

Local Exchange Telecom Service Provider

GPON for FTTB and FTTH/FTTP

- ◆ High capacity 2.488Gbps Down /1.244Gbps Up
- ◆ Upto 60km; Up to 128 ONTs per PON
- ◆ High Availability options with support for GPON Type B (to 2xM splitters)
- ◆ Local and remote optical power monitoring
- ◆ Can start as a drop-in service replacement for xDSL and the add new FTTx services
- ◆ Quadruple-play – Internet, Video, Voice, Wi-Fi service bundles
- ◆ 1GE High Speed Internet support
- ◆ Multiple IPTV set tops per ONT
- ◆ PPPoE or DHCP Authentication
- ◆ N:1 or 1:1 TR-156 VLAN Service Models
- ◆ Option for TR-069 provisioning
- ◆ Lower carbon footprint over xDSL

Fibre-based access networks, referred to as FTTx networks, are the most attractive and future-proof local loop access technology for Local Exchange (LE) Telecom service providers to deliver high-bandwidth, carrier-class services to consumers.

FTTx Architecture

The two predominant FTTx architectures that GPON supports for LE service providers are:

FTTB – Fibre-to-the-Building where the existing twisted pair and/or coaxial cable in the building or just on each floor is reused for expediency for connecting to the GPON ONT's UNI ports, otherwise new CAT5/6 Ethernet cabling will need to be installed.

FTTH/FTTP – Fibre-to-the-Home / Fibre-to-the-Premise where the fibre is run right to the user's room or office location in the single-family/Multi-family/Multi-tenant buildings.

The architecture of choice is FTTH/FTTP since the maximum operational benefit of fibre can be realized by taking the fibre inside the user's building and locating the ONT as close to the terminated CPE devices as possible. This is straight forward to do for single-family dwellings but can be an issue for multi-family dwellings, especially for established high-risers where the cabling



conduits are full of twisted pair and coaxial cabling. In lower level cases FTTB is initially deployed with a GPON ONT placed in the lower level of the building and the existing building copper wiring re-used.

Fibre Types

Standard practice is ITU-T G.652D fibre in the outside plant and bend-insensitive G.657 fibre from the curb to the ONT.

Optical Splitting

GPON optical splitters can be centralized, for example, at the CO/LE, or at the far remote end such as an apartment building to create a star ODN, or they can be cascaded to create a tree and branch ODN. The typical is a two stage split combination of a 1x4 followed by a 1x8 /1x16 splitter for high-dense areas and 1x8/1x16 followed by a 1x4 splitter for less dense areas. Used less frequently by service providers but asymmetrical 1x2 splitters can be linearly chained to create a linear bus ODN.

ONT Placement

ONTs are typically mounted on the wall, but can be left free-standing on a table or desktop. The ONT terminates the GPON fibre and presents many user network Interfaces (UNI) ports to a single subscriber, terminating each UNI at the subscriber's CPE equipment, such as a PC, wireless router, home gateway, phone, or set-top box. The UNI ports for a residential ONT are the typical native subscriber service interfaces such as 10/100/1000Base-T for High Speed Internet (HSI) or IP Video, RF Coax for RF Video overlay systems, and FXS analog phone interfaces for VoIP PSTN voice. The distance from the ONT to devices connected to its

Ethernet ports is 100m (328 ft.). With ONTs supporting Wi-Fi the ONT should be placed to minimize multi-path interference.

Service Model

A GPON OLT system and its connected ONT together are regarded as a ‘GPON Access Node’ in Broadband Forum, TR-156 the GPON equivalent of the ‘Ethernet based Access Node’ defined TR-101 for xDSL. The GPON Access Node supports the Ethernet-based services defined in ITU-T G.984.1 and G.984.4. N:1 VLAN (MEF E-Tree) where a single VLAN is shared among multiple subscribers, 1:1 VLAN (MEF E-Line) where a single VLAN is dedicated for a single subscriber and TLS (MEF E-LAN) multipoint-to-multipoint transparent LAN service.

Broadband Services

Service providers typically start by offering the same PPPoE Internet as their xDSL network and DHCP IPTV service bundles as their xDSL network, but at higher speeds and Voice as on their PSTN network but over VoIP. They then add special FTTx services packages that exploit GPON’s higher bandwidth to offer multiple IPTV set top connections per ONT, up to 1Gbps “Gigabit” Internet, Symmetrical data connections, 300Mbps Wi-Fi Hotspots and more.

QoS

GPON offers 2.488 Gbps on the downstream and 1.244 Gbps on the upstream; this bandwidth is distributed fairly among the end users attached to the PON. Within

Real-World Local Exchange Telecom Service Provider GPON Networks

The figure below is of a Local Exchange Telecom Service Provider’s GPON Network with a triple-play service offering of Internet, IPTV and Telephony Voice. The ONTs are 4xFE and 2xFXS POTs with 8-hour battery backup

the total bandwidth allocation for a particular subscriber, the service provider can control the bandwidth allocated for each of the services to which the user subscribes using IEEE802.1ad CoS.

Security

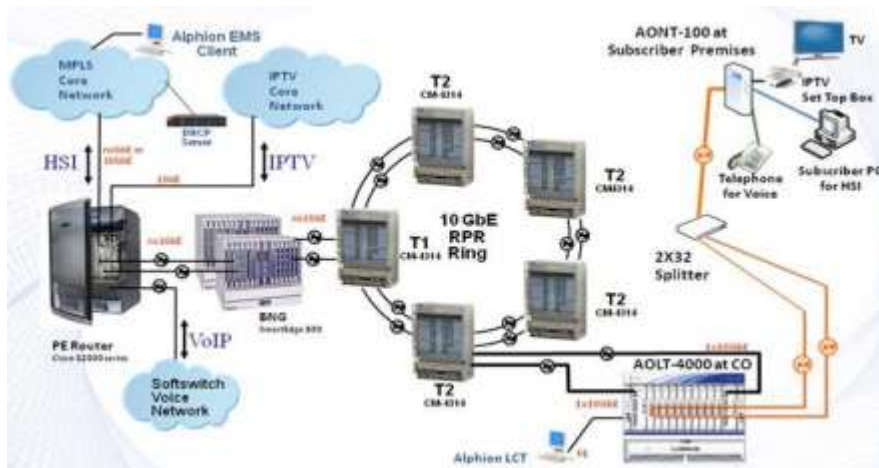
The GPON medium is inherently secure, employing 128-bit AES (Advanced Encryption Standard) to encrypt both downstream and upstream Data and voice and decrypting only the data and voice for designated for that addressed authenticated and authorized ONT.

Core Network Connections

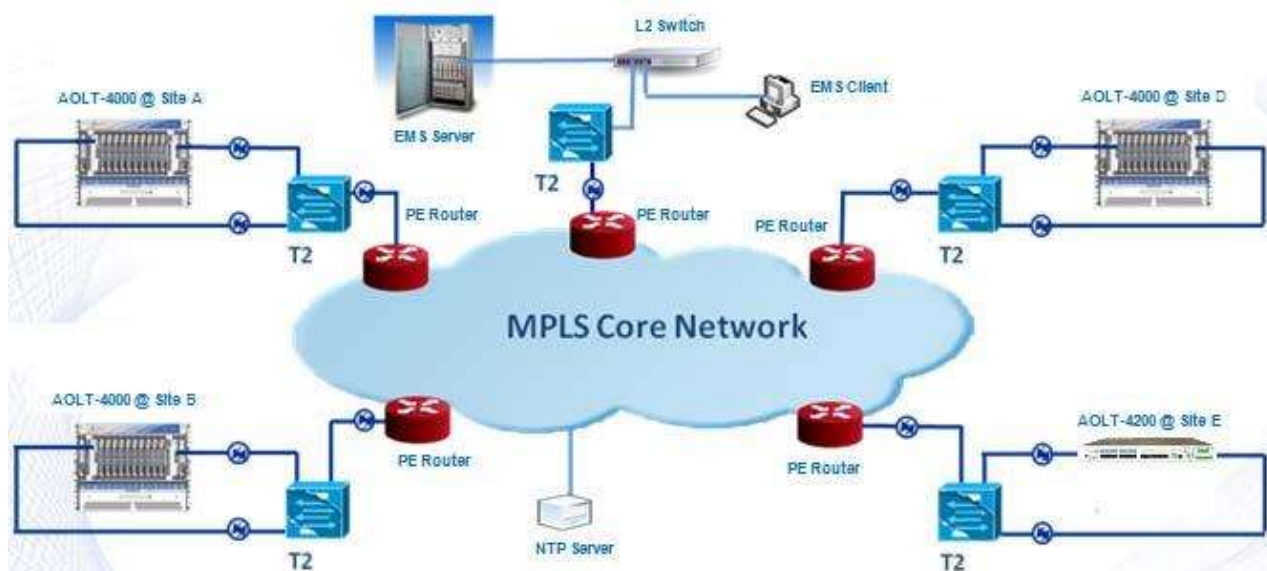
Alphion GPON OLTs can connect to the service providers MPLS Core network with 2x/4x 10GE and 4x/8x 1GE SNI Ethernet Links, fibre or copper. The SNI interfaces support link aggregation and 1+1 redundancy.

Management

An Alphion GPON network is managed by Alphion’s Element management system (AEMS) that communicates to Alphion’s AOLT-4000/4200 series GPON OLTs over SNMP and to the Service provider’s NMS in their NOC over a north-bound interface. Since the standard practice is to have redundant NOCs, a main and backup, an appropriately sized AEMS server would be installed in each of these two NOCs.



The figure below is of second Local Exchange Telecom Service Provider’s GPON Network also with a triple-play service offering of Internet, IPTV and Telephony Voice. The ONTs are also 4xFE and 2xFXS POTs with 8-hour battery backup.



In both of the above networks, triple-play service of internet, IPTV and telephony voice is offered. Internet service will allow the subscriber to securely browse the Internet, download music, video and other data as well as watch streaming video. IPTV is used to deliver the traditional TV services, including broadcast television, pay-per-view, VOD, time shifted PVR, interactive TV over a broadband IP network to an IP enabled set-top box. With IPTV, the network operator controls the user experience, the programming and applications delivered, and the quality of service (QoS) of the broadband IP pipe to the subscriber. IPTV includes support for both standard and high definition television (HDTV) and uses MPEG-2 or MPEG-4 encoding. Subscribers can access legacy voice services via RJ-11 FXS ATA ports of the ONT. The subscriber’s phone will access a SIP Softswitch in the core network. An alternative would be to access a legacy Class 5 CO over the IP network via a SIP-to-V5.2 gateway.

Solution	Benefits
<ul style="list-style-type: none"> ◆ Last mile fibre with GPON Technology 2.488Gps Down / 1.244Gbps Up ◆ GPON ONT with GE ports ◆ PPPoE Authentication & Authorization to leverage PPPoE infrastructure from xDSL ◆ Indoor ONTs brings brand inside and can up-sell to an ONT w/Wi-Fi ◆ Passive tree and branch ODN with multi-stage splitting <ul style="list-style-type: none"> ◆ Up to 128 ONTs per PON, but typically 32 or 64 ◆ Deploy Type-BPath protection for high construction areas 	<ul style="list-style-type: none"> ◆ 1GE High Speed Internet and Multiple HDTV set tops and IEEE802.11n 300Mbps Wi-Fi ◆ Drop-in service plan replacement for xDSL to leverage xDSL back-office investment ◆ Lower operational expense for new installs/attachments ◆ Eliminate the need to build and maintain a telephony copper infrastructure, including loop powering ◆ Future proof fibre topology GPON- ODNs are XG-PON and NGPON2 ready

