

TECHNICAL SPECIFICATION

PASSIVE OPTICAL NETWORK (PON)
EQUIPMENT

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Glossary and Abbreviations

AN	Access Network
ADSL	Asynchronous Digital Subscriber Line
BER	Bit Error Ratio
CLI	Command Line Interface
DBA	Dynamic Bandwidth Allocation
DHCP	Dynamic Host Configuration Protocol
EIRP	Effective Isotropic Radiated Power
ETSI	European Telecommunication Standardization Institute
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	Generic Encapsulation Method
GPON	Gigabit Passive Optical Network
GUI	Graphical User Interface
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ITU-T	International Telecommunication Union – Telecommunication Sector
NBTC	Office of the National Broadcasting and Telecommunication commission
MSAN	Multi Service Access Node
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



PON	Passive Optical Network
POTS	Public Old Telephone Service
RFCs	Requests for Comments
SNMP	Simple Network Management Protocol
VDSL	Very High Bit Rate Digital Subscriber Line
WLAN	Wireless Local Area Network
xDSL	x Digital Subscriber Line (of any type) <i>Pr</i>

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PASSIVE OPTICAL NETWORK

1 Introduction

- 1.1 This document is the technical specification for the "Passive Optical Network" equipment or "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 purchase document shall be comprised both of the technical specification document and the technical requirement document.
- 1.2 This technical specification relies on the Gigabit Passive Optical Network (GPON) technologies, the proposed PON equipment shall be based on GPON technology.
- 1.3 TOT shall specify the following items or features in the technical requirement document or other TOT's concerning document.
- 1.3.1 Number of subscribers
 - 1.3.2 Bandwidth per subscriber
 - 1.3.3 Type of uplink interface
 - 1.3.4 Type of service
 - 1.3.5 Type of ONT/ONU
 - 1.3.6 Optical transmission distance
 - 1.3.7 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. *Done*

- 2.3 The equipment shall be designed to fulfill the purpose and fully comply with the latest relevant, but not limit to ITU-T recommendations or other international standards specifies e.g. IEEE, ETSI, ANSI, UL, and IEC.
- 2.4 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 proposed equipment would offer an equivalent or better performance.
- 2.5 The proposed equipment shall work properly with TOT's existing network.
- 2.6 TOT will specify quantity, type and other relevant details of this equipment by statement of technical requirement document.

3 Equipment Description and Application

- 3.1 The proposed Gigabit Passive Optical Network (GPON) is a system with point to multipoint network architecture which optical splitters are used to enable a single optical signal to serve multiple premises. The Optical Line Terminal (OLT) is used to provide multichannel while the Optical Network Terminal (ONT) and Optical Network Unit (ONU) are used to terminate the optical transmission signal.
- 3.2 The proposed GPON equipment shall be able 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)
 - 3.2.4 Fiber to the Home (FTTH)
- 3.3 In this technical specification, the major GPON equipment defined according to networking configuration shall consist of:
 - 3.3.1 Optical Line Terminal (OLT) *Ami*

Multiplex the entire subscriber channels into the single core optical fiber cable. The OLT also provides management and maintenance functions for the PON system.

3.3.2 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.

3.3.3 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.

3.3.4 Optical Splitter

Passive equipment used for splitting and combining the optical signal between OLT and ONT/ONU.

3.4 For the most efficiently use, TOT will deploy the ONT/ONU equipment with two kinds of deployment as follows:

3.4.1 Indoor ONT/ONU equipment

The indoor ONT/ONU equipment shall be designed for indoor deployment and installed inside the home or the building.

3.4.2 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 7.8 in this technical specification document.

The kinds of deployment as referred above shall be specified in the technical requirement document if required.

3.5 The proposed GPON equipment shall support the triple play services that shall be provided in the TOT's access network.

3.6 The proposed GPON equipment shall comply and support front access operation.

4 Equipment Specification

4.1 The proposed GPON equipment, which consists of OLT, ONT and ONU, shall comply with the following common features.

4.1.1 The proposed GPON 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 GPON equipment shall support high-speed data channel through a single optical fiber with an upstream rate of 1.244 Gbit/s and a downstream rate of 2.488 Gbit/s.

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 GPON 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 that used with the GPON 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 TOT's technical requirement document.

4.1.7 The proposed GPON 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 Or the combination of both *Arno*



4.1.8 The proposed GPON equipment shall support 28 dB (At BER $\leq 10^{-10}$ without FEC) of minimum optical link loss budget. The calculation of the GPON 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 GPON 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 GPON OLT equipment shall comply with the following features.

4.2.1 The proposed GPON OLT equipment shall be the modular chassis design for service expansion. TOT shall be able to extend the numbers of GPON service by adding or plug-in GPON Cards/Units. The minimum number of GPON ports supported is 24 GPON ports per chassis. TOT is not allowable for the GPON OLT equipment which is designed as a stackable unit in order to connect two units or more together for service expansion to serve the number of GPON ports as mentioned.

4.2.2 The laser type used in the transmitter of GPON interface shall be the distributed-feedback (DFB) laser or better.


4.2.3 The proposed GPON OLT equipment shall be configured with built-in switch that is non-blocking capability and wire speed forwarding. The capacity of core switching shall not be less than 200Gbps (Full Duplex) or 400Gbps (Half Duplex).

4.2.4 The proposed GPON OLT equipment shall be configured with MAC address table that support at least 16,000 MAC address.

4.2.5 All of the GPON ports provided on the proposed GPON OLT equipment shall be designed to be GPON transceiver modules. A key of modules is that they are hot-pluggable, which means that one can insert and remove them from the GPON card without interrupting existing services on the same card and different cards.

4.2.6 GPON Encapsulation Method (GEM) payload *Ami*

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- 4.2.6.1 The proposed GPON OLT equipment shall consist of 3,800 different usable GEM port ID and 320 different usable T-CONs per GPON interface as minimum. The bidder is kindly requested to specify the maximum number of usable GEM ports or T-CONs per GPON port.
- 4.2.6.2 The proposed GPON OLT equipment shall support the mapping function between VLAN ID and GEM port ID.
- 4.2.6.3 The proposed GPON OLT equipment shall support the mapping function between GEM port ID from GPON part to 8 priority levels of Ethernet part.
- 4.2.7 The proposed GPON OLT equipment shall support the synchronization scheme as the following;
 - 4.2.7.1 Network Time Protocol (NTP) for real time clock service
 - 4.2.7.2 Building Integrated Timing System (BITS) or IEEE1588v2 or Synchronous Ethernet (Sync-E) or other packet timing for network clock service
- 4.2.8 Uplink Interface from the GPON OLT equipment to upper network
 - 4.2.8.1 The proposed OLT equipment support the ability to balance load amongst the links in a Link Aggregation Group (LAG) using LACP signaling, specified in the IEEE standard 802.3ad.
 - 4.2.8.2 The uplink interfaces from different uplink interface cards/units and on the same card/unit shall be configured in one LAG group, this is in order to load sharing between redundant configuration, and in event one links fails the other links should compensate in the LAG group.
 - 4.2.8.3 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.
 - 4.2.8.4 Type of interface (as an selective item and minimum requirement)
 - 4.2.8.4.1 1000Base-TX (IEEE 802.3ab)
 - 4.2.8.4.2 1000Base-SX (IEEE 802.3z)
 - 4.2.8.4.3 1000Base-LX (IEEE 802.3z)
 - 4.2.8.4.4 10GBASE-LR (IEEE 802.3ae) 



4.2.9 The proposed GPON OLT equipment shall support the following features.

4.2.9.1 DHCP relay and DHCP option 82 (IETF RFC 3046)

4.2.9.2 PPPoE Intermediate Agent

4.2.9.3 IGMP proxy and IGMP snooping V1/V2/V3

4.2.9.4 1,024 active IGMP multicast groups or more

4.2.9.5 IEEE 802.1Q (with 4,000 distinct VLANs or more)

4.2.9.6 IEEE 802.3x (Flow Control)

4.2.9.7 IEEE 802.1ad (Q-in-Q or VLAN Stacking)

4.2.9.8 IEEE 802.3ad (Link Aggregation)

4.2.9.9 IEEE 802.1p (Quality of Service)

4.2.10 The alarm notification (such as buzzer, beep sound, blinking light and etc), part of the proposed GPON 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.

4.2.11 The proposed GPON 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.

4.2.12 The proposed GPON OLT equipment shall properly work with a 2: N splitter to protect the feeder fiber from a single link failure. This protection scheme can be operated on the two GPON ports (one for working and other for protection) that are on both the same GPON unit/card and different GPON units/cards.

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 3 types as follow:

As follows



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

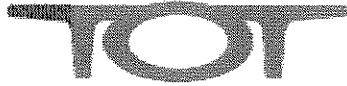
This type shall provide Ethernet ports, POTS ports. It shall support bridged mode (Layer2).

4.3.1.1.3 ONT Type C

This type shall provide Ethernet ports, POTS ports and WLAN interface. It shall be the ONT with built-in Residential Gateway (RG) functionality that supports both bridged and routed mode (Layer2/3).

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

No	Features	ONT Type A	ONT Type B	ONT Type C
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/v3	✓	✓	✓
1.6	8 different T-CONs per ONT	✓	✓	✓
1.7	Learning MAC addresses	≥ 64	≥ 64	≥ 128
1.8	Point to Point Protocol over Ethernet (PPPoE)	✓ (Forwarded transparently without discard and blocking)	✓ (Forwarded transparently without discard and blocking)	✓ <i>Ami</i>



1.9	Internet Protocol over Ethernet (IPoE)	✓ (Forwarded transparently without discard and blocking)	✓ (Forwarded transparently without discard and blocking)	✓
1.10	IPv4	✓ (Forwarded transparently without discard and blocking)	✓ (Forwarded transparently without discard and blocking)	✓
1.11	IPv6	✓ (Forwarded transparently without discard and blocking)	✓ (Forwarded transparently without discard and blocking)	✓
1.12	IP DHCP Server	-	-	✓
1.13	NAT (Network Address Translation) and NAPT (Network Address Port Translation)	-	-	✓
1.14	DNS (Domain Name System Proxy)	-	-	✓
1.15	Dynamic DNS	-	-	✓
1.16	Port Forwarding	-	-	✓
2	VLAN features			
2.1	IEEE 802.1Q (VLAN)	✓	✓	✓
2.2	Port-Based VLAN	✓	✓	✓
2.3	Q-in-Q or VLAN Stacking	✓	✓	✓
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	-	-	✓
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.	-	-	✓
4	POTS Voice Specifications			
4.1	G.711 (A-law and μ -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.	-	✓	✓
5	Subscriber Interfaces			
5.1	10/100/1000 Base-T with RJ-45 connector	✓	✓	✓
5.2	POTS interfaces with RJ-11 connector	-	✓	✓
6	Management Features			
6.1	OMCI	✓	✓	✓
6.2	Web GUI	-	-	✓
6.3	Telnet	✓	✓	✓
6.4	TR-069	-	-	✓
7	Power Supply			
7.1	Power adapter: Input 220 VAC ± 5%, 50/60 Hz, Output 9V-22 VDC or Manufacturer's standard	✓	✓	✓
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	-	✓	✓

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-T) 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

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 μ -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 GPON optical interface provided on ONT/ONU equipment shall be a female single-mode SC/APC connector.

4.3.4 In case of purchasing the ONT/ONUs only, the proposed ONT/ONU equipment shall properly work with the existing OLT which is connected to it.

5 Power Supply

5.1 The GPON 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 It is the bidder's responsibility to state the equipment's power consumption at full load operation.

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



6 Redundancy and Protection Scheme (OLT only)

6.1 The GPON OLT equipment shall support the following protection mechanism.

6.1.1 1+1 or 1:1 protection for power supply unit and common unit which shall not make the system down if it failed.

6.1.2 Power supply unit with distributed power supply system concept is acceptable as redundancy and protection scheme.

6.1.3 While operating, all of units or modules shall be immediately plugged-in and plugged-out without disturbing to the services (fully hot swappable).

6.2 System must not down and still work properly if one of the management unit or power supply unit was failed. All of services shall be continued their operation with fully existing equipment configuration.

6.3 Uplink backup for GPON OLT equipment to the existing higher level of TOT's network shall be redundant. The main of uplink interface and backup of uplink interface shall be configured in separate card that not causing any traffic interruption while inserting and removing each uplink interface card. The functions of load sharing/balancing and link aggregation shall be supported to protect the uplink traffic from failures of uplink interfaces.

6.4 It is the bidder's responsibility to state the redundancy and protection scheme of each unit in technical details.

7 Mechanical and Environmental

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

7.2 The proposed GPON OLT equipment shall support the fan cooling system. The fan cooling system shall be configured with fan module that was the integration of fan units for redundancy. The Management System shall be able indicated the problem when any of fan unit failed.

7.3 The maximum heat dissipation in each type of equipment shall be stated in the technical documentation.



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- 7.4 The proposed GPON OLT equipment shall be operated and met the stated performance requirements under the conditions in the TOT's latest appendix.
- 7.5 The proposed GPON OLT equipment shall be kept or stored in TOT's warehouse with 10°C to 65°C temperature ranges and 10% to 90% humidity.
- 7.6 All equipment shall be kept in the original packing from the manufacturer during transport and storage.
- 7.7 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
- 7.8 Outdoor ONT/ONU equipment and enclosure
- 7.8.1 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.
- 7.8.2 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 "ONT/ONU equipment" installed inside the enclosure.
- 7.8.3 The outdoor enclosure shall be sealed to prevent the entry of sand, dust, moisture, insects and vermin etc.
- 7.8.4 The outdoor ONT/ONU 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")
- 7.8.5 The section that contains electronic device/equipment shall conform to or exceed IP55 standard of IEC 529. *Ami*



7.8.6 The enclosure shall be finished both internally and externally to prevent corrosion or rusting throughout the life of the enclosure.

7.8.7 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.

8 Management System

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

8.1 The proposed GPON OLT and ONT/ONU equipment shall support the management featured via Management and Control Interface (OMCI) specification which refer to the ITU-T G.984.4.

8.2 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.

8.3 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.

8.4 The EMS shall have the Optical Signal Strength indication function to monitor at least the following GPON Optical Line Parameters.

8.4.1 ONT/ONU's Transmit power (Tx)

8.4.2 ONT/ONU's Received power (Rx)

8.4.3 OLT's Transmit power (Tx)

8.4.4 OLT's Received power (Rx)

8.5 Standard features

8.5.1 In-band or Out-band management

8.5.2 Command Line Interface (CLI) and Graphical User Interface (GUI)



8.5.3 Telnet (or console management) and Simple Network Management Protocol (SNMP) base management

8.5.4 Remote management

8.5.5 Remote loop-back test (at ONT/ONU side)

The loop-back testing signals are initiated by OLT and sent to ONT/ONU. From there, ONT/ONU status reports are returned to OLT. The method of remote loop-back test shall be based on ITU-T or IEEE or other universal standards which are widely used but the proprietary method is prohibited.

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

8.6.1 Equipment management

8.6.2 Fault management

8.6.3 Performance management

8.6.4 Topology management

8.6.5 Security management

8.6.6 Database Management

8.6.7 Terminal Management (Depended on the type of ONT/ONU)

9 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.

10 Operation and Maintenance Facilities

10.1 The operation and maintenance procedure shall be explained with sufficient detail to allow corrective and preventive maintenance to be performed by TOT.



10.2 The operation and maintenance procedures shall comprise at least the following features.

10.2.1 Circuit schematics

10.2.2 Circuit explanations

10.2.3 Wiring diagrams

10.2.4 Component layout and identification

10.2.5 Troubleshooting procedure

10.2.6 Detailed module and sub-assembly specification for the repair facility

10.2.7 Mechanical assembly

11 Tools, Test Equipment and Spare Parts (Optional Items)

11.1 Tools

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

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

11.2 Test Equipment

11.2.1 The bidder shall propose test equipment for routine maintenance.

11.2.2 The bidder shall propose test equipment for system test.

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

11.3 Spare Parts

11.3.1 Spare module

11.3.2 Spare component for two years of operation

11.3.3 Consumable parts for one year of operation

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

12 Accessories

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