall be designed to have protection of power transient, power-surge and power blowouts. However,

- In case of DC operation, the adaptor for AC↔DC conversion shall be provided. The adaptor can be external or internal to the device.
- The power rating shall be clearly marked on the device.
- The power backup requirement for R-ONU is left to the purchaser's discretion.
- The ONU shall provide external 4-6 hours battery backup (to be specified by purchaser for the exact backup duration) to withstand commercial power outages. This assumes 0.5 average traffic in erlangs for POTS and 4-6 hours average usage time for 10/100/1000Base interface with 30% activity factor.
- The battery shall have a minimum life of 2 years. The replacement of the battery shall not cause any service interruption. The backup system should have a low voltage cut-off at battery voltage below 10.5V to prevent overdraw.
- The system shall be equipped to test, monitor and report (through EMS and LCT) the following:
  - Battery present or not (assessed by voltage of the battery)
  - Battery useful or not (assessed by a short periodic discharge/charge test)
  - Low capacity (means going to shutdown soon). **Yes / No**

d. **Powering requirements: Mini-OLT and related equipment in CO**

Nominal power supply is –48V DC with a variation in the range from -40V to -60V. The equipment shall operate over this range without any degradation in performance.

- The equipment shall be adequately protected in case of voltage variation beyond the range as specified above and also against input reverse polarity.
- The derived DC voltages in the equipment shall have protection against over-voltage, short-circuit and overload.
- The power consumption shall be minimal. The actual power rating/ consumption to be furnished by the manufacturer on the equipment.
- The OLT system shall be provided with at least two power feeds – centralized power supply or distributed on-board power supply as follows:

The Mini-OLT shall have the option of power source operating at 160 to 270V AC, 50±5 Hz for this case. The Mini-OLT shall be designed to have protection of power transient, power-surge and power blowouts. However,
- In case of DC operation, the adaptor for AC↔DC conversion shall be provided. The adaptor can be external or internal to the Mini-OLT.
- The power rating shall be clearly marked on the Mini-OLT.
- The power backup requirement for Mini-OLT is left to the purchaser's discretion.

▫ The Mini-OLT shall provide external 4-6 hours battery backup (to be specified by purchaser for the exact backup duration) to withstand commercial power outages.

▫ The battery shall have a minimum life of 2 years. The replacement of the battery shall not cause any service interruption. The backup system should have a low voltage cut-off at battery voltage below 10.5V to prevent overdraw.

▫ The Mini-OLT should also be provided with the feature of power monitoring and automatic shutdown to safe guard the system, before the power backup goes below the cutoff level. The system shall also be equipped to test, monitor and report (through EMS and LCT) the following:
  ➤ Battery present or not (assessed by voltage of the battery)
  ➤ Battery useful or not (assessed by a short periodic discharge/charge test)
  ➤ Low capacity (means going to shutdown soon).

Yes / No

Clause 7.0: Accessories

Clause 7.1: The supplier shall provide complete set of:
- All the necessary 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: The quality shall be as ordered by purchaser.
- Special tools, extender-boards, extender-cables and accessories essential for installation, operation and maintenance of the equipment shall be clearly indicated and supplied along with the equipment.

Clause 8.0: Documentation

Technical literature in English language only shall be accepted.

Installation spares, operation and maintenance manual: It should cover the following:
- Safety measures to be observed in handling the equipment;
- Precautions for installation, operation and maintenance;
- Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance, troubleshooting and sub-assembly replacement;
- Illustration of internal and external mechanical parts.

Repair manual: It should cover the following:

- List of replaceable parts used including their sources and the approving authority.

- Detailed ordering information for all the replaceable parts shall be listed in the manual to facilitate recording of spares.
- Procedure for trouble-shooting and sub-assembly replacement shall be provided. Test fixture and accessories required for repair shall also be indicated. Systematic trouble shooting chart (fault-tree) shall be given for the probable faults with their remedial actions.

Clause 9.0: Optical access port

- The optical access ports should be designed to protect themselves against the entry of dust when they are not occupied by an external fiber-optic connection.
- The optical access port shall be so positioned on the card as to be easy- to- clean by the user as well as for operation/handling purposes.

CHAPTER 3: SAFETY REQUIREMENTS

Clause 1.0: Operating personnel safety requirements

1.1 The equipment shall conform to IS 13252 part 1: 2010+Amd 2013+Amd 2015 "Information Technology Equipment – Safety- Part 1: General Requirements" [equivalent to IEC 60950-1:2005+A1:2009+A2:2013 "Information Technology Equipment –Safety- Part 1: General Requirements"]. **The Manufacturer/supplier shall submit a certificate in respect of compliance to these requirements.**

1.2 The laser product shall meet the optical safety requirement as per IEC-60825-1. The equipment shall meet the optical safety requirement as per ALSD/ APR procedure of ITU-T Rec. G.664 (latest edition) on Class B laser. The equipment shall have visual warning and controls ensuring danger-free operation.

1.3 The equipment shall follow proper construction practice to minimize unintended radiation due to leakage from any gap or monitoring points. All unused ports and monitoring points should be terminated. The power flux density shall not exceed 1 mW/cm2 at a distance of 2.5 cms.

1.4 Protection against short circuit/open circuit in the accessible points shall be provided. All switches/controls on front panel shall have suitable safeguards against accidental operations. There shall be a provision for the terminal for grounding the equipment.

1.5 The optical access ports should be designed to protect themselves against the entry of dust when they are not occupied by an external fibre-optic connection. The optical access port shall be so positioned on the card as to be easy- to- clean by the user as well as for operation/handling purposes.

1.6 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.

CHAPTER 4: EMC REQUIREMENTS

Clause1.0: 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.

Result: EMI/EMC Compliance test report from certified agency to be attached in annexure.

CHAPTER 5: MANAGEMENT REQUIREMENTS

PART-I: ELEMENT MANAGEMENT SYSTEM REQUIREMENTS

EMS is a logical network consisting of a centralized management station that interacts with the GPON Access network elements to query and control their operations.

The role of the EMS is to control and manage all aspects of the domain and to ensure maximum usage of the devices' resources. The EMS then abstracts relevant aspects of the detailed knowledge it has of the Mini-OLT and the user nodes into an information model that communicates this information via the northbound interface to higher-level management systems.

The EMS is a critical piece in the total telecommunications-management solution. Only the EMS is exposed to the complete management-information content of the whole access network in its domain. The EMS is the sole mediator of this information and the control of the GPON access network to the network management layer. Therefore, an EMS is intimately matched to a particular network-element type and must accompany the deployment of those NEs in the network in order to enable and manage the functioning of the Mini-OLT and user nodes present in the access network.

Test setup for LCT/EMS: This is the test setup for all features testing of LCT/EMS as shown in Fig.1.
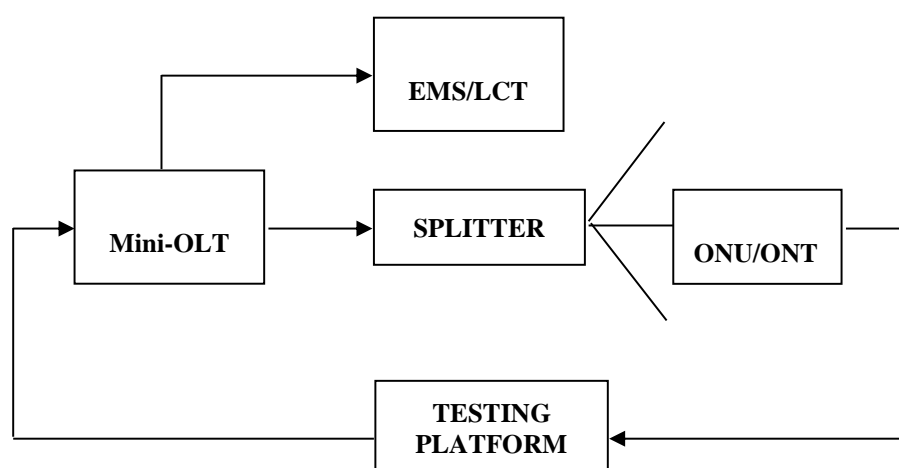
Fig. 1: Test setup for EMS requirements

Clause 1.0:   General operation and functional requirements.

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Login the EMS from different subnet through the EMS GUI	EMS should be logged in the different subnets	**OK**	

Clause 1.0 (1): Management system compliance with ITU G.984.x series

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check whether management system is complied with ITU G.984.x series	Management system should comply with ITU G.984.x series.	-	

Clause 1.0 (2): Access network management system

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check the access network management system is able to execute and configure the following (clause 1.0 (3))	Access network management system should be able to execute and configure the following (clause 1.0 (3))	-	

Clause 1.0 (3): Management Menu functionality

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	View the Alarm monitoring functionality through the management menu selection in the EMS	Alarm monitoring is displayed on EMS	-	
2	View the customized functionality through the management menu selection in the EMS	Customized functionality is displayed on EMS	-	
3	Select the remote view on ONU/ON functionality through the management menu selection in the EMS	Remote view on ONU/ON is displayed on EMS	-	
4	View the FTTX management functionality through the management menu selection in the EMS	FTTX management is displayed on EMS	-	
5	View the IP management functionality through the management menu selection in the EMS	IP management is displayed on EMS	-	
6	Select the Alarm management functionality through the management menu selection in the EMS	Alarm management is displayed on EMS	-	
7	View the equipment management functionality through the management menu selection in the EMS	Equipment management is displayed on EMS	-	
8	View the log management functionality through the management menu selection in the EMS	Log management is displayed on EMS	-	
9	View the loop back management functionality through the management menu selection in the EMS	Loop back management is displayed		For ONU only
10	View the operational state functionality through the management menu selection in the EMS	Operational state is displayed on EMS	-	
11	View the performance monitoring functionality through the management menu selection in the EMS	Performance monitoring is displayed on EMS	-	
12	View the user security functionality through the management menu selection in the EMS	User security is displayed on EMS	-	

Clause 1.0 (4): Configuration of Equipment, Error detection threshold, Display of color coded graphical fault, System status, alarm logging, performance data

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Configure the equipment with modules (ONU/ONTs, Mini-OLT and all related equipment modules	The ONU/ONTs, Mini-OLT and related modules shall be configured through EMS	-	
2	Configure the thresholds to different BER levels and generate the errors in path	LCT/EMS should give the error indication	-	
3	Create any alarm in the system and view the alarm status through the GUI of EMS.	The alarm status and messages shall be displayed with the faulty unit as well.	-	
4	Create any alarm in the system and view the alarm status through the GUI of EMS.	Software file should be downloaded successfully by the LCT/EMS	-	
5	View the system status, alarm information, alarm logging, performance data and performance system diagnostics through the GUI of EMS	System status, alarm information, alarm logging, performance data and performance system diagnostics will be displayed on EMS	-	

Clause 1.0 (5): Management privilege control, EMS security control, NE Configuration, Database management

SN	Procedure of the required feature	Expected Result	Result	Remarks
1-(a)	Enable the low level protection to any of the user and login with that user_ID	The user accessibility is read only to the performance and fault, information. He is not allowed for any change.	-	
(b)	Enable the medium level protection to any of the user and login with that user_ID	The user accessibility is up to configuration status and features only. Further more he is not allowed.	-	
(c)	Enable the high level protection to any of the user and login with that user_ID.	The user accessibility is allowed to change in the configuration and can control the parameters too.	-	
2-(a)	Login the EMS and try unauthorized command for five times	EMS should block the access to operator	-	
(b)	Login to EMS with wrong password for five consecutive times	EMS should not allow the entry into the EMS	-	
(c)	View the security log through LCT/EMS	All log in and log out attempt should be logged in security log file for a minimum of six months in the LCT/EMS	-	
3	Configure the parameters for the	The parameters shall be configured on	-	

	Network Element, UNIs, Physical ports etc.	that NE.		
4-(a)	View the system data through the EMS	System data is displayed on the EMS	-	
(b)	View the software version through the EMS	Information regarding all the versions of software present at the EMS is available.	-	
(c)	View the database backup through the EMS	Information regarding database backup at the EMS is available.	-	

Clause 1.0 (6): Generation of reports and security log

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Configure the schedule monitoring for any individual element for a day or week or month through the EMS and view the dump report through the EMS	EMS should store the report of a schedule for a day or week or month. And the display shall be in table/text and based on GUI.	-	
2	View the security log through EMS	All log in and log out attempt should be logged in security log file for a minimum of six months in the EMS	-	

Clause 1.0 (7): Drill down up to module level in each NE

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Select the FTTX network thorough the EMS and zoom in the FTTX network	The selected FTTX network is displayed on EMS and by zooming in it shall be possible to drill down up to module level in each NE for configuration and fault management	-	

Clause 1.0 (8): Drill down up to card and port level configuration

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Select the NE and drill down to card then to port through the EMS by clicking on icon of NE	The selected port of card is displayed on EMS for configuration	-	

Clause 1.0 (9): EMS data backup

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Take the data backup of the system through the EMS	The data backup is restored at EMS successfully after one month	-	

Clause 1.0 (10): Visual presentation of NE and alarm and status display

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Create any alarm in the system and view the alarm status through the GUI of EMS	The alarm status shall be displayed in red color in the window of EMS GUI	**-**	
2	Restore the alarm in the system and check the status through the GUI of EMS	No alarm shall be displayed and faulty unit shall be displayed in green color in the window of EMS GUI	**-**	

Clause 1.0 (11): NE out of service and in service, Restart of NE from the EMS

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Configure any NE out of service through GUI of EMS	NE should be displayed out of service at the EMS	**-**	
2	Configure the NE in-service through the EMS	NE should be displayed in-service at the EMS	**-**	
3	Restart the NE from the EMS GUI	NE should get start from the command from the EMS	**-**	

Clause 1.0 (12): Systematic Health Monitoring

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Enable the systematic health monitoring of the any element of the network with settable periodicity @ 24hrs, 1 week and 1 month through the EMS	Health monitoring report should be displayed.	**-**	

Clause 1.0 (13): Configuration of network element like creating, viewing and editing

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Configure the network element like creating, viewing and editing through the EMS	NE should be created, viewed and edited through the EMS	**-**	
2	Store the configuration of NE at suitable place from where it can retrieved	Configuration of NE should be stored	**-**	

Clause 1.0 (14): soft copy of EMS on a CD

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Soft copy of EMS should be on CD and setup procedure should be clearly mentioned in system manual of equipment.	Soft copy of EMS is available on a CD and setup procedure is clearly mentioned in system manual of equipment	**-**	

Clause 1.0 (15): Calendar management

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Attach a time tag to execute any scheduled administrative command through the EMS	Command should be executed when the Network real time matches the time tag and should be possible to define both time and date	**-**	

Clause 1.0 (16): Messaging system

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Configure the messaging system which generates and sends the message on e-mail to the designated personnel depending upon the location of NE and create any alarm through the EMS	The e-mail should be received by the designated personnel	**-**	

Clause 1.0 (17): Response time of command/query

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Generate any command through the EMS	The response time of the command should 10 or better.	**-**	

Clause 1.0 (18)   Interface details

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check all necessary interface details (with document) for integration of EMS with system's existing or proposed NMS and time bound supports under NDA are available	All necessary interface details (with document) for integration of EMS with system's existing or proposed NMS and time bound supports under NDA should be provided.	**-**	

Clause 1.0 (19): Infrastructure requirement for EMS

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check whether there is Infrastructure requirement for setting up EMS.	Infrastructure requirement for setting up EMS should be provided.	**-**	

Clause 1.0 (20): Critical components and units of EMS

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check for all critical components and	All critical components and	**-**	

	units of EMS i.e. LAN interfaces, hard-disk, processor etc. are fault resistant	units of EMS i.e. LAN interfaces, hard-disk, processor etc. should be fault resistant		

Clause 1.0 (21): Installation and commissioning of the EMS

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check for installation and commissioning of the EMS include supply & installation of cables, distribution frames, and electrical switches.	Installation and commissioning of the EMS shall include supply & installation of cables, distribution frames, and electrical switches.	-	

Clause 1.0 (22): Response time of command/query

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	The purchaser shall validate the EMS and all the instruments necessary for carrying out validation test shall arranged by supplier.	EMS will be validated by the purchaser and all the instruments necessary for carrying out validation test shall be arranged by supplier.	-	

Clause 2.0   EMS architecture & server hardware specification

Clause 2.1   Architecture

Clause 2.1 (1): Restoration of performance data to central EMS server

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Remove the EMS connectivity and provided that PM data shall be stored in the controller card and shall be sent to the central EMS server upon restoration of EMS connectivity and after that regain the EMS connectivity	EMS should restore the PM data	-	

Clause 2.1 (2): LCT privilege in case of loss of EMS connectivity

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Remove the EMS connectivity and login the LCT for local NE	The LCT should be logged in for local NE	-	

Clause 2.1 (3): EMS server

SN	Procedure of the required feature	Expected Result	Result	Remarks

1	Check whether EMS server may consist of standalone application server and database server or it can be a standalone EMS server.	The centralized EMS server may consist of standalone application server and database server or it can be a standalone EMS server.	-	

Clause 2.1 (4): LCT connectivity to EMS

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Login the EMS through LCT connectivity.	The EMS should be logged in through password.	-	

Clause 2.1 (5): Two display units

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check for the two display units for all the servers (application, database and Firewall server).	There are two display units for all the servers (application, database and Firewall server).	-	

Clause 2.2: Scalability aspects

Clause 2.2 (1): Support of Mini-OLT

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Configure the 500 Mini-OLT through the EMS	500 Mini-OLT should be supported	-	
2	Configure the 10000 ONT/ONUs through the EMS	10000 ONT/ONUs should be supported	-	

Clause 2.2 (2): Support of concurrent users

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Login EMS by 25 concurrent user	EMS should be multi user with minimum 25 concurrent users		

Clause 2.2 (3) Support of concurrent users

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Check for the minimum four operator terminals at EMS site.	There will be minimum four operator terminals at EMS site.	-	
2	Check whether EMS shall be equipped to	EMS shall be equipped to	-	

	connect at least 5 local terminals at EMS site.	connect at least 5 local terminals at EMS site		
3	Check for the operator terminal configuration, it should be PC-Pentium-IV with 80 HDD, 17" video display, Ethernet interface with standard OS UNIX/LINUX /WINDOWS but having GUI.	The operator terminal configuration will have PC-Pentium-IV with 80 HDD, 17" video display, Ethernet interface with standard OS UNIX/LINUX /WINDOWS but having GUI.	-	

Clause 2.2 (4): Compliance for SNMP version2c [or later interface] with standard MIB Browser

SN	Procedure	Expected Result	Result	Remarks
1	Do the compliance testing for SNMP version2c with standard MIB Browser	System should respond to all Get, Set and Trap commands from the standard MIB Browser.	-	

Clause 2.3: EMS server specifications

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	View for the operating system of Application server and Database server.	Operating system should be UNIX.	-	

Clause 2.4   Application server specification

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	View the application server should have multiprocessor	The multiprocessor based with each processor having at least 2 processor should be at least 1.5KHz	-	
2	View the RAM of application server	The RAM should be 8GB	-	
3	View the cache memory of application server	The cache memory should be 512KB	-	
4	View the HDD of application server	The HDD should be 80 GB	-	
5	View the disk drive of application server	The disk drive should be CD-ROM/DVD-ROM	-	
6	View the Ethernet LAN interface of application server	The interface should be Ethernet LAN	-	
7	Look for the high availability cluster mode in application server	The high availability cluster mode should be present	-	

Clause 2.5: Database server specification

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	View the database server should have multiprocessor	The multiprocessor based with each 4 processor and expandable to 8 processor, RISC based 64 bit system should be at least 1.5KHz	-	
2	View the RAM of database server	The RAM should be 8GB	-	
3	View the cache memory of database server	The cache memory should be one GB	-	
4	View the HDD of database server	The HDD should be 80 GB	-	
5	View the disk drive of database server	The disk drive should be 20/40 GB DAT drive	-	
6	View the high availability cluster mode in database server	The high availability cluster mode should be present	-	

Clause 2.6: Firewall server [optional to purchaser's requirement

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	View the firewall system	The firewall system should be as per TEC GR No. : GR/FWS-01	-	
2	Create 20000 concurrent sessions of firewall system	The firewall system should have the capability of handling a concurrent session of around 20000	-	

Clause 2.7: Specification for LCT/workstation

SN	Procedure of the required feature	Expected Result	Result	Remarks
1	Verify the speed of workstation.	Speed of work station should be 2GHz and above	-	
2	View the RAM of workstation.	The RAM should be 256 MB	-	
3	View the HDD of workstation.	The HDD should be 40 GB	-	
4	View the disk drive of workstation.	The disk drive should be 48X CD-ROM	-	
5	View the interface of workstation.	The interface should be Ethernet LAN	-	
6	View the modem of workstation.	The modem should be inbuilt V.90	-	
7	View the USB ports of workstation.	2 USB ports should be present	-	
8	View the printer, mouse, PS-2 Keyboard port of workstation.	The printer, mouse and PS-2 Keyboard port should be present	-	
9	Login the remote site through the remote monitoring in the LCT.	The LCT should be logged in remotely	-	

CHAPTER 5: MANAGEMENT REQUIREMENTS
PART-И: FCAPS REQUIREMENT TESTING

Local Management Interface

The local manager will be able to install, monitor, control and configure the GPON system (Mainly Mini-OLT and ONT). It will be possible to monitor, control and configure the whole GPON network through LMI. Specifications for LMI interface are:

Interface	V.24/V.28, RS238, RS485 or RJ45 (Ethernet)
Bit Rate	e.g. for Ethernet 10/100BaseT etc.
Connector	Different connectors for different type of interface

Test setup for LCT/EMS: This is the test setup for all features testing of LCT/EMS as shown in Fig.1.
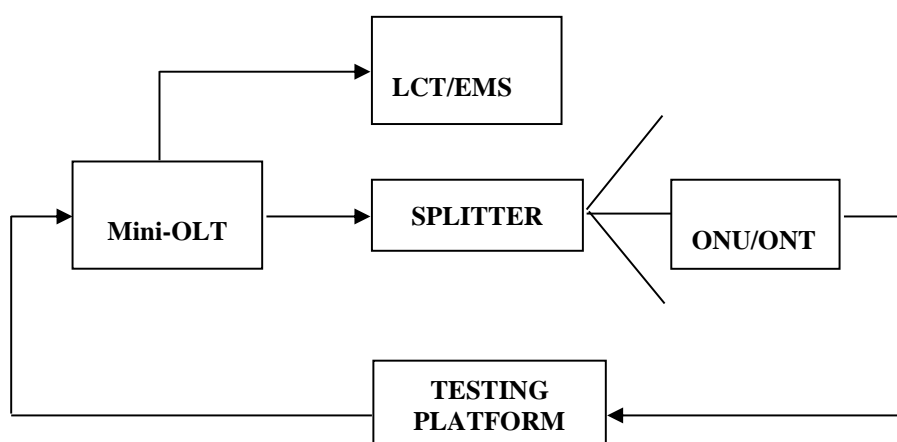
Fig. 1: Test setup for FCAPS requirements

Clause 1.0   Network

Clause 1.1 General Functions:

The Centralized EMS system and LCT for single system supports the management functionality including the following:
- Configuration Management.
- Fault Management.
- Performance Management.
- Security Management.
- Inventory Management.

Clause 1.1.1Configuration Management: -

The configuration management will provide the functionality to configure the GPON system. LCT or EMS will be mandatory for installation of the system.
Clause 1.1.1(1)   Network Element Creation

SN	Procedure	Expected Result	Result	Remarks

1	Create the user node (ONU/ ONT) at Mini-OLT and Assign the Station name and IP address to NE through LCT/EMS	NE should be created with assigned with name and IP address	-	Supported by LCT

Clause 1.1.1(2) Programming of multiple interfaces

SN	Procedure	Expected Result	Result	Remarks
	Create different interfaces at the user node through LCT/EMS	Different assigned interfaces shall be created on the user node.	-	

Clause 1.1.1(3) Equipment protection to a unit/interface

SN	Procedure	Expected Result	Result	Remarks
1	Enable the protection mode for the node	The node shall be in the protection enable mode.	-	

Clause 1.1.1(4) Error detection threshold

SN	Procedure	Expected Result	Result	Remarks
1	Configure the thresholds to different BER levels and generate the errors in path	LCT/EMS should give the error indication	-	

Clause 1.1.1(5) Network Element Configuration

SN	Procedure	Expected Result	Result	Remarks
	Configure the parameters for the Network Element, UNIs, Physical ports etc.	The parameters shall be configured on that NE.	-	

Clause 1.1.1(6) Software download

SN	Procedure	Expected Result	Result	Remarks
1	Download the software on local NE through the LCT/EMS	Software file should be downloaded successfully by the LCT/EMS	-	
2	Download the software on remote NE through the LCT/EMS	Software file should be downloaded successfully by the LCT/EMS	-	

Clause 1.1.1(7) Protection switching

SN	Procedure	Expected Result	Result	Remarks
1	Break the main live traffic path for the protection enabled node	The node shall be working OK after switching to the Protection path.	-	

Clause 1.1.1(8) Ethernet interface bandwidth

SN	Procedure	Expected Result	Result	Remarks
1	Allocate the required bandwidth for the user node on Ethernet interface	The Bandwidth shall be allocated for the particular user node.	-	

Clause 1.1.1(9)   Layer 2 control protocol between ONU/ONT and Mini-OLT

SN	Procedure	Expected Result	Result	Remarks
1	Configure the traffic based on Layer2 protocol (MAC table / bridging) as Ethernet over GEM and TDM over Packet between Mini-OLT and ONT/ONU	PON interfaces as per the configuration should be displayed on LCT/EMS	-	

Clause 1.1.2 Fault Management: -

Fault management is the set of functions that detect, isolate, and correct malfunctions in the access network, compensate for environmental changes, and include maintaining and examining error logs, accepting and acting on error detection notifications, tracing and identifying faults, carrying out sequences of diagnostics tests, correcting faults, reporting error conditions, and localizing and tracing faults by examining and manipulating database information.

When a fault or event occurs, a network component will often send a notification to the network operator /LCT/EMS using a protocol such as SNMP. An alarm is a persistent indication of a fault that clears only when the triggering condition has been resolved. A current list of problems occurring on the network component is often kept in the form of an active alarm list. A list of cleared faults is also maintained in history by the LCT/EMS

SN	Procedure	Expected Result	Result	Remarks
1	**The time taken to declare the fault shall be as per ITU-T G.984.x series**			
	Create any alarm in system and measure the time taken to declare a fault	Time taken should be as per ITU-T G.984.x by the LCT/EMS	-	
2.	**Failure and clearance shall be time stamped**			
	Create any alarm in the system note the time and clear the after some time	View the alarm log the created and cleared alarms will be time stamped.	-	
3.	**The equipment shall do surveillance of alarm and their detection reporting of relevant events and conditions that lead to the generation of alarm after filtering**			
	Create any alarm in the system and take the observations, view the current alarm window through the LCT/EMS	Alarm reporting and the deffer- -ed action on the user interface shall be reported.	-	
4.	**Path alarm notification (occurrence, severity, cause and clearing).**			
	Introduce path alarm in the system and clear the same, then view the current and history alarm window through the LCT/EMS	Occurrence of alarm and clearing shall be reported The alarm shall present in history alarm window.	-	
5.	**Graphical representation of alarm and status display**			
	Create any alarm in the system and view the alarm status through the GUI of LCT/EMS	The alarm status shall be displayed in the window of LCT/EMS GUI.	-	
6.	**Fault localization**			
	Create any alarm in the system and observe the same through LCT/EMS	The alarm status shall be displayed with the faulty unit as well.	-	

7.	**Storing and processing of current alarm information, up to module/unit level**			
	Create any alarm in the system and observe the same through LCT/EMS	The alarm status shall be displayed with the information of faulty unit	**-**	
8.	**Storing and processing of historical alarm information for 30 days minimum**			
	Create any alarm in the system and clear the alarm and view the history alarm log through the LCT/EMS	LCT/EMS should store the alarm in history for 30 days	**-**	
9.	**On line logging capability for historical alarms, events and with filter settings**			
	Create any alarm in the system after that clear that alarm, then view the history alarm log through the LCT/EMS. Also set the filter to display the specific list of alarms.	Display of historical alarms with sufficient resources as followed managed resource, alarm/event type, severity, day & time of occurrence. And see the list of alarms as per the filter setting.	**-**	
10.	**FCS errors for Ethernet clients**			
	Create alarm in Ethernet client through analyzer and view the performance monitoring report log for Ethernet client through the LCT/EMS	LCT/EMS should indicate the FCS error for Ethernet clients	**-**	
11.	**Assigning alarm severity**			
	Configure the alarm severity for critical, major, minor or deffered and create any of the above alarms type in the system through the LCT/EMS	LCT/EMS should display the alarm along with its corresponding severity when the alarm is created in actual.	**-**	

Clause 1.1.3: Performance Management: -

There shall be provision of monitoring the performance of the system. The performance related information will be reported to the LCT/EMS. It will perform the following tasks.

SN	Procedure	Expected Result	Result	Remarks
1.	**Storage of all the performance monitoring data and support history for 30 days.**			
	Start performance monitoring for any individual element and after some time stop the monitoring through the LCT/EMS.	LCT/EMS should store the performance and traffic statistics for a period of month	**-**	
2.	**Daily, weekly, monthly reports configured as scheduled report for any individual element/interface as well as complete domain.**			
	Configure the schedule monitoring for any individual element for a day or week or month through the LCT/EMS and view the dump report through the LCT/EMS	LCT/EMS should store the report of a schedule for a day or week or month. And the display shall be in table/text and based on GUI.	**-**	
3.	**Conformance of performance monitoring to IETF RFC 2544 or RFC 2558 for Ethernet Clients**			
	Go for performance monitoring for	The report shall in conformance	**-**	

SN	Procedure	Expected Result	Result	Remarks
	any individual element or the interface for Ethernet clients.	with IETF RFC 2544 or RFC2558 in case of SNMP as the management interface.		
4.	**Configuration of thresholds concerning the error counters**			
	Configure the thresholds concerning error counter of any module through LCT/EMS and degrade the input level below the thresholds through analyzer and view the performance monitoring through the LCT/EMS	LCT/EMS should indicate the error in performance monitoring log window	-	
5.	**FCS error check for Ethernet clients**			
	Start performance monitoring for Ethernet client through LCT/EMS and degrade the input level from the analyzer and view the performance monitoring through the LCT/EMS	LCT/EMS should indicate FCS error in performance monitoring window	-	
6.	**Frame /Packets dropped in case of Ethernet frames**			
	Start performance monitoring for Ethernet client through LCT/EMS and do the testing for Ethernet client from the analyzer , then view the performance report through the LCT/EMS	LCT/EMS should indicate Frame/packets dropped in performance report	-	
7.	**Performance statistics in graphical and text mode**			
	Schedule performance monitoring for any individual element through LCT/EMS	Display of the performance statistics in form of text/table and in graphical mode.	-	

Clause 1.1.4: Security Management: -

Security Management module is provided to ensure authorized access. The management system shall provide adequate security to the data and for the access to the management system as per the following details:

SN	Procedure	Expected Result	Result	Remarks
1	**Management of network through local and remote**			
	Login the LCT/EMS on to local station and remote NE through password.	LCT/EMS should be able to manage in both the cases.	-	
a.	**Low -level protection for read only access to faults and performance information**			
	Enable the low level protection to any of the user and login with that user_ID	The user accessibility is read only to the performance and fault, information. He is not allowed for any change.	-	
b.	**Medium level protection for access to configuration status and features**			
	Enable the medium level protection to any of the user and login with that user_ID	The user accessibility is up to configuration status and features only. Furthermore he is not allowed.	-	
c.	**High level protection for control of access to change in the configuration and control**			

SN	Procedure	Expected Result	Result	Remarks
	parameters			
	Enable the high level protection to any of the user and login with that user_ID.	The user accessibility is allowed to change in the configuration and can control the parameters too.	-	
2.	**Network management security**			
	Login the LCT/EMS and try unauthorized command for five times	LCT/EMS should block the access to operator	-	
	Login to EMS/LCT with wrong password for five consecutive times	LCT/EMS should not allow the entry into the LCT/EMS		
3.	**Dynamic password facility**			
	Change the operator password through login of super user of LCT/EMS	Password should get changed in the LCT/EMS	-	
4.	**Security log**			
	View the security log through LCT/EMS	All log in and log out attempt should be logged in security log file for a minimum of six months in the LCT/EMS	-	
5.	**IP-MPLS network connectivity with security required.**			
	Configure the EMS or access network for the connectivity to the IP-MPLS network based on Login and user password.	There shall be a secure connectivity to the IP-MPLS -VPN based network	-	
6.	**Back up for program and data**			
	View Software version information through LCT/EMS	There should be idle version as back up for program in LCT/EMS	-	
7.	**Restore the back up and data base**			
	Switch the software version through LCT/EMS	Idle software should switch to the running version and restore the database as well in LCT/EMS	-	
8.	**External security measures (optional to the purchaser requirement)**			
	Configuration of Firewall	Firewalls should be present	-	
	Access control to server	Access to server is controlled	-	
	Data Encryption devices	Encryption is provided	-	
	Antivirus Package	Antivirus is installed	-	
	Gate Way NE Architecture	Gate Way NE Architecture is supported.	-	

Clause1.1.5: Inventory Management:
EMS is supposed to track the change in hardware if there is any and keep the record of inventory of the network. The same has traceability chronologically.

SN	Procedure	Expected Result	Result	Remarks
1.	**Presence of any physical module**			
	Jack out any physical module from	Indication of absence of the module	-	

	the system. and view the chassis on GUI.	shall be there with appropriate alarm.		
2.	**Indication of usage of module/port/interface.**			
	View the chassis of module /port/ interface through LCT/EMS	The detail information of the port/ interface in use or free to use is available on the Element manager.	**-**	
3.	**Discovery of device in the network**			
	Insert any module/card to the system or switch on any new device connected in the network.	The same is available in the chassis window of GUI or on the element manager.	**-**	
4.	**Tracing of any change in network inventory reported**			
	Make any changes related to network inventory on to the system	Traceability and the information of the same module is available on the EMS afterwards also.	**-**	
5.	**Provision of complete view of the Network Elements and interconnecting links**			
	View the chassis of the Network Element through LCT/EMS	complete view of the network elements and interconnecting links should be displayed by the LCT/EMS	**-**	

Clause 1.1.6: Software Management:

SN	Procedure	Expected Result	Result	Remarks
1.	**Loading of new system software**			
	Download the new system software through the LCT/EMS	Software should be downloaded through the LCT/EMS	**-**	
2.	**Different versions of software**			
	View the software version through the LCT/EMS	Information regarding all the versions of software present at the LCT/EMS is available. In case multiple versions, one is active and the other version is in idle (passive) mode.	**-**	
3.	**Installation of software patches and message display. Authorized user is only allowed to download the software**			
	Download the software through LCT/EMS	Software downloaded successfully or failed at this stages is displayed while downloading the S/W.	**-**	
	Download the software through LCT/EMS	Software downloading is possible only when user is logged in with the authorized login and user password.	**-**	
4.	**Loading of any software with the terminal administrator's authorization**			
	Download the software through LCT/EMS	The operator should not allow the loading of s/w without the terminal administrator's authorization	**-**	

Clause 1.1.7: Software Download:

1.	**Local and remote software download**			
	Download the software of local and	S/W download should take place in	**-**	

remote NE through LCT/EMS	case of both local and remote NE. And data / traffic shall remain uninterrupted and the network map will also remain unchanged.		

Clause 1.1.8 Management Interface: -
The complete detail of management interface and the protocol, as pertaining to each layer of the the protocol –stack implemented in the system shall be made available, for the purpose of integrating the local management capabilities with the centralized NMS as later date.

SN	Procedure	Expected Result	Result	Remarks
1.	**Protocol detail at all layers of TCP/IP stack**			
	View protocol detail through LCT/EMS	LCT/EMS should display the protocol detail at all layer	-	
2.	**Physical Interface**			
	View PHY I/F through LCT/EMS	LCT/EMS should display the PHY I/F at each layer	-	
3.	**Database structure**			
	View database structure through LCT/EMS	LCT/EMS should display the database structure	-	
4.	**Number format**			
	View Number format through LCT/EMS	LCT/EMS should display the Number format	-	
5.	**Node addressing System**			
	View Node addressing System at LCT/EMS	LCT/EMS should display the Node addressing System	-	
6.	**Application software**			
	View Application software	Complete application software details should be available	-	
7.	**EMS software check sum**			
	Software check sum through EMS	Get the software check sum through the EMS / LCT GUI	-	

Clause 1.1.9: Southbound Management Interface: -
EMS is a logical network consisting of a centralized management station that interacts with the GPON network element to query and control their operation. The building block of the model are, a management station often called a manager, NE, and a management communication stack.

SNMP protocol: - SNMP allows for performing read/write operations on the NE variables specifies the syntax and semantics of messages both Manager and agent (resides in NE) will exchange. These Messages are encoded using ASN.1 basic encoding rules.

SN	Procedure	Expected Result	Result	Remarks
1.	At least one remote management interface and one local management (LMI) interface at each Network Element			
	Login the LCT/EMS locally as well as remotely at each Network	At least one local management and remote management interface at	-	

	Element	each NE should take place		
2.	Compliance for SNMP version2c [or later interface] with standard MIB Browser			
	Do the compliance testing for SNMP version2c with standard MIB Browser	System should respond to all Get, Set and Trap commands from the standard MIB Browser.	**-**	

Clause 1.1.10: North Bound Management Interface: -
For the North Bound, TMF 814 is used to provide the standardization.

To provide interoperability between multi-platforms, CORBA Architecture is used.
2 services of CORBA are used in this

Naming service: - This is used to provide the IOR of Server (EMS) to the client (NMS).

Notification service: -This is used to send the alarms from EMS to NMS
Initially, session is created by NMS with EMS. NMS gets the IOR of EMS Server(EMS Session Factory) sends its own NMS Session object to EMS and in turn EMS sends its own back. CORBA Naming service is used for this purpose.

For the get set operations it may directly interact with the database or can interact with SNMP manager to get the data directly from system.
All the alarms from the system are given to EMS then EMS conveys it back to NMS using CORBA notification service.

SN	Procedure	Expected Result	Result	Remarks
1	**Northbound interface the EMS towards NMS layer**			
	Do the compliance testing for XML/ TMF814 CORBA.	System complied with XML interface towards NBI.	**-**	

Clause 1.1.11 Local Management Interface

SN	Procedure	Expected Result	Result	Remarks
1.	**Work station/Network Server**			
	Install the EMS on work station/Network server	Work station should work without any problem with manager	**-**	
2.	**Connection of PC server as a Local Craft Terminal**			
	View the PC server connection to the LCT	Connection of PC server as a Local Craft Terminal should be based on RS232/RS-485/USB	**-**	

Clause 1.1.12: User Interface:

SN	Procedure	Expected Result	Result	Remarks
1.	**User interface**			
	View user interfaces	The management system should be provided with user friendly interfaces based on Windows/UNIX icons & menus and mouse	**-**	
2.	**The EMS start up and shut down**			
	Start up EMS and shut it down	The EMS start up and shut down should be user friendly and will be provided with on line	**-**	

		help		
3.	**Geographical view of the managed network**			
	View the EMS manager chassis	EMS should provide an on-screen nested geographical view of the managed network in the management domain of the manufacturer	**-**	
4.	**Failure state of each link a**			
	Create any failure between two node in the management domain	EMS should depict the failure state of each link and node in displayed network	**-**	
5.	**Details of status of an individual managed NE**			
	View the managed element through the EMS	EMS should get details of status of an individual managed NE, such as equipment presence, setting, alarm status etc.	**-**	

Clause 1.2 (a): ONT/ONU requirements:
ONUs/ONTs shall perform the following tests/monitor to the battery to be reported through NMS and LCT

Clause 1.2.1: Battery / Power monitoring status:

Check for the status monitoring of power backup at LCT/EMS in case of ONU   Yes / No

Clause 1.2.2: Status reporting of ONU/ONT:

Status reporting of ONU/ONT at LCT/EMS

SN	Procedure	Expected Result	Result	Remarks
1	View the ONU/ONT through LCT/EMS	Status along with ID of ONU/ONT is displayed on LCT/EMS	**-**	
2	View the PON link through the LCT/EMS	PON port link status should be displayed on LCT/EMS	**-**	
3	View the UTP access port link status through	UTP access port link status should be displayed on LCT/EMS	**-**	
4	View Loop-back test status through the	Loop-back test status should be displayed on LCT/EMS		For ONU
5	View the Loop-back time-out status through the LCT/EMS	Loop-back time-out status should be displayed on LCT/EMS		For ONU
6	View the Power supply status through	Power supply status should be displayed on LCT/EMS		For ONU
7	View the Vendor code and vendor number in EEPROM through the LCT/EMS	LCT/EMS should display Vendor code and vendor number in EEPROM	**-**	
8	View the Model number through the LCT/EMS	LCT/EMS should display Model number of ONU/ONT.	**-**	

Clause 1.2.3: Other Status reporting of ONU/ONT:

SN	Procedure	Expected Result	Result	Remarks
1.	**Vendor Code and model number in EEPROM**			
	Vender code & model number is stored.	Vender code and model no. is stored in memory.	-	
2.	**Remote download firmware upgrade**			
	Download the remote firmware upgrade through the LCT/EMS	LCT/EMS should support the remote download firmware upgrade	-	
3.	**Auto negotiation or manual configuration of 10M/100Mbps and half duplex or full duplex**			
	Enable auto negotiation of 10M/100Mbps through the LCT/EMS	LCT/EMS should support the auto negotiation	-	
	Manually configure the 10M/100Mbps and half duplex or full duplex through the LCT/EMS	Configuration of 10M/100Mbps and half duplex or full duplex should take place	-	
4.	**UTP port MDI-MDIX auto détection**			
	Enable the MDI-MDIX auto detection through LCT/EMS	UPT port MDI-MDIX detection is provided while connecting any device.	-	
5.	**Maximum Frame supported**			
	Check what is the maximum size of packet supported	The maximum size of the packet forwarded supported is 1522 bytes.	-	

LED status Indication at ONT/ONU:

SN	Procedure	Expected Result	Result	Remarks
a.	**LED status of power**			
	View the LED status of power of ONU/ONT	Power LED status should be displayed to indicate on/off status.	-	
b.	**LED status of voice**			
	View LED status of voice ONU/ONT chassis.	voice LED should be displayed to indicate at least 1 call active on the ONT and prevent service interruption through the LCT/EMS	-	
c.	**LED to E1 service for B-ONT**			
	View LED to E1 ONU/ ONT chassis.	E1 service LED should be displayed	-	
d.	**LED status of operation**			
	View the LED status of operation on ONU/ONT chassis.	Operation LED should be displayed to indicate PON fiber link and OAM channel.	-	
e.	**LED status of voice/data NW**			
	View the LED status of voice/data NW on ONU/ONT chassis.	LED status of voice/data NW should be displayed to indicate voice/data NW is received.	-	
f.	**Test, indicates ONT is in loop back test status**			
	Indicates ONT is in loopback test status by one or a combination of	Loop back is received should be displayed.		For ONU only

	LEDs Perform loop back test and view ONU/ONT chassis			
g.	**UTP Connection. Indication of ONT access port link**			
	Make the physical link active between Mini-OLT and ONT.	Indication for access port at ONT is provided while connected to access device.	**-**	
h.	**Data Indicates ONT UTP access actively**			
	LED Indication for Data communication on ONT access port.	LED indication during data transmission is provided on the access port of ONT.	**-**	
i.	**Full Duplex mode indication at ONT.**			
	Check for Indication of full duplex data transmission mode at ONT.	Indication for full duplex data transmission mode is provided at ONT access port.	**-**	
j.	**Speed indication for 10/100/1000 Mbps data rate.**			
	Check the indication for different data rates.	Different indications for different data rates are provided.	**-**	

Clause 1.3: Mini-OLT Requirements:

SN	Procedure	Expected Result	Result	Remarks
1.	**One Craft Terminal at Mini-OLT**			
	Check for One Local Craft Terminal (LCT) is provided at Mini-OLT.	One Local Craft Terminal (LCT) is provided at Mini-OLT for user interaction with system.	**-**	
2.	**In-Band Management connection for EMS.**			
	Check for the in-band connection is provided at Mini-OLT for EMS access.	The in-band connection is provided at Mini-OLT for EMS access.	**-**	
3.	**Out-Band Management connection for EMS.**			
	Check for the out-band connection is provided at MINI-OLT for EMS access.	Check for the out-band connection is provided at MINI-OLT for EMS access.	**-**	
4.	**Support for Alarms output and control**			
	Critical alarm output			
	Create any critical alarm at Mini- OLT and view the critical alarm log through the LCT/EMS	LCT/EMS should support the critical alarm output	**-**	
	Major alarm output			
	Create any major alarm at Mini-OLT and view the major alarm log through the LCT/EMS	LCT/EMS should support the major alarm output	**-**	
	Minor alarm output			
	Create any minor alarm at Mini-OLT and view the minor alarm log through the LCT/EMS	LCT/EMS should support the minor alarm output	**-**	

5.	**Line Rate, Security, and Performance**			
	Check for data rate, security and performance at Mini-OLT.	Data rate, Security and system Performance are provided through EMS/LCT.	**-**	
6.	**Line rate**			
	View the line rate at Mini-OLT through the LCT/EMS	The PON system should support 2.488Gbps line rate downstream and 1.244Gbps line rate upstream	**-**	
7.	**AES (key size of 128 bit) support per port-id**			
	View AES key at Mini-OLT through the LCT/EMS	LCT/EMS should support AES key per port-id	**-**	
	Enable the AES key at Mini-OLT through the LCT/EMS	AES key should be enabled by the LCT/EMS	**-**	
8.	**FEC support**			
	View FEC at Mini-OLT through the LCT/EMS	LCT/EMS should support FEC enable/disable capability in both upstream and downstream	**-**	
	Enable or disable FEC at Mini-OLT through the LCT/EMS	FEC should be enabled or disabled by the LCT/EMS	**-**	
9.	**Power leveling**			
	Create any minor alarm at Mini-OLT	LCT/EMS should support the minor alarm output	**-**	
10.	**Network Diagnostics and Healthy check**			
	Check for the network diagnosis and system health check	The network diagnosis and system health check is available at EMS & LCT.	**-**	
11.	**Perform Logical Loopback test on ONT**			
	Check for the Logical loopback is provided at ONT for testing.	The Logical loopback is not provided at ONT for testing.		

ABBREVIATIONS

ACL	Access Control List
AES	Advanced Encryption Standard
ADSL2+	Asymmetric Digital Subscribers Line 2+
AIS	Alarm Indication Signal
APC	Angle Polished Connector
BITE	Built-In Test Equipment
BSNL	Bharat Sanchar Nigam Limited
CATV	Cable Television
CD	Compact Disc
CISPR	Special International Committee on Radio Interference
CO	Central Office
CORBA	Common Object Request Broker Architecture
CPU	Computer Processing Unit
DBA	Dynamic Bandwidth Allocation
DBRu	Dynamic Bandwidth Report - upstream
DHCP	Dynamic Host Control Protocol
DOS	Denial of Service
DSCP	Differential services code point
DSLAM	Digital Subs Line Access Multiplexer
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMC	Electro Magnetic Compatibility
EMS	Element Management System
FEC	Forward Error Correction
FTTB	Fibre To The Building
FTTC	Fibre To The Curb
FTTCab	Fibre To The Cabinet
FTTCell	Fiber To The Cell
FTTH	Fibre To The Home
FWS	Firewall Server
GEM	GPON Encapsulation Method
GPON	Gigabit capable Passive Optical Network
ICMP	Internet Control Message Protocol
IEEE	International Electronic and Electrical Engineering
IETF	Internet Engineering Task Force
IGMP	Internet Group Multicast protocol
IP	Internet Protocol
ISO	International Standard Organization
LCT	Local Craft Terminal
LED	Light Emitting Diode
LMI	Local Management Interface
LOS	Loss of Signal
MAC	Media Access Control
MDI	Media Dependent Interface
MDIX	Media Dependent Interface Crossover
MDU	Multi-Dwelling Unit
MTBF	Mean Time Between Failure
MTTR	Mean Time To Restore
MTU	Multi-Tenant Unit
NE	Network Element
NMS	Network Management System
NNI	Network Node Interface
OAN	Optical Access Network
ODN	Optical Distribution Network
OLT	Optical Line Terminal
Mini-OLT	Scale down version of OLT
OMCI	ONT Management and Control Interface
ONU	Optical Network Unit

ONT	Optical Network Termination
OSI	Open System Interconnection
P2P	Point to Point
PBX	Private Branch Exchange
PC	Personal Computer
PCM	Pulse Code Modulation
PMD	Physical Media Dependent
PON	Passive Optical Network
POP	Point of presence
POTS	Plain Old Telephone System
PRC	Primary Reference Clock
PVC	Permanent Virtual Circuit
QA	Quality Assurance
QM	Quality Manual
QoS	Quality of Service
RDBMS	Relational Database Management System
RISC	Reduced Instruction Set Computer
RO	Remote Office
ROM	Read Only Memory
RSTP	Rapid Spanning Tree Protocol
SDH	Synchronous Digital Hierarchy
SFP	Small Form Factor Pluggable Transceiver
SIP	Session Initiation Protocol
SNI	Service Node Interface
SNMP	Simple Network Management Protocol
SOAP	Simple Object Access Protocol
STB	Set Top Box
TC	Transmission Convergence
T-CONT	Traffic Containers
TCP	Transmission Control Protocol
TDM	Time Division Multiplexing
TDMoP	Time Division Multiplexing over Packet
TMN	Telecommunication Management Network
UNI	User Network Interface
USB	Universal serial Bus
VDSL	Very High-speed Digital Subscriber Line
VEIP	Virtual Ethernet Interface Protocol
VLAN	Virtual LAN
VoD	Video on Demand
VoIP	Voice over Internet Protocol
WiFi	Wireless Fidelity
XML	Extensible Markup Language

J. SUMMARY OF TEST RESULTS

GR/IR No._____

TSTP No._____

Equipment name & Model No._____

Clause No.	Compliance (Complied /Not Complied / Submitted/Not Submitted / Not Applicable)	Remarks / Test Report Annexure No.

[Add as per requirement]

Date:

Place: *Signature & Name of TEC testing Officer /*

*   * *Signature of Applicant / Authorized Signatory*

* Section J as given above is also to be submitted by the Applicant/ Authorised signatory as part of in-house test results along with Form-A. The Authorised signatory shall be the same as the one for Form 'A'.