



## TECHNICAL SPECIFICATION

### MINI PASSIVE OPTICAL NETWORK (MINI PON) EQUIPMENT

Equipment Name : MINI PASSIVE OPTICAL NETWORK (MINI PON) EQUIPMENT

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## Glossary and Abbreviations

AN	Access Network
ANSI	American National Standards Institute
ADSL	Asynchronous Digital Subscriber Line
ARP	Address Resolution Protocol
BER	Bit Error Ratio
BTS	Base Transceiver Station
CE	Conformite European
CES	Circuit Emulation Service
CISPR	International Special Committee on Radio Interference
CLI	Command Line Interface
CSA	Canadian Standard Association
DBA	Dynamic Bandwidth Allocation
DHCP	Dynamic Host Configuration Protocol
EAPS	Ethernet Automatic Protection Switching
EIRP	Effective Isotropic Radiated Power
EN	European Union
ETSI	European Telecommunication Standardization Institute
FCC	Federal Communication Commission
FTTB	Fiber to the Building
FTTC	Fiber to the Curb
FTTH	Fiber to the Home
FTTN	Fiber to the Node
FTTx	Fiber to the x
Gbps	Gigabit per second
GEM	GPON Encapsulation Method
GPON	Gigabit Passive Optical Network
GUI	Graphical User Interface
ID	Identifier
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
ITU-T	International Telecommunication Union – Telecommunication Sector
MSTP	Multiple Spanning Tree Protocol
NBTC	Office of the National Broadcasting and Telecommunication commission

NMS Network Management System  
OAM Operations, Administration, and Maintenance  
ODF Optical Distribution Frame  
ODN Optical Distribution Network  
OLT Optical Line Terminal  
ONT Optical Network Terminal  
ONU Optical Network Unit  
OMCI ONT Management and Control Interface  
PLOAM Physical Layer Operations, Administration and Maintenance  
PON Passive Optical Network  
POTS Public Old Telephone Service  
PPPoE Point-to-Point Protocol over Ethernet  
RFCs Requests for Comments  
RSTP Rapid Spanning Tree Protocol  
SNMP Simple Network Management Protocol  
STP Bridging and Spanning Tree Protocol  
T-CONT Transmission Container  
TMN Telecommunications Network Management  
UL Underwriter Laboratory  
VDSL Very High Bit Rate Digital Subscriber Line  
VoD Video on Demand  
VoIP Voice over IP  
VPN Virtual Private Network  
WLAN Wireless Local Area Network  
xDSL x Digital Subscriber Line (of any type)

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## MINI PASSIVE OPTICAL NETWORK (MINI PON) EQUIPMENT

### 1 Introduction

- .1.1 This document is the technical specification for the “Mini Passive Optical Network” equipment or “Mini PON” equipment which will be utilized within the telecommunication network of TOT Public Company Limited (TOT). This technical specification focuses on technical aspects of the “Optical Distribution Network (ODN)” and “Access Network (AN)”. The complete set of the purchasing document shall be composed of both the technical specification document and the technical requirement document.
- .1.2 This technical specification relies on the Gigabit Passive Optical Network (GPON) technologies. Therefore, the proposed Mini PON equipment shall be based on GPON technology.
- .1.3 The GPON architecture shall support at least the following services.
  - .1.3.1 Voice over IP (VoIP)
  - .1.3.2 High Speed Internet
  - .1.3.3 Video on Demand (VoD)
  - .1.3.4 IPTV via Multicast
  - .1.3.5 Interactive Multimedia Service such as Interactive Games
  - .1.3.6 Data Transmission (Layer 2 VPN, CES, BTS Backhaul)
  - .1.3.7 RF video overlay (for possible future use)
- .1.4 TOT shall specify the following items or features in the technical requirement document or other TOT’s concerning document.
  - .1.4.1 Number of subscribers
  - .1.4.2 Bandwidth per subscriber
  - .1.4.3 Type of uplink interface
  - .1.4.4 Type of service
  - .1.4.5 Type of ONT/ONU
  - .1.4.6 Optical transmission distance
  - .1.4.7 Type of the optical connector

### 2 General Requirement

- .2.1 The equipment shall be modernized design, full field-proven capability with high-demonstrated reliability.
- .2.2 Comprehensive details such as lists of users in history records, quantity of equipment supplied and letters from users including the extent of experience gained with the system are considered as integral part of this specification. Therefore, those documents shall be fully and inevitably submitted to TOT.

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- .2.3 The equipment shall be designed to fulfill the purpose and fully comply with the latest relevant, but not limited to ITU-T recommendations or other international standards specifies e.g. IEEE, ETSI, ANSI, UL, and IEC.
  - .2.4 The bidder shall state all of the documents to certify that:
    - .2.4.1 The proposed OLT and ONT/ONU equipment shall comply with at least one of the following electrical safety standards.
      - .2.4.1.1 Underwriter Laboratory (UL)
      - .2.4.1.2 Canadian Standard Association (CSA)
      - .2.4.1.3 European Union (EN)
      - .2.4.1.4 International Electrotechnical Commission (IEC)
    - .2.4.2 The proposed OLT and ONT/ONU equipment shall comply with at least one of the following electromagnetic wave standards.
      - .2.4.2.1 Federal Communication Commission (FCC)
      - .2.4.2.2 Conformance European (CE)
      - .2.4.2.3 European Union (EN)
      - .2.4.2.4 International Special Committee on Radio Interference (CISPR)
  - .2.5 The proposal may offer deviation equipment, which is superior to this specification. Nevertheless the bidder shall be clearly explained, from technical and economical point of views, to confirm how the proposed equipment would offer an equivalent or better performance.
  - .2.6 The proposed equipment shall work properly with TOT's existing network.
  - .2.7 TOT will specify quantity, type and other relevant details of this equipment in the technical requirement document.

### **3 Equipment Description and Application**

- .3.1 The Mini PON equipment is the GPON equipment that the height of the OLT shall not exceed 2U standard size. In addition, the minimum number of PON ports supported shall be 4 PON ports per unit/chassis. This Mini PON equipment shall be designed for indoor or outdoor deployment. The deployment of the equipment shall be specified in the technical requirement document.
- .3.2 The proposed Mini PON equipment shall be applied to the existing TOT's optical fiber cable, providing the access services such as Fiber to the x (FTTx). There are 4 major FTTx services depending on the optical distance of the ODN and the method of providing the access service to the end subscriber which are:
  - .3.2.1 Fiber to the Node (FTTN)
  - .3.2.2 Fiber to the Curb (FTTC)
  - .3.2.3 Fiber to the Building (FTTB)

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- .3.2.4 Fiber to the Home (FTTH)
- .3.3** Apart from the PON topology, the use of point-to-point Ethernet topology in the proposed Mini PON equipment should be optional and will be specified in the technical requirement document if needed.
- .3.4** In this technical specification, the major Mini PON equipment defined according to networking configuration shall consist of:
- .3.4.1 Optical Line Terminal (OLT)  
The OLT is a device that is used to terminate the PON signals from all of ONT/ONUs and send them into upper network and vice versa. The OLT also provides management and maintenance functions for the PON system.
- .3.4.2 Optical Network Unit (ONU)  
The PON signals were originated and terminated by the ONU unit which is any one of the distributed endpoints of an ODN. The ONU equipment shall distribute the access services to the end subscriber via other access technologies such as LAN, xDSL and POTS. The ONU equipment is mainly used for providing the FTTC and FTTB service.
- .3.4.3 Optical Network Terminal (ONT)  
A single subscriber device that terminates any one of the distributed endpoints of an ODN, implements a PON protocol between OLT and ONT. The ONT equipment is mainly deployed at the subscriber's house which is called FTTH service.
- .3.4.4 Optical Splitter  
An optical splitter is passive equipment used for splitting and combining the optical signal between OLT and ONT/ONU.
- .3.5** For the most efficiently use, TOT will deploy the ONT/ONU equipment with two kinds of deployment as follows:
- .3.5.1 Indoor ONT/ONU equipment  
The indoor ONT/ONU equipment shall be designed for indoor deployment and installed inside the home or the building.
- .3.5.2 Outdoor ONT/ONU equipment  
The outdoor ONT/ONU equipment designed for outdoor deployment and installed outside the home or the building must be installed inside the outdoor cabinet or enclosure which describe in issue 6.7 in this technical specification document.  
The kinds of deployment as referred to above shall be specified in the technical requirement document if required.
- .3.6** The proposed Mini PON equipment shall support the triple play services that shall be provided in the TOT's access network.
- .3.7** The proposed Mini PON equipment shall comply and support front access operation.

## 4 Equipment Specification

- .4.1 The proposed Mini PON equipment, which consists of OLT, ONT and ONU, shall comply with the following common features.
  - .4.1.1 The proposed Mini PON equipment shall be complied with the following ITU-T standard
    - .4.1.1.1** G.984.1: General Characteristics
    - .4.1.1.2** G.984.2: Physical Media Dependent (PMD) layer
    - .4.1.1.3** G.984.3: Transmission convergence layer specification
    - .4.1.1.4** G.984.4: ONT management and control interface specification
  - .4.1.2 The proposed Mini PON equipment shall support high-speed data channel through a single optical fiber with an upstream rate of 1.244 Gbps and a downstream rate of 2.488 Gbps.
  - .4.1.3 Wavelength pattern
    - .4.1.3.1 1310 nm wavelength for upstream traffic
    - .4.1.3.2 1490 nm wavelength for downstream traffic
    - .4.1.3.3 1550 nm wavelength for video service (optional)
  - .4.1.4 The proposed Mini PON equipment shall support the following features
    - .4.1.4.1 Dynamic Bandwidth Allocation (DBA) for upstream traffic
    - .4.1.4.2 Advance Encryption Standard (AES) for downstream traffic
    - .4.1.4.3 Forward Error Correction (FEC) for upstream and downstream traffic
  - .4.1.5 The proposed OLT and ONT/ONU shall work properly with each other.
  - .4.1.6 The proposed optical splitter used with the Mini PON equipment shall comply with the TOT latest optical splitter's specification. Specific requirement of the proposed optical splitter shall be referred to the requirements in the technical requirement document.
  - .4.1.7 The proposed Mini PON equipment shall support the implementation of
    - .4.1.7.1 VLAN per subscriber model
    - .4.1.7.2 VLAN per service model
    - .4.1.7.3** Combination of both VLAN per subscriber and VLAN per service model
  - .4.1.8 The proposed Mini PON equipment shall support 28 dB (At  $BER \leq 10^{-10}$  without FEC) of minimum optical link loss budget. The calculation of the PON optical link budget shall be shown in the proposal by using all parameters (e.g. Cable Loss, Connector Loss, Splice Loss etc.) specified in the technical requirement document.
  - .4.1.9 Bidder shall state the following parameters value of the proposed Mini PON equipment in the bidder's proposal.
    - .4.1.9.1 Optical output power of the proposed OLT, ONT and ONU
    - .4.1.9.2 Optical receive sensitivity of the proposed OLT, ONT and ONU



.4.1.9.3 Attenuation loss of the proposed optical splitter

**.4.2 OLT Equipment**

The proposed OLT equipment shall comply with the following features.

- .4.2.1 The height shall not exceed 2U standard size.
- .4.2.2 The minimum number of PON ports supported shall be 4 PON ports per unit/chassis. The number of PON Ports required shall be specified in the technical requirement document.
- .4.2.3 The laser type used in the transmitter of PON interface shall be the distributed-feedback (DFB) laser or better.
- .4.2.4 The proposed OLT equipment shall be configured with built-in switch that is non-blocking capability and wire speed forwarding. The switching capacity (Full duplex) shall not be less than the following calculated value.

$\text{Switching Capacity (Gbps)} \geq [(2.5 \times G) + (10 \times M) + N] \times 2$
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Where:

G is the maximum number of GPON ports that the OLT can support.

M is the maximum number of 10GE interfaces that the OLT can support.

N is the maximum number of GE interfaces that the OLT can support.

- .4.2.5 The proposed OLT equipment shall be configured with MAC address table that support at least 16,000 MAC address.
- .4.2.6 All of the PON ports provided on the proposed OLT equipment shall be designed to be PON transceiver modules. A key of modules is that they are hot-pluggable, which means that one can insert and remove them from PON ports without interrupting other PON ports' existing services on the same OLT.
- .4.2.7 GPON Encapsulation Method (GEM) payload
  - .4.2.7.1** The proposed OLT equipment shall consist of 3,800 different usable GEM port-ID and 320 different usable T-CONs per PON interface as minimum. The bidder is kindly requested to specify the maximum number of usable GEM ports or T-CONs per PON port.
  - .4.2.7.2** The proposed GPON OLT equipment shall support the mapping function between VLAN ID and GEM port-ID.
  - .4.2.7.3** The proposed OLT equipment shall support the mapping function between GEM port-ID from PON part to 8 priority levels of Ethernet part.
- .4.2.8 The proposed OLT equipment shall support the synchronization scheme as the following;

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- .4.2.8.1** Network Time Protocol (NTP) for real time clock service
  - .4.2.8.2** Building Integrated Timing System (BITS) or IEEE1588v2 or Synchronous Ethernet (Sync-E) or other packet timing for network clock service is optional and will be specified in the technical requirement document if needed.
  - .4.2.9 Uplink Interface from the OLT equipment to upper network
    - .4.2.9.1** The proposed OLT equipment support the ability to balance load amongst the links in a Link Aggregation Group (LAG) using [Link Aggregation Control Protocol](#) (LACP) signaling, specified in the IEEE standard 802.3ad.
    - .4.2.9.2 The Ethernet uplink shall be capable of transmitting frames of up to 2000 bytes. The bidder shall be kindly requested to specify the maximum Ethernet MTU and confirm that frame transmission with multiple VLAN headers can occur without fragmentation.
    - .4.2.9.3** Type of interface (as an selective item and minimum requirement)
      - 4.2.9.3.1** 1000Base-TX (IEEE 802.3ab)
      - 4.2.9.3.2** 1000Base-SX (IEEE 802.3z)
      - 4.2.9.3.3** 1000Base-LX (IEEE 802.3z)
      - 4.2.9.3.4** 10GBASE-LR (IEEE 802.3ae)
  - .4.2.10 The proposed OLT equipment shall support the following features.
    - .4.2.10.1** DHCP relay and DHCP option 82 (IETF RFC 3046)
    - .4.2.10.2 PPPoE Intermediate Agent
    - .4.2.10.3** IGMP proxy and IGMP snooping V2 or Higher
    - .4.2.10.4 Multicast Listener Discovery (MLD) Snooping
    - .4.2.10.5 DHCP and/or PPPoE snooping needs to support v6 equivalent
    - .4.2.10.6 Neighbor Discover (ARP equivalent) snooping
    - .4.2.10.7 Anti spoofing of IPv6 address
    - .4.2.10.8 256 active IGMP multicast groups or more
    - .4.2.10.9** IETF RFC3619 (EAPS)
    - .4.2.10.10** IEEE 802.1d (Bridging and STP)
    - .4.2.10.11** IEEE 802.1w (RSTP)
    - .4.2.10.12** IEEE802.1s (MSTP)
    - .4.2.10.13 IEEE 802.1Q (with 4,000 concurrent VLANs or more)
    - .4.2.10.14 IEEE 802.3x (Flow Control)
    - .4.2.10.15 IEEE 802.1ad (Q-in-Q or VLAN Stacking)
    - .4.2.10.16 IEEE 802.3ad (Link Aggregation)
    - .4.2.10.17 IEEE 802.1p (Quality of Service)
    - .4.2.10.18 IEEE 802.3ah (OAM)

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.4.2.10.19 IEEE 802.1ag (OAM)

.4.2.11 The OLT shall be able to prevent forwarding traffic between user ports (user isolation). This behavior shall be configurable per VLAN.

.4.2.12 The proposed OLT equipment shall support T-CONT types 1, 2, 3 and 4. Each T-CONT type shall be able to use the full bandwidth available on the GPON.

.4.2.13 The OLT shall support at least the following pre-provisioning approaches.

**.4.2.13.1** Pre-provisioning of ONT/ONU serial numbers and their associated ONT/ONU-IDs into the OLT. The ONT/ONU-ID shall be assigned manually.

**.4.2.13.2** Pre-provisioning of ONT/ONU Registration IDs (or Passwords) and their associated ONT/ONU-IDs into the OLT. The ONT/ONU-ID shall be assigned manually.

.4.2.14 The proposed OLT equipment shall support the fan cooling system. The fan cooling system shall be configured with the integration of fan units. The Management System shall be able indicated the problem when any of fan unit failed.

.4.2.15 The alarm notification (such as buzzer, beep sound, blinking light and etc), part of the proposed OLT equipment, shall indicate the different between normal status and any of malfunctions status. Any modification to support the alarm notification as specified above shall be allowable.

.4.2.16 Other interfaces:-

**.4.2.16.1** CLI Serial interface (for Local Craft Terminal): RS-232 or Ethernet port.

**.4.2.16.2** TMN interface (NMS): Ethernet interface with RJ-45.

**.4.2.16.3** External Alarm interface: 4 inputs and 1 outputs (minimum)

.4.3 ONT and ONU Equipment

In the proposal, the bidder can particularly make the compliance statement according to types and interfaces of ONT/ONU which are purchased as specified in the technical requirement.

.4.3.1 ONT Equipment

The proposed ONT equipment used in the TOT's PON network shall meet the minimum features as minimum requirement.

**.4.3.1.1** The proposed ONT equipment used for FTTH service shall be classified into 4 types as follow:

4.3.1.1.1 ONT Type A

- This type shall provide Ethernet ports. It shall support bridged mode (Layer2).
- 4.3.1.1.2 ONT Type B  
This type shall provide Ethernet ports. It shall support both bridged and routed mode (Layer2/3).
- 4.3.1.1.3 ONT Type C  
This type shall provide Ethernet ports, POTS ports. It shall support both bridged and routed mode (Layer2/3).
- 4.3.1.1.4 ONT Type D  
This type shall provide Ethernet ports, POTS ports and WLAN interface. It shall support both bridged and routed mode (Layer2/3).

**Note** For all types of ONT, the external equipment/adaptor that is used to support all of features is prohibited.

Table 1 shows the features which shall be supported by each type of ONTs.

No	Features	Type A	Type B	Type C	Type D
1	General features				
1.1	IEEE 802.1D (Bridging)	✓	✓	✓	✓
1.2	Bridged Mode (Layer2)	✓	✓	✓	✓
1.2.1	Each Ethernet port can be individually configured in bridged mode.	✓	✓	✓	✓
1.2.2	All Ethernet port can be configured in bridged mode.	✓	✓	✓	✓
1.3	Routed Mode (Layer2/3)	-	✓	✓	✓
1.4	IEEE 802.1p (Quality of Service)	✓	✓	✓	✓
1.5	IGMP Snooping v2 or higher	✓	✓	✓	✓
1.6	8 different T-CONS per ONT	✓	✓	✓	✓
1.7	Learning MAC addresses	✓ ≥ 128	✓ ≥ 256	✓ ≥ 256	✓ ≥ 256
1.8	Point to Point Protocol over Ethernet (PPPoE)	✓ (Forwarded Transparently without discard and blocking)	✓	✓	✓
1.9	Internet Protocol over Ethernet (IPoE)	✓ (Forwarded Transparently without	✓	✓	✓

		discard and blocking)			
1.10	IPv4 and IPv6 (Dual Stack)	✓ (Forwarded Transparently without discard and blocking)	✓	✓	✓
1.11	IPv4	-	✓	✓	✓
1.11.1	IP DHCP Client/Server	-	✓	✓	✓
1.11.2	NAT (Network Address Translation) and NAPT (Network Address Port Translation)	-	✓	✓	✓
1.11.3	DNS (Domain Name System Proxy)	-	✓	✓	✓
1.11.4	Dynamic DNS	-	✓	✓	✓
1.11.5	Port Forwarding	-	✓	✓	✓
No	Features	Type A	Type B	Type C	Type D
1.12	IPv6	-	✓	✓	✓
1.12.1	IPv6 WAN	-	✓	✓	✓
1.12.1.1	IPv6 over Ethernet [RFC2464]	-	✓	✓	✓
1.12.1.2	IPv6 over PPP [RFC5072]	-	✓	✓	✓
1.12.1.3	Stateless Address Auto Configuration (SLAAC) [RFC4862]	-	✓	✓	✓
1.12.1.4	DHCPv6 Client [RFC3315]	-	✓	✓	✓
1.12.1.5	DHCPv6 Prefix Delegation (Client) [RFC3633]	-	✓	✓	✓
1.12.1.6	DNS resolver via DHCPv6 [RFC3646]	-	✓	✓	✓
1.12.1.7	DNS resolver via Router Advertisement) [RFC 6106]	-	✓	✓	✓
1.12.2	IPv6 LAN	-	✓	✓	✓
1.12.2.1	RA/SLAAC (Server)	-	✓	✓	✓
1.12.2.2	DHCP Server [RFC3736]				
1.12.2.3	Manual address configuration	-	✓	✓	✓
1.12.2.4	DHCPv6 Prefix Delegation (Server) [RFC3633]	-	✓	✓	✓
1.12.2.5	DNS resolver via DHCPv6 [RFC3646]	-	✓	✓	✓
1.12.2.6	DNS resolver via Router Advertisement [RFC 6106]	-	✓	✓	✓
2	VLAN features				
2.1	IEEE 802.1Q (VLAN)	✓	✓	✓	✓
2.2	Port-Based VLAN	✓	✓	✓	✓
2.3	Q-in-Q or VLAN Stacking (This feature is optional and shall be specified in the technical requirement document if needed)	✓	✓	✓	✓
2.4	VLAN Translation	✓	✓	✓	✓
2.5	VLAN Pass Through	✓	✓	✓	✓
2.6	Port Trunking (To carry multiple VLAN on each Ethernet port)	✓	✓	✓	✓
3	Wireless Features				
3.1	IEEE 802.11 2X2 b/g/n	-	-	-	✓
3.2	Up to 11 Mbps (IEEE 802.11b)	-	-	-	✓



3.3	Up to 54 Mbps (IEEE 802.11g)	-	-	-	✓
3.4	Up to 300 Mbps (IEEE 802.11n)	-	-	-	✓
3.5	Multiple SSID (At least 4 concurrent active SSIDs)	-	-	-	✓
3.6	Hide SSID	-	-	-	✓
3.7	Auto Channeling	-	-	-	✓
3.8	MAC Access/Deny List	-	-	-	✓
3.9	Binding between VLAN and SSID	-	-	-	✓
3.10	Wireless Security	-	-	-	✓
<b>No</b>	<b>Features</b>	<b>Type A</b>	<b>Type B</b>	<b>Type C</b>	<b>Type D</b>
3.10.1	64/128-bit WEP	-	-	-	✓
3.10.2	WPA/WPA2	-	-	-	✓
3.11	Transmit Power	-	-	-	
3.11.1	The proposed ONT shall have the ability to adjust the transmit power via management system.	-	-	-	✓
3.11.2	Maximum transmit power level shall meet with the latest relevant regulation of NBTC (The Office of the National Broadcasting and Telecommunication commission)	-	-	-	✓
3.11.3	The coverage distance for both indoor and outdoor deployment shall be stated by the bidder.	-	-	-	✓
<b>4</b>	<b>POTS Voice Specifications</b>				
4.1	G.711 (A-law and $\mu$ -law) and G.729 (A and B) for VoIP Coding	-	-	✓	✓
4.2	T.38 (Fax over IP)	-	-	✓	✓
4.3	H.248 or SIP for VoIP protocol (Type of VoIP signal shall be specified in the Technical Requirement Document)	-	-	✓	✓
4.4	Call feature: Caller ID, Call waiting, Call forward, Call Transfer, Three way conference	-	-	✓	✓
4.5	An external ATA device is not allowed	-	-	✓	✓
4.6	The proposed equipment shall be compatible with TOT's existing soft switch.	-	-	✓	✓
<b>5</b>	<b>Subscriber Interfaces</b>				
5.1	10/100/1000 Base-T with RJ-45 connector (Auto-sensing)	✓	✓	✓	✓
5.2	POTS interfaces with RJ-11 connector	-	-	✓	✓
<b>6</b>	<b>Management Features</b>				
6.1	OMCI	✓	✓	✓	✓
6.2	Web GUI	-	✓	✓	✓
6.3	Telnet	✓	✓	✓	✓
6.4	TR-069	-	✓	✓	✓
<b>7</b>	<b>Power Supply</b>				
7.1	Power adapter: Input 220 VAC $\pm$ 5%, 50/60 Hz, Output based on Manufacturer's standard	✓	✓	✓	✓

No	Features	Type A	Type B	Type C	Type D
8	LED or other indicators on panel for indicating status as follows:				
8.1	Power status indicator	✓	✓	✓	✓
8.2	PON port status	✓	✓	✓	✓
8.3	Wireless link activities	-	-	-	✓
8.4	Ethernet link activities	✓	✓	✓	✓
8.5	Telephone port status	-	-	✓	✓

**Note:** “✓” means that each type of ONTs shall support the feature specified.

#### .4.3.2 ONU Equipment

**.4.3.2.1** The proposed ONU equipment which is mainly used for FTTB and FTTC service shall be able to serve types of interface specified in the technical requirement document. The following is the examples of interfaces which are specified in the technical requirement document if required.

4.3.2.1.1 Ethernet interface

4.3.2.1.2 xDSL interface

4.3.2.1.3 POTS interface

**Remark** Any of two or all types of interface above can be on the same equipment or separated individually that it is based on each equipment manufacturer’s design and standard.

#### .4.3.2.2 Ethernet interface

**4.3.2.2.1** IEEE 802.3u (100Base-TX) or IEEE 802.3ab (1000Base-TX) of client interfaces (Type of client interfaces shall be specified in the Technical Requirement Document)

**4.3.2.2.2** IEEE 802.1d (Bridging)

4.3.2.2.3 IEEE 802.1Q

4.3.2.2.4 IEEE 802.1p

**4.3.2.2.5** Q-in-Q or VLAN Stacking (This feature is optional and shall be specified in the technical requirement document if needed)

4.3.2.2.6 MAC address filtering

.4.3.2.3 xDSL interface

4.3.2.3.1 ADSL2+ (G.992.5 Annex A)

4.3.2.3.2 ADSL2+ (G.992.5 Annex M)

4.3.2.3.3 VDSL2

4.3.2.3.3.1 G.993.2

**4.3.2.3.3.2** 8a, 8b, 8c, 8d, 12a, 12b, 17a Band profiles or better

**4.3.2.3.3.3** Data Transmission shall support both Asymmetric (Plan 998) and Symmetric (Plan 997).

.4.3.2.4 POTS interface

**4.3.2.4.1** G.711 (A-law and  $\mu$ -law) and G.729 (A and B) for VoIP Coding

4.3.2.4.2 H.248 or SIP for VoIP protocol (Type of VoIP signal shall be specified in the Technical Requirement Document)

4.3.2.4.3 T.38 (Fax over IP)

**4.3.2.4.4** Call feature: Caller ID, Call waiting, Call forward, Call Transfer, Three way conference

4.3.2.4.5 The proposed equipment shall be compatible with TOT's existing soft switch.

.4.3.2.5 The proposed ONU equipment shall provide at least the following features

4.3.2.5.1 8 different T-CONs per ONU

4.3.2.5.2 8 different GEM Port-ID per UNI port

.4.3.3 The proposed ONT/ONU shall support a dying gasp that is a message (or signal) sent by the ONT/ONU to the OLT when a power outage occurs or ONT/ONU is powered on/off. Therefore, the management system shall be able to display the status that a power outage occurs or ONT/ONU is powered on/off.

.4.3.4 The PON optical interface provided on ONT/ONU equipment shall be a female single-mode SC/APC connector.

## 5 Power Supply

.5.1 The OLT equipment shall be operated under -48 VDC or 220 VAC.

.5.2 The ONU equipment shall be operated under -48 VDC or 220 VAC.

.5.3 The bidder shall state the equipment's power consumption at full load operation.

.5.4 Other parameters shall be complied with TOT's latest Appendix.

## 6 Mechanical and Environmental

.6.1 The proposed Mini PON equipment (OLT and ODF) shall be installed via racking configuration with 19 inches or ETSI standard rack.



- .6.2 The maximum heat dissipation in each type of equipment shall be stated in the technical documentation.
- .6.3 The proposed OLT equipment shall be operated and met the stated performance requirements under the conditions in the TOT's latest appendix.
- .6.4 The proposed OLT equipment shall be kept or stored in TOT's warehouse with 10°C to 65°C temperature ranges and 10% to 90% humidity.
- .6.5 All equipment shall be kept in the original packing from the manufacturer during transport and storage.
- .6.6 The bidder shall state the following parameters.
- a) Size and weight
  - b) Location and method of ventilation
  - c) Internal temperature expected when fully equipped
  - d) Humidity control
  - e) Materials and finishes used
  - f) Method of disconnecting power
  - g) Mounting arrangements
- .6.7 Outdoor equipment and enclosure
- In case of outdoor deployment, the outdoor equipment that consists of OLT and ONT/ONU and their enclosure shall support the following properties.
- .6.7.1 The outdoor enclosure proposed shall be able to withstand exposure to sunlight and the atmospheric temperatures and stressed reasonably expected in normal use in Kingdom of Thailand.
- .6.7.2 The cooling system of the outdoor enclosure shall keep the temperature inside the outdoor enclosure between the minimum and maximum operating temperature of the proposed "equipment" installed inside the enclosure.
- .6.7.3 The outdoor enclosure shall be sealed to prevent the entry of sand, dust, moisture, insects and vermin etc.
- .6.7.4 The outdoor equipment installed inside the enclosure shall have the operating temperature ranging 0 °C to 55 °C or wider. (The temperature rang for Outdoor unit in the TOT's appendix-04 shall also be replaced with "temperature range 0 °C to 55 °C or wider")
- .6.7.5 The section that contains electronic device/equipment shall conform to or exceed IP55 standard of IEC 529.
- .6.7.6 The enclosure shall be finished both internally and externally to prevent corrosion or rusting throughout the life of the enclosure.

- .6.7.7 Outdoor enclosures will be exposed to direct sunlight. A sun shield shall be provided to reduce thermal loading due to solar heating effects and as may be otherwise advantageous for climatic and security reasons.

## 7 Management System

Management System is the system that provides monitoring functions and configuring functions for PON system (between OLT equipment and ONT/ONU equipment). The proposed Management System shall be performed the features which were detailed in the following section.

- .7.1 The proposed OLT and ONT/ONU equipment shall support the management featured via OMCI and PLOAM as per ITU-T G.984.
- .7.2 In the event of a link failure between the management system and the network element (NE) (e.g. OLT, ONT/ONU), the management system shall generate and display an alarm notification on the GUI.
- .7.3 In the event that the link between the management system and the NE is down, the NE shall retain all alarm information until the link is re-established and then forward the stored information to the management system.
- .7.4 The management system shall support auto-discovery of network devices and synchronization of database between the management system and NEs to make necessary update when changes of network devices occurred. Therefore, the network map shall be automatically updated as well.
- .7.5 The EMS shall have the Optical Signal Strength indication function to monitor at least the following Parameters of a PON Optical Line.
- .7.5.1 ONT/ONU's Transmit power (Tx)
  - .7.5.2 ONT/ONU's Received power (Rx)
  - .7.5.3 OLT's Transmit power (Tx)
  - .7.5.4 OLT's Received power (Rx)
- .7.6 Standard features
- .7.6.1 In-band and Out-band management
  - .7.6.2 Command Line Interface (CLI) and Graphical User Interface (GUI)
  - .7.6.3 Embedded Web Graphical Interface
  - .7.6.4 Telnet (or console management) and Simple Network Management Protocol (SNMP) base management
  - .7.6.5 Remote management
- .7.7 Management features

The Management features are the features that provide the abilities to the end user for configuring, setting and monitoring the equipment, parameters, states, problems and

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others of the PON equipment in the network. The proposed PON equipment shall be complied with the following features.

**.7.7.1 Configuration management**

Configuration management involves the service configuration and maintenance for all the devices in the FTTx network that consist of OLT and ONT/ONU. Configuration management shall be used:

- .7.7.1.1** To monitor both network setup information and network device configuration.
- .7.7.1.2** To allow a system to provision network resources and services, monitor and control their state, and collect status information. This provisioning includes assigning bandwidth of special features requested by a user, distributing software upgrades to the devices and reconfiguring equipment to isolate faults.
- .7.7.1.3** To control and manage all the parameters of subscribers' voice and data services such as types of services provided, bandwidth, VLAN, VLAN Stacking, QoS, IGMP ,etc.
- .7.7.1.4** To store all information involved in a readily accessible database so that when a problem occurs the database can be searched for assistance in solving the problem.

**.7.7.2 Fault management**

Fault management is used to monitor, isolate and correct faults in a network. Fault management shall be used:

- .7.7.2.1** To monitor faults in a network, such as physical cuts in a fiber transmission line or failure of an OLT or an ONT/ONU that cause the entire FTTx network or portions of it to be inoperable. As a result, fault management shall be able to display at least the following status.
  - 7.7.2.1.1** The status that ONT/ONU is connecting and working
  - 7.7.2.1.2** The status that OFC is cut or Loss of signal
  - 7.7.2.1.3** The status that the ONT/ONU is powered ON/OFF or a power outage occurs.
- .7.7.2.2** To determine whether the ONT/ONU is working properly or discover a failing ONT/ONU in a network.
- .7.7.2.3** To report alarms and their possible causes to the management system. These alarms are activated in response to detection of fault or degradation symptoms and have different levels of severity. Different levels of severity shall have different colors according to the urgency level of the faults.

- .7.7.2.4 To provide a summary of unresolved alarms and allow the network manager to retrieve and view the alarm information from an alarm log.
  - .7.7.2.5** To determine the origin, location, and possible cause of faults either automatically or through the intervention of a network manager. This can include functions such as alarm correlation from different parts of the network and diagnostic testing.
  - .7.7.2.6 To check, recover and show for details and resolve the problems of the device within the network.
  - .7.7.2.7** To display faults and alarms as real time and save as a file (Log Event) that can be used to analyze the cause.
- .7.7.3 Performance management
- Performance management shall be used:
- .7.7.3.1** To monitor and control key parameters that are essential to the proper operation of a network in order to guarantee a specific QoS to subscribers. These parameters include a remote monitoring, fault supervision, reporting of ONT/ONU failure statistics, bit error rate, optical power levels at both the OLT and the ONTs/ONUs, etc.
  - .7.7.3.2** To assign threshold values to such parameters and inform the management system or generate alarms when these thresholds are reached.
  - .7.7.3.3 To collect data from the traffic measurements to record in the Hard-Disk or CD-ROM or better in order to analyze equipment's performance on the network.
  - .7.7.3.4 To generate performance reports of the network provider's equipment.
  - .7.7.3.5 To collect various statistical data from the devices in the network and store it to the database.
  - .7.7.3.6 To schedule in bringing information out (Export) in the form of ASCII or CSV.
  - .7.7.3.7 To report the following problems
    - 7.7.3.7.1 Network equipment causes problems
    - 7.7.3.7.2 Interface causes problems
    - 7.7.3.7.3 Thresholds of problems
    - 7.7.3.7.4** Loss of signal and analysis
  - .7.7.3.8** To generate performance with real time reports with details at least the follows.
    - 7.7.3.8.1** OLT, ONT : Device view

- 7.7.3.8.2 CPU Usage
- 7.7.3.8.3 Buffer Failures
- 7.7.3.8.4 Used Memory
- 7.7.3.8.5 Buffer Misses
- 7.7.3.8.6 Buffer Utilization
- 7.7.3.8.7 Availability

#### .7.7.4 Security management

The principal goal of security management is to establish and enforce guidelines to control access to network resources. This control is needed to prevent viewing of modification of sensitive information by people who do not have appropriate access authentication. Security management shall be used:

- .7.7.4.1 To set up password at least 2 levels in order to enter the management system.
- .7.7.4.2 To record the usage of users in each time by recording when users are able to reach the management system in the format of log files.
- .7.7.4.3 To define the effective and expiration date of users who access the management system
- .7.7.4.4 To apply encryption techniques to certain types of traffic
- .7.7.4.5 To establish access authentication procedures
- .7.7.4.6 To develop security policies and principles

## 8 Installation Material

All installation materials, including racks, cables connectors, DC distribution and circuit breakers, intermediate distribution facilities, DC power cable and etc shall be supplied as part of the complete system.

## 9 Operation and Maintenance Facilities

- .9.1 The operation and maintenance procedure shall be explained with sufficient detail to allow corrective and preventive maintenance to be performed by TOT.
- .9.2 The operation and maintenance procedures shall comprise at least the following features.
  - .9.2.1 Circuit schematics
  - .9.2.2 Circuit explanations
  - .9.2.3 Wiring diagrams
  - .9.2.4 Component layout and identification
  - .9.2.5 Troubleshooting procedure
  - .9.2.6 Detailed module and sub-assembly specification for the repair facility
  - .9.2.7 Mechanical assembly

**10 Tools, Test Equipment and Spare Parts (Optional Items)****.10.1 Tools**

.10.1.1 The bidder shall propose the necessary tools that required for preventive and corrective maintenance to the FTTx services.

.10.1.2 The bidder shall propose module extenders, connectors plug, jacks, test leads, adapters and etc for the purposed of maintenance and repair.

**.10.2 Test Equipment**

.10.2.1 The bidder shall propose test equipment for routine maintenance.

.10.2.2 The bidder shall propose test equipment for system test.

.10.2.3 The break down price list of necessary test equipment for test and maintenance must be stated by bidder.

**.10.3 Spare Parts**

.10.3.1 Spare module

.10.3.2 Spare component for two years of operation

.10.3.3 Consumable parts for one year of operation

.10.3.4 The break down price list of necessary spare parts must be stated by bidder.

**11 Accessories**

The bidder shall provide all necessary accessories for maintenance and operation of the proposed PON equipment.

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