PTC GPON TENDER SPECIFICATIONS

Contents

1 General Introduction

1.1 Introduction

PTC has a key objective to enhance the level of telecommunications services and solutions. GPON system is expected to offer a wide variety of services including the traditional narrowband, broadband, business and Mobile backhaul services, although the significant growth of bandwidth demands is forecasted. Optical systems among the new possibilities and the passive solutions, the PON networks, in optical infrastructure will play an increasing role for NGN.

The main target of this technical specification is to functionally define the requirements of the services for GPON network as FTTx configuration.

1.2 Scope of the specification

The specification covers the requirement of the following equipment and elements:

- GPON OLT
- GPON ONT/ONU
- Connectorized optical splitters for indoor and outdoor environment with the following splitting ratio: 1:2; 1:4; 1:8; 1:16 and 1:32
- Management system and principles for GPON system
- Quotation Requirements

Legend:

ONT: Optical Network Termination

ODN: Optical Distribution Network

OLT: Optical Line Termination

Optical Line Termination (OLT): OLT provides an interface to PDN network side (Optical Access Network) and sends the signal through one or more ODNs, which is distributed to a certain number of ONU´s Optical Line Terminal (OLT) is to deliver residential, Business and mobile backhaul services either through conventional GPON network via splitters or via P2P from active Ethernet card on GPON OLT

Optical Distribution Network (ODN): An Optical Distribution Network provides a transmission mean between OLT and users in both transmission directions. It uses passive optical components (optical fibers, cables, optical connectors, filters, splitters, attenuators and splices).

Optical Network Termination (ONU): Optical Network Unit provides the user side interface of the Optical Access Network and it is connected to ODN. All system's ONU/ONT receives the same signal and each one of them extracts the corresponding information according to an access protocol. In the reverse sense (downstream), data are transmitted according to an OLT control mechanism using TDMA (Time Division Multiple Access) protocol that allocates a transmission time to each ONU/ONT.

Optical Network Termination (ONT): Optical Network Terminal is an UN used for the FTTH (Fiber to the Home) architecture and includes user's port functions

1.3 Proposal Conditions

PTC reserves the right to break off the RFP process at any time and is under no circumstances committed to signing a contract with any of the recipients.

1.4 Proposal Contents

For adherence to standards, the bidder shall describe where the product is fully compliant to the standard or if **it is partially compliant, describe the limitations**. Also if the bidder's equipment has features not listed here but the bidder feels that they will

be valuable to the total network solution, the bidder should mention that in the appropriate category.

Include a full roadmap of the product indicating which features are finalized and which features are still under discussion. For new software releases, additional feature and functionalities must be mentioned. Also for new releases, any additional hardware upgrade requirement must be indicated. Software upgrades will be assumed to be Free of Cost otherwise stated clearly.

1.5 Complied Standards

The GPON solutions offered must comply, but not limited to the following International Standards.

1. ITU-T standards

   - ITU-T G.984.1: GPON General characteristics
   - ITU-T G.984.2: GPON Physical Media Dependent (PMD) layer specification
   - ITU-T G.984.3: GPON Transmission convergence layer spécifications
   - ITU-T G.984.4: GPON ONT management and control interface spécifications.
   - ITU-T G.652: Characteristics of a single-mode optical fiber and cable.
   - ITU-T G.703: Physical/electrical characteristics of hierarchical digital interface.
   - ITU-T G.704: Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 Kbit/s hierarchical levels.
   - ITU-T G.823: The control of jitter and wander within digital networks which are based on the 2048 Kbit/s hierarchy.
   - ITU-T G.983.4: A broadband optical access system with increased service capability using dynamic bandwidth assignment.

2. IEEE 802 standards :

   - The proposed equipments should support IEEE 802.1ad Provider Bridges
   - The proposed equipments should support IEEE 802.1D Spanning Tree Protocol
   - The proposed equipments should support IEEE 802.1p VLAN prioritization
   - The proposed equipments should support IEEE 802.1Q VLAN tagging

- The proposed equipments should support IEEE 802.1w Rapid Spanning Tree Protocol of at least 8 ports, based on port-based, address-based, and round robin
- The proposed equipments should support IEEE 802.3u 100 Mbps Fast Ethernet
- The proposed equipments should support IEEE 802.3ad Ethernet Link Aggregation
- The proposed equipments should support IEEE 802.3ae 10 Gigabit Ethernet
- The proposed equipments should support IEEE 802.3z Gigabit Ethernet
- The proposed equipments should support IEEE 802.3x Flow Control.
- IEEE 802.1ag Ethernet OAM.
- IEEE 802.3 10 Mbps Ethernet.

3. IETF standards:
   - The proposed equipments should support IETF RFC 2131: DHCP
   - The proposed equipments should support IETF RFC 2236: Internet Group Management Protocol, Version 2
   - The proposed equipments should support IETF RFC 3376: Internet Group Management Protocol, Version 3
   - The proposed equipments should support IETF RFC 3046: DHCP Relay Agent Info Option (Option 82).
   - IETF RFC 2132: DHCP Options and BOOTP bidder Extensions.
   - IETF RFC 2933: Internet Group Management Protocol Management Information Base.
   - IETF RFC 2698: Two Rate Three Color Marker.
4. The proposed equipments should support SIP and H.248 for Voice providing.
5. Any other standards inter-related with all the above Specifications and any other standards mentioned in other part of this RFP document.
6. The Bidder must ensure that the compliance to any standards specified above is kept up-to-date with the latest version available.

7. The version of hardware and software of the equipment should be provided.
8. The proposed equipment must use a highly flexible, modular, scalable, and non-blocking platform at all level/part of the design without any restriction.
9. The Bidder shall submit the detail chipset type, manufacturer, and version of the proposed Equipment including the ONT.

2 OLT System Specification

2.1 System Architecture

Chassis Characteristics

1. The size of the OLT shelf should fit in PTC standards.
2. Front-access & back-access cabinet shall be supported.
3. Type of power supplies (DC is mandatory) and power supply redundancy shall be supported.
4. The bidder shall give the information and level of compliance for the following questions:
   - Weight of the equipment (in kg) in case of empty and full configuration
   - Range of temperatures at which the equipment is guaranteed to function normally
   - Range of humidity at which the equipment is guaranteed to function normally
   - Number of fans shall be provided and fans redundancy shall be supported.
   - Heat dissipation for a fully loaded chassis
   - Conformity to international specifications for security, EMC, environment, etc

2.2 Technical Requirements

2.2.1 Transmission Requirements

1. The bit rates downstream (2488,32Mbit/s), upstream (1244,16Mbit/s) of optical interfaces of the offered GPON system must comply with the requirements of clause 8.2.3.1 – 8.2.3.2 of ITU-T G.984.2 (03/2003) Recommendations.

2. The architecture of the offered GPON system must be single fiber.
3. The logical reach of the offered GPON system shall be minimum 60km.
4. The offered GPON system must support minimum 1:64 split ratio.
5. The physical reach of the offered GPON system must be minimum 20km.
6. The **differential fiber distance** of the offered GPON system must be minimum 40km.
7. The offered GPON system must support downstream security: AES conformity to clause 12.2 of ITU-T Rec. G.984.3 (02/2004). GPON system should be able to switch the encryption on/off.
8. GPON system must be able to establish AES encryption per ONT/ONU basis.
9. GPON system should be 4/8 ports per board.

2.2.2 Physical layer

1. The type of the offered GPON system must support 32 dB link budget according to ITU-T Rec. G.984.2 Amendment 2. (03/2008).
2. System must support GPON Class C+ optical budget.

2.2.3 Downstream direction: OLT transmitter

1. Operating wavelength range: 1480 to 1500nm
2. Line code: Scrambled NRZ
3. Mask of the transmitter eye diagram: Figure 2/G.984.2
4. Minimum ORL of ODN at Olu and Old more than 32dB
5. Main launched power: min. +3dBm
6. Main launched power: max. +7dBm
7. Extinction ratio: min. 10dB
8. Spectral characteristic:
   - -20 dB width (SLM laser): max. 1nm

- Side mode suppression ratio (SLM laser): min. 30dB

2.2.4 Upstream direction: OLT Receiver

1. Maximum reflectance of equipment, measured at receiver wavelength less than - 20dB
2. Minimum sensitivity: -29dBm (Bit error ratio <1x10-10)
3. Minimum overload: -8dBm (Bit error ratio <1x10-10)
4. Consecutive identical digit immunity: > 72bit
5. Tolerance to the reflected optical power less than 10dB

2.2.5 Uplink interface

2.2.5.1 Optical Gigabit Ethernet

1. The offered GPON system must support 1000Base-LX (Long Wavelength Laser) and 1000Base-SX (Short Wavelength Laser) optical uplink interfaces corresponding to the provisions of Chapter 38 of the Standards IEEE 802.3 2005.
2. The GbE interface must be interchangeable SFP module.
3. The uplink card support mixed plug, uplink card should support 10G and 1G ports.
4. The proposed equipment shall support cascading.
5. The proposed equipment shall support ring topology with other networks equipment.
6. The uplink interface shall support link aggregation and the mode as below can be configurable.
7. Load balancing, Active and standby
8. The proposed equipment shall support residential, business and mobile backhaul.
9. For mobile backhaul access, the proposed equipment shall support uplink card which can support 1588V2.

- The bidder **shall give the information for the following questions:**
  - What are the OLT layer-2 specifications?
  - How many GE uplink interfaces which could be supported per chassis?

2.2.5.2 10 GbE

1. The offered GPON system must support 10GBase-LR (1310nm, LAN PHY) optical uplink interface. The parameters of the 10 GbE interfaces of the offered equipment shall comply with the parameters corresponding to the provisions of Chapter 52 of the Standards IEEE 802.3 2005.
2. The 10 GbE optical interface must be replaceable XFP.
3. The offered GPON system must support 10GBase-LR optical uplink interface.
4. The offered GPON system must support 10GBase-ER optical uplink interface.
5. The offered GPON system must support 10GBase-ZR optical uplink interface.

2.2.5.3 E1

The offered GPON system must support E1 Standards ITU-T G.703

2.2.5.4 STM-1/STM/4

The offered GPON system must support STM-1/STM-4 Standards ITU-T G.707

2.2.6 Optical Fiber Protection Switchover Requirements

The GPON system must adopt the optical fiber protection switchover mechanism to improve the network reliability and viability. The optical fiber protection switchover must be implemented in the following two modes:

1. Automatic switchover: It is triggered by faults, including:

5. The offered GPON system shall support FEC functionalities conformity to clause 13 of ITU-T Rec.G.984.3 (02/2004).

6. The activation procedure in the ONT/ONU must comply with clause 10.2 of ITU-T Rec.G.984.3 (02/2004).

2.2.8 OLT - ONT/ONU interoperability

1. PTC intends to open the optical interface in order to achieve interoperability between OLT and ONT of different vendors. To ensure the required interoperability between multiple OLT and/or ONT the bidder must commit to open the GPON interface (incl. OMCI) and to share this information with other selected vendors.

2. The bidder must provide information of already tested interoperability between GPON systems of the vendors invited to this RFP.

2.2.9 Ethernet OAM

Describe any activities in any of the standards bodies in enhancing Ethernet OAM to make it carrier grade. These may include:

1. Fault isolation capabilities similar to SDH and ATM (using AIS and RDI like functions).

2. Performance measurement capabilities such as delay, loss, jitter across VLANs. These may also include measurements used in SDH such as ES, SES etc.

3. Describe any activities in standards bodies in enhancing Ethernet restoration capabilities.

4. Include any contributions made to the following forums (regarding OAM and restoration):

   - Metro Ethernet Forum.
   - Resilient Packet Ring.
   - ITU-948.1,2,3,4

5. ONT Ethernet port monitoring

6. Packet drop statistic support for all range of packet sizes

7. Uplink BW utilization statistics support.

8. Display PON, ONT optical power.
9. Configurable transmit gain, receive gain and Fax mode parameters through OMCI.
10. Performance monitoring features should support uplink cards, Ethernet uplink cards and active Ethernet line cards.
11. Should show total dropped events.
12. Should show total dropped frames.
13. Should show total octets.
14. Should show total packets.
15. Should show total broadcast frames.
16. Should show total multicast frames.
17. Should show total CRC alignment errors.
18. Should show total undersized packets.
19. Should show total fragments.
20. Should show total jabbers.
21. Should show total collision.
22. Should show total multicast bridged packets.
23. Should show total multicast routed packets.
24. Should show total packet size in any selected range from 64 bytes to 9216 bytes.

2.3 OLT Service Specific Requirements

2.3.1 User Side Requirements of OLT

2.3.1.1 GPON Layer

1. GEM Port IDs must be assigned automatically (default) and manually by the OLT.

2. A GEM Port must identify one or more traffic flows of a specific class of service going to a specific U interface on a specific ONT/ONU.

3. Support service flow and GEM PORT mapping

2.3.1.2 Traffic management and QoS

1. The GPON OLT must be able to prioritize traffic based on service VLAN in the downstream direction.

2. The GPON OLT must provide traffic shaping on per service basis in downstream direction.

3. The GPON OLT must be able to prioritize traffic based on service VLAN forwarding to the uplink interface.

4. The GPON OLT must support at least 4 queues per interface (including GPON ports and Ethernet uplink interfaces), one per traffic class.

5. The GPON OLT must support at least 4 traffic classes for Ethernet frames, and shall support configurable mapping to these classes from the 8 possible values of the Ethernet priority field.

6. The GPON OLT must support strict priority queuing& weighted fair queuing.

7. The GPON system must support traffic shaping in both directions

8. The bidder should provide information about traffic limit; minimum rate limit step, available rate limit values, is limitation on L2 or L3 packets

9. The GPON OLT must support Hierarchical QoS.

2.3.2 Network side requirements of OLT

2.3.2.1 Functionality

1. The Ethernet interfaces must conform to IEEE 802.1q VLAN trunking standard.

2. The Ethernet interfaces should provide double-tagged VLAN capabilities conform to IEEE 802.1ad standard.

3. The Ethernet interfaces must conform to IEEE 802.1p standard.

4. GPON OLT must support defining of 802.1p priority at VLAN level.
5. If the equipment has more than one Ethernet uplink interface, the interfaces must support link aggregation according to IEEE 802.3 ad standard.
6. The Ethernet interface must support oversized Ethernet frames at least 1526 byte.

2.3.2.2 VLAN Considerations

1. GPON OLT must support mapping of user VLANs of a given GPON port to different service VLANs.
2. Corresponding to the guidelines of DSL Forum TR-101, GPON OLT must support simultaneously the following mappings of User VLANs and Service VLANs:
   - Mapping multiple User VLANs (of same or different GPON ports) to a single Service VLAN,
   - Mapping multiple (m) User VLANs (of same or different GPON ports) to multiple (n) Service VLANs, where m=n and n=1.
3. The GPON OLT must be able to translate the VLAN tag received from customer to the Service VLAN tag in the upstream direction.
4. The GPON OLT must be able to translate the Service VLAN tag to User VLAN tag in the downstream direction.
5. The GPON OLT must support untagged frames received from the customer and must be able to add the Service VLAN tag in the upstream direction.
6. The GPON OLT must be able to detach the Service VLAN tag and forward untagged frames in downstream direction in case of single tagged frame.
7. The GPON OLT must be able to accept both tagged and untagged frames from the customer and must attach the service VLAN tag to the frames.
8. The GPON OLT should support selective QinQ (double stacking) encapsulation Ethernet frames received from the customer should be dropped, forwarded without change of the VLAN field, forwarded with QinQ encapsulation or forwarded with translated VLAN field based on configuration.

9. The GPON OLT must conform to N:1 VLAN forwarding defined in TR-101 of DSL Forum.

2.3.2.3 Multicast Considerations

1. IGMPv2 operation must be in conformance to RFC2236.
2. IGMPv3 operation should be in conformance to RFC3376.
3. GPON OLT must support IGMP snooping function.
4. GPON OLT must support IGMP proxy function.
5. GPON OLT should support configurable filtering of IGMP Membership Report messages.
6. The GPON OLT must support dropping of all IGMP messages received on a subscriber port.
7. The GPON OLT must support an IGMP v2 (IGMP v3) transparent snooping function. This feature shall be configurable on a per VLAN basis.
8. The GPON OLT must support IGMP immediate leave (Fast Leave) as part of the IGMP function.
9. The GPON OLT must support IGMP join delay below 1ms.
10. The GPON OLT should be able to configure per GPON port the maximum number of simultaneous multicast channels allowed.
11. GPON OLT must support the Globally Scoped Multicast Addresses (224.0.1.0 – 238.255.255.255).
12. GPON OLT must support the Limited Scoped Multicast Addresses (239.0.0.0/8).
13. The GPON OLT must support a mechanism to prevent a user port from becoming a multicast router port by blocking IGMP query messages.
14. The GPON OLT must support mechanisms to stop user ports injecting unauthorized multicast traffic into the aggregation network.
15. The GPON OLT must be able to rate limit the number of IGMP messages per user port.

16. Multicast packets transported between RG (Routing Gateway) and GPON OLT are using IPoE encapsulation.

17. The desired goal is to support multicast optimization by controlling the flooding of Ethernet multicast frames making use of IGMP agents in intermediate (L2) devices (e.g. GPON OLT, Ethernet aggregation).

18. N:1 VLANs forwarding mode should be used in order allow efficient forwarding of multicast traffic. (It is to be noted that other types of traffic (data, voice, unicast video) could be delivered via N:1 VLANs as well.)

19. Dedicated Multicast VLAN model should be supported. (This is a model where a dedicated N:1 VLAN is used to send some multicast groups from a multicast router / BNG to one or several access nodes (GPON OLT), over an aggregation network. Other traffic is sent across different VLANs, where these VLANs could be 1:1 or N:1.)

20. Integrated Multicast VLAN model should be supported. (This is a model where multicast traffic is inserted into one of the N:1 VLANs that are terminated at a subscriber GPON port, or alternatively dot1q trunked to the RG. This effectively means multicast and unicast share a VLAN.)

2.3.2.4 Access Methods

1. GPON OLT must support PPPoE connection methods.

2. GPON OLT must support DHCP connection methods.

3. GPON OLT must support filtering options in order to prevent L2 traffic between customers connected to the same GPON OLT considering PPPoE and DHCP environment (Intra-GPON filtering).

4. GPON OLT should support filtering options in order to prevent L2 traffic between customers connected to different GPON OLTs considering PPPoE and DHCP environment (Inter-GPON filtering) considering N:1 VLAN forwarding.

5. Intra-GPON and Inter-GPON filters of the GPON OLT must be capable to be disabled partly or entirely on VLAN basis.

6. The OLT shall support ONU MAC address authentication based on PON port and ONU logic identification authentication and their hybrid mode. The ONU logic identification mode is the best choice. To authenticate the ONU legality, the OLT shall refuse the illegal ONU access. It shall support to

enable and disable the function, and reduce the bad effect caused by ONU's continual authentication trial. In consideration of construction convenience, the ONU should have a certain chances of authentication trial.

2.3.2.5 Additional Functional Requirements

1. GPON OLT must support configurable Ether type filter for upstream direction.
2. GPON OLT should support configurable Destination MAC (single address or a range) filter in upstream direction.
3. GPON OLT should support configurable Source MAC (single address or a range) filter in upstream direction.
4. GPON OLT must support configurable Broadcast (blocking/enabling) filter for downstream direction.
5. GPON OLT must support configurable Multicast (enabling, disabling, prefix specific enabling) filter for upstream direction.
6. GPON OLT must be able to store at least K*8 MAC addresses, where "K=Maximum number of GPON-ports multiplied by the maximum splitting ration supported by GPON ports".
7. In order to prevent source MAC flooding attacks the GPON OLT must be able to limit the number of source MAC addresses learned from a user VLAN
8. MAC addresses learning on the Network Side Ethernet interface should be configurable per Service VLAN (enable/disable) if implemented
9. GPON OLT must support Virtual MAC address and MAT (MAC Address Translation) for both PPPoE and DHCP connection methods. If this feature is currently not implemented it must be developed within 6 months.
10. Virtual MAC address and MAT must be configurable (enable/disable) at least per Service VLAN.
11. GPON OLT must support L2 marking (802.1p) of the traffic coming from the User VLANs.
12. Binding management traffic to a dedicated VLAN must be provided.

2.3.3 IPv6

1. The OLT shall support an IPv6.

2.3.4 VoIP

When the GPON system adopts VoIP mode to bear the voice service, it shall meet the following requirements:

1. Basic Performance Indices
    1. Voice encoding dynamic switchover time < 60 ms
    2. 80 ms cache storage capacity to prevent voice discontinuity and jitter.
2. Voice Objective Evaluation
    1. In a good network condition, PSQM average value < 1.5
    2. In a poor network condition (packet loss ratio = 1%, network jitter = 20 ms, delay = 100 ms), PSQM average value<1.8
    3. In an extremely bad network condition (packet loss rate = 5%, network jitter = 60 ms, delay = 400 ms), PSQM average value< 2.0
3. Voice Subjective Evaluation
    1. In a good network condition, MOS > 4.0
    2. In a poor network condition (packet loss ratio = 1%, network jitter = 20 ms, delay = 100 ms), MOS>3.5
    3. In an extremely bad network condition (packet loss rate = 5%, network jitter = 60 ms, delay = 400 ms), MOS >3.0
4. Encoding Rate
    1. G.711, encoding rate=64 kbit/s
    2. G.729a, encoding rate< 18 kbit/s
    3. G.723.1 encoding rate is G.723.1 (5.3) <18 kbit/s, G.723.1 (6.3) <15 kbit/s.
5. Delay Indices (Loop Delay)
6. The VoIP delay includes decoding and encoding delay, receiving end input cache delay, and the internal queue delay, etc:

G.729a encoding, the loop delay < 150 ms

G.723.1 encoding, the loop delay < 200 ms

2.3.5 Security

1. Please describe PON security features. Both logical and physical security should be addressed.
2. The proposed Equipment must be equipped with the security features to prevent malicious DOS attack to the network and to other users.
3. The proposed Equipment must support broadcast suppression per VLAN.
4. L2 and L3 ACL should be supported on your OLT
5. Support MAC and IP Address Anti Spoofing
6. Support MAC and IP Address binding
7. Support Anti ICMP/IP Attacking
8. The proposed Equipment should support the IP address filtering function. Details explanation shall be given on how the user traffic is permitted and denied based on source and/or destination IP addresses.
9. The proposed Equipment must support the following, but not limited to:
    - IP anti-spoofing
    - DHCP snooping
11. Support IEEE based dynamic port security – IEEE 802.1x
12. Anti DOS-Attacking
13. The proposed Equipment must support the Ethernet MAC address filtering function.

3 GPON equipment-ONT part

3.1 General requirements

Specify if the ONT/ONU is fully Comply with ITU-T G.984.1~G.984.4

The bidder offer ONT must support the massive ONT upgrade.

3.2 Business ONT Support Features

1. Offered ONT shall support ONT (4 X 10/100/1000 Mbps), 1GE uplink.
2. Offered Business ONT shall support the following:-
    1. Transparent transmission of OSPF/BGP/RIP and known-unknown Multicast.
    2. 802.1q VLAN tagging
    3. 802.1ad VLAN stacking QinQ
    4. 802.1p, QoS/CoS for traffic prioritization
    5. VLAN Trunking (VTP)
    6. Multiple VLAN per FE port
    7. Maximum number of VLAN can be created on each FE port to be mentioned, ideally range would 0-4095
    8. 802.1ag Ethernet OAM
    9. Virtual Private LAN service (VPLS)
    10. Virtual Private Routed Network (VPRN)
    11. IGMP Proxy & Snooping (specify version)
    12. PPPoE Client
    13. MAC security filtering
    14. MAC forced forwarding
    15. IP security filtering
    16. IP MAC binding
    17. Anti ARP spoofing
    18. 802.1 x port based security

19. Full scale VLAN translation.
20. VLAN ID range should be as per standard 0-4095
21. PWE3 Pseudo wire emulation, detailed description is required from vendor to explain PWE3 support mechanism and type IP, MPLS etc.
22. SSH, SSL, SFTP, HTTPS
23. IPv4/IPv6 support
24. GPON Type C Protection (Optional)
25. GPON Type B Protection with dual parenting
26. GE Port throughput to be describer by vendor for all packet sizes from 64 Bytes to 1518 bytes

3.3 ONT for Mobile Backhaul Support Features

1. Wall Mount /Rack Mount Outdoor ONT (4 X10/100/1000Mbps + 4 E1, to be used for mobile backhaul
2. Offered equipment shall be installed indoor and outdoor and must meet IP65 for outdoor and IP56 for indoor environment. Vendor can propose one ONT that can serve both purposes and support modular AC & DC Power inputs.
3. Offered Mobile Backhaul ONT shall support the following:
    1. Transparent transmission of OSPF/BGP/RIP and known-unknown Multicast.
    2. 802.1q VLAN tagging
    3. 802.1ad VLAN stacking QinQ
    4. 802.1p, QoS/CoS for traffic prioritization
    5. VLAN Trunking (VTP)
    6. Multiple VLAN per FE port
    7. Maximum number of VLAN can be created on each FE port to be mentioned, ideally range would 0-4095
    8. 802.1ag Ethernet OAM
    9. Virtual Private LAN service (VPLS)
    10. Virtual Private Routed Network (VPRN)

11. IGMP Proxy & Snooping (specify version)
12. SIP support
13. PPPoE Client
14. Subscriber Pulse metering (SPM) 12/16 KHz
15. Transparent support of SPM over Ethernet
16. DHCO option 82
17. MAC security filtering
18. MAC forced forwarding
19. IP security filtering
20. IP MAC binding
21. Anti ARP spoofing
22. 802.1 x port based security
23. Full scale VLAN translation.
24. VLAN ID range should be as per standard 0-4095
25. Framed E 1
26. Un Framed E1
27. Fractional E1
28. CES
29. PWE3 Pseudo wire emulation, detailed description is required from vendor to explain PWE3 support mechanism and type IP, MPLS etc.
30. 1588V2 support
31. ONT should have a local oscillator to lock on the incoming clock and distribute the same to the connecting devices.
32. SSH, SSL, SFTP, HTTPS
33. IPv4/IPv6 support
34. GPON Type C Protection (Optional)

35. GPON Type B Protection with dual parenting

36. GE Port throughput to be describer by vendor for all packet sizes from 64 Bytes to 1518 bytes

37. PPPoE IA support.

38. MGCP /H.248/SIP

4 Network Management system:

1. Bidder shall provide detailed information on the Element and Network Management Systems network management systems used to provision and manage the offered equipment.

2. Bidder shall explain what hardware is required to run the management software. Also explain the impact on hardware as the size of the network increases.

3. Bidder shall explain the high-level software architecture of the management software.

4. Bidder shall explain any licensing procedure needed. What license(s) will be required per network element and what licenses will be required for the different elements of the Management System.

5. The management system shall be able to self discover the network including the network elements.

6. The management system shall be able to support SLA/SLM features across the offered equipment OLT, ONT & NMS.

7. The management system shall provide access using remote clients that use HTTP.

8. The functionalities of the offered NMS and EMS system shall cover these management layers:

    - Network Element Management Layer: This shall manage the Network Elements such as their configuration, alarms or performance.

    - Network Management Layer: This shall manage end-to-end network connectivity, network level protection, network level paths and performance and other network level issues.

9. Network Management System should be capable of supporting redundant server either in active standby or load sharing.

10. Network Management System should be capable of supporting real time data duplication/synchronization at two servers.

11. Network Management System should be capable of upgrading bulk ONTs/OLTs or performing bulk tasks.

12. All the profiles referred by OLT/ONT shall be configured in NMS globally and to be automatically download to OLT/ONT on demands.

13. The offered solution shall support the sufficient mechanism for logging in different logging levels, such as Management system level, element level and user level. The offered solution shall have the capability to store the logs for at least One year without degrading the performance of the management system.

14. The offered management solution shall provide full inventory tools for the offered services/devices (OLT&ONT)/ports/hardware/software in global/map/NE based and can be outputted in various file formats such as CSV, TXT, DOC, HTML, XML. ONT status (online/offline) and PON Port Status must be available in the inventory tools.

15. The offered management solution shall support automatically upgrade the NMS client SW.

16. The offered management solution with associated OLT/ONT features shall provide full Environment Management.

17. The alarm reporting shall be configurable for individual ONT or base on the ONT type.

18. The offered management solution shall implement the full backup of OS level, DB level and Application level.

19. The offered NMS shall provide the facility to perform both manual and automatic backup of its database and applications. The backup file shall be verified by the NMS system automatically and shall be retransmitted if the backup file is not valid. And the backup shall be restored in case of crash.

20. The offered NMS shall provide the facility to perform the health check for the usage of Disk Partition, usage of CPU/Memory and usage of Database.

21. The offered management solution shall support the batch creation of different users in the provided OLT with different privileges/roles (e.g. read-only, operator, admin roles) remotely without logging into the device.

22. The offered management solution shall support to generate the network topology automatically based on the 802.1ab.

23. The offered solution shall fulfill the performance and statistics management requirements such as device/port/VLAN level statistics for both OLT and ONT.

24. The offered management solution shall fulfill the fault management requirements such as service alarm reporting/alarm corresponding/alarm filtering (masking)/alarm forwarding/trap forwarding.

25. The offered management solution shall fulfill the log management requirements.

26. The offered management solution with associated OLT/ONT features shall be able to provide the service configuration, service trouble shooting and service simulation testing for all types of services to fulfill the service management requirements.

27. The offered management solution with associated OLT features shall be able to manage the OLT in Rack/Frame/Board/Port level to fulfil the OAM activity requirements which shall include but not limited to Software Management, Data Management, Resource Management, Synchronization Management, OoS Management and Security Management.

28. The offered management solution with associated OLT/ONT features shall be able to manage the ONT to fulfil the ONT OAM activity requirements which shall include but not limited to ONT GPON Port Management, Software Management, Operation Management, DBA Management, GEM port Management and Ports(Ethernet/E1/POTS) Management and UNI (PPPoE/DHCP/Firewall/WiFi) Management.

29. The offered management solution shall provide the solution to search ONT by its SN/Alias/Type/Firmware version.

30. The offered solution shall provide the mechanism to prevent the duplication of ONT SN and ONT IP address.

31. The offered solution shall be able to check the connectivity between the NMS and OLTs to address the connectivity issue.

32. The offered solution shall be able to monitor the ONT status in bulk (OLT level and NMS level) including SR/NSR status, ONT online/offline status, ONT administration Status, ONT type, ONT Software version, ONT running time.

33. The status of devices (OLT/ONT)/Board/Ports and the configuration shall be updated immediately without manual intervention.

34. Bidder shall specify the maximum number of OLT shall be upgraded simultaneously.

35. Bidder shall specify the maximum number of OLT/ONT can be managed with proposed solution.

36. The offered solution must implement the necessary mechanisms to guarantee the synchronization between OLT and NMS, no manual interventions shall be requested.

37. The offer system shall support allocation of management authorities on the basis of user groups, privileges and users.

38. System updates and patches should be free of charge.

39. The proposed management system shall be based on the latest technology and ready for future development.

40. The proposed system shall provide alert message before executing the high level commands.

41. The proposed system shall run on either UNIX server or Windows server.

42. The proposed system should be open API.

5 Environment and Working Requirements

5.1 Environmental

5.1.1 Temperature, humidity and altitude

1. Must support operating temperature of 0 – 70° C inside the closed enclosure with outside ambient temperature reaching a maximum of 55° C for outdoor cabinets.
2. Must support an operating temperature of 45° C for indoor cabinets.
3. Must support storage temperature of 0 - 85° C.
4. Must operate at 95% relative-humidity which is non-condensing.
5. Must operate at altitude of up to 4000 ft.
6. Must support ETS - 300 019-2-x.
7. Must support ISTA Transportation and Handling.

5.1.2 DC Power

1. Must have dual DC power feeds.
2. Must operate on -48v DC.
3. Dissipated power (as heat) shall be specified by the Bidder.
4. The bidder shall describe the maximum overall power consumption of the equipment in full configuration for shelf and cabinet.
5. All power cables should be properly arranged and protected with spiral and Mains cable should be with PVC trunk.

5.1.3 Safety

Must support the following safety standards:

1. UL60950.
2. CSA 950.
3. EN 60950.
4. IEC 950.

5.1.4 Electromagnetic radiation

Must support the following standard for emitted electromagnetic radiation:

1. EN 55022A.

5.1.5 Electromagnetic radiation Immunity

Must support the following standard for immunity from electromagnetic radiation:

1. EN 55024.
2. EN 55082-1.

5.2 Reliability and Availability Requirements

5.2.1 Maintainability

1. GPON OLT and ONT equipment shall operate 24 hours a day, and every day of the year. GPON OLT equipment shall be designed to meet an operational lifetime over 10 years with normal parts replacement.
2. The bidder is obliged to ensure spare parts for offered platform for at least 10 year period

5.2.2 Availability

Availability of the GPON OLT and ONU equipment shall be annually 99.99% for all nodes

5.2.3 Reliability

The bidder shall give the information for questions:

1. What is the MTBF of the GPON equipment used in the system?
2. What is the minimum MTBF for GPON equipment without PON cards?
3. What is the GPON PON cards MTBF?
4. What is the minimum ONT/ONU MTBF?
5. What is the methodology used to calculate the MTBF?
6. What is the MTTR of OLT?
7. The bidder must show evidence to demonstrate that the predicted availability/reliability of the proposed equipment is better than 99.999%.
8. The bidder must state the maximum environmental operating temperature of the fully equipped OLT in order to provide an availability/reliability of better than 99.999%.

5.3 Installation Conditions

The bidder shall provide a complete plan for installation and configuration supported with technical details and diagrams including OLT, ODN (from COs to end user), ONT, etc.

The bidder shall be responsible for Installation, commissioning, provisioning of two sites.

5.3.1 General requirement

1. Installation, operation and maintenance shall not require the use of special, non-standard tools.
2. All necessary materials for the installation shall be provided within the ONT, ONU, OLT Kits and ODN.
3. The ODF is assumed as FC/PC type for quotation purpose
4. The actual values of installation materials will be determine on site-survey for each OLT site.
5. The proposed connectorized optical splitters (splitting ratio: 1:2; 1:4; 1:8; 1:16 and 1:32) for indoor locations shall be fitted in PTC standard racks.
6. The connectorized optical splitters installation must assure the eyes protection and easy cabling.

7. Each connectorized optical splitters shall have clear identification marks

8. The outer cover of the offered unit(s) shall be resisting to mechanical damaging impacts that may occur during implementation/installation and operation.

9. The outer cover of the offered units should meet the requirements of Flammability Class V.1 according to Standard EN 60950-1, 2.0 Ed..

6 Training

1. The bidder shall offer three outside training courses (2 sessions) to be conducted at the bidder Academy with 10 trainees (5 trainees per session). The training shall cover the operation and maintenance, of all aspects of the offered equipment and their associated Network Management System.

2. Bidder shall submit detailed syllabus and duration of the training courses.

3. The instructors shall be conversant with both systems and equipment design concepts and be able to communicate in the English language.

4. The contract shall not be considered complete for the purpose of acceptance until such training requirements as are called for have been provided.

5. The bidder shall make all arrangements for traveling and living expenses for the trainees.

7 Acronyms

Acronym	Expansions
CP	Communications Provider
DoS	Denial of Service (hacker attack)
EMS	Element Management System
FSAN	Full Service Access Network
FTTB	Fiber To The Building typically basement or communications room.
FTTC	Fiber to the Cabinet , also known as Fiber to the Curb, Fiber to the Node.
FTTH	Fiber To The Home
GA	General Availability
GEA	Generic Ethernet Access
GEPON	Gigabit Ethernet Passive Optical Network [IEEE/ITU-T]

Acronym	Expansions
GPON	Gigabit Passive Optical Network [FSAN/ITU-T]
IEEE	Institute of Electronic and Electrical Engineers [USA]
ISP	Internet Service Provider
ITU-T	International Telecommunication Union - Telecommunications Standardization Sector
MDU	Multiple Dwelling Unit
MSAN	Multi-Service Access Node
OF	Optical Fiber
OLT	Optical Line Termination
ONT	Optical Network Termination
OOB	Out of Band
OSS	Operational Support System
PON	Passive Optical Network
POTS	Plain Old Telephony Service (Analogue Telephony)
SIP	Session Initiation Protocol
SME	Small Medium Enterprise
SoR	Statement Of Requirements
T&D	Test and Diagnostics
TDM	Time Division Multiplexing
TSR	Telecommunications Strategic Review
USO	Universal Service Obligation
VLAN	Virtual Local Area Network
WDM	Wavelength Division Multiplexing
MTBF	Main Time Between Failures
MTTR	Main Time To Repair
API	Application Programming Integration

8 Bill of Quantity

	ITEM	Qty
	OLT:	
Bo1	Chassis	10
Bo2	Control cards/ Chassis	2
Bo3	GE uplink cards/ Chassis	2

Bo4	GPON port/ Chassis	16
	Passive Splitter:	
Bo5	1:2	20
Bo6	1:4	20
Bo7	1:8	20
Bo8	1:16	20
Bo9	1:32	20
	ONT:	
Bo10	ONT for business	100
Bo11	ONT for mobile backhauling	10
	Accessories:	
Bo12	All needed accessories, such as SFP's, Patch cords, ..etc, must be included	
	Management system:	
Bo13	Servers	1
Bo14	Clients	2