

Educational Institutions

University, College and Secondary School Campus Networks

- ◆ High capacity 2.488Gbps Down /1.244Gbps Up
- ◆ Quadruple-play – Internet, Video, Voice, Wi-Fi
- ◆ High Data Bandwidth enables new applications and improves performance of existing ones
- ◆ Transparent LAN service (TLS) (MEF E-LAN) for departmental LAN interconnection
- ◆ Secure Advanced 128-bit AES Encryption
- ◆ Leaner Infrastructure with no per floor Data Rooms/Closets
- ◆ Lower Total Cost of Ownership (TCO) over coaxial cable, twisted pair copper or point-to-point fibre approaches
- ◆ Ability of current installations to co-exist with future PON standards on the same ODN

GPON can be used by educational Institutions for building a Campus Broadband Network that can support all of the Institution's communications needs today and for the future.

FTTx Architecture

The two predominant FTTx architectures that GPON supports for institutional campus network 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.

FTTP – Fibre-to-the-Premise where the fibre is run right to the user's room or office location.

The architecture of choice is 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.

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 in Campus GPON Networks are



normally cascaded forming a tree and branch ODN that facilitates easier re-arrangement of the fibre drops should it be required in the future. The typical is a two-stage split combination of 1x4 followed by a 1x8 or 1x16 splitter for high-density of users and 1x8 or 1x16 followed by a 1x4 or 1x8 splitter for low-density of users. Used less frequently by service providers but asymmetrical 1x2 splitters can be linearly chained to create a linear bus ODN for fibreing ONTs connected to widely spaced CCTV cameras or ONTs dedicated as Wi-Fi hotspots.

ONT Placement

The ONTs in a campus network are typically mounted on the wall, but can be left free-standing on a table or desktop. In all instances the ONT will be placed as near to the majority of its connected CLE devices as possible to minimize the length of copper Ethernet and Telephony cabling.

Service Model

N:1 VLAN (MEF E-Tree), 1:1 VLAN (MEF E-Line), and TLS (MEF E-LAN) multipoint-to-multipoint transparent LAN service models are supported, but N:1 is the preferred service model, with PPPoE or DHCP Authentication & Authorization depending on bulk internet provider.

Faculty and Officers Chambers Services

The typical services would be Internet for the Faculty and Officer's PCs, Transparent LAN Service (TLS) Departmental VLAN connections, Phone service from an IP-PBX, Network Printers connections, closed Wi-Fi, Surveillance using HD IP CCTV cameras, and building



amenities (security sensors and door entry card reader, etc) management.

Laboratory Services

The typical services would be the same as for the Faculty and Officers Chambers Services but with a much higher PIR (Peak Information Rate) and CIR (Committed Information rate) for the internet and TLS (Transparent LAN service) services.

Residence (Hostels & Guest) Room Services

The typical services would be Internet for the Desktop/laptop/Tablet, IPTV and/or RF Broadcast Video, “one residence room, one phone” phone service from an IP-PBX either using an analog or VoIP phone and room amenities (security sensors and door entry card reader, etc) management. Common area would have Wi-Fi Hotspots, networked PTZ CCTV IP cameras, Digital signage and TVs set to the Campus information channel.

Meeting Rooms & Common Area Services

The typical Meeting/Conference rooms & Common Area services would be Internet Access, Audio Visual Systems for Long-Distance Learning (LDL) and Tele-presence, Wi-Fi Hotspots, Digital Signage, secure ABM banking connections, PTZ CCTV IP cameras, Information kiosks and VoIP phones.

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 the total bandwidth allocation for a particular user, the IT department can control the bandwidth allocated for each of the services to which the user is 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 that addressed authenticated and authorized ONT.

ISP and Content Connections

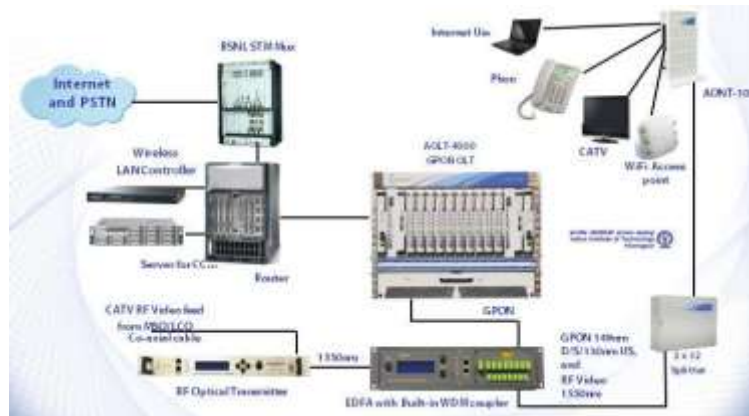
Alphion GPON OLTs can connect to the ISP, IPTV and VoIP network with 2x/4x 10GE and 4x/8x 1GE SNI Ethernet Links, fibre or copper. The SNI interfaces support link aggregation and 1+1 redundancy, etc.

Management

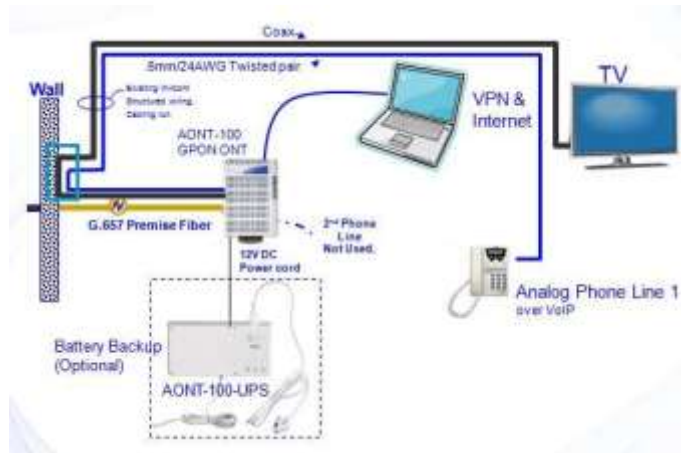
An Alphion GPON network is managed by Alphion’s Element management system (AEMS) that communicates to Alphion’s AOLT-4000/4200 series GPON OLTs over SNMP and to IT department’s NMS in their data center over a north-bound interface. An appropriately sized AEMS server would be installed in right in the data center.

Real-World Educational Institutions Campus GPON Networks

IIT Kharagpur is home to the 1st Campus GPON Deployment in India and the largest gigabit network in eastern region of India. The network is used for delivering Internet, Courseware, E-learning, IPTV, VoD and Voice within the campus. The network covers all campus locations covering 30,000 people and over 2,000 acres and spans across academic areas of the various departments, laboratories, faculty and officers chambers, halls of residences (Hostels & Guest Houses) and covers the total residential quarters complex via QPN Network.



The figure below illustrates the connectivity of the equipment in IIT Kharagpur’s Campus GPON Network for their Guest House. It supports a triple-play service offering of Internet, Telephony Voice, IPTV and RF linear broadcast video.



In this GPON campus networks not just triple-play service is offered, but the broadcast video is provided using the GPON RF video overlay capability. The IPTV TV service is strictly for accessing past Lecture Archives and campus Information Channels. This was for this network, but IPTV can be used to deliver the equivalent of broadcast television digitally with a much higher quality plus delivering VOD, in the cloud PVR, front lobby/door channel and more.

Solution	Benefits
<ul style="list-style-type: none"> ◆ Last mile fibre with GPON Technology 2.488Gbps Down / 1.244Gbps Up ◆ AOLT-4000 Chassis OLT with straightforward expense by plugging in additional GPON Linecards ◆ Indoor ONTs – with and without RF overlay for FTTP and MDU ONTs for FTTB or FTTF. ◆ Passive tree and branch ODN with multi-stage splitting ◆ Broadband Internet Access for office, residence and on-campus commercial establishments ◆ Connections to Backbone IP Network through Alphion ONTs ◆ VoIP (Voice over IP) Service using an IP-PBX for office and residence and on-campus commercial establishments ◆ RF TV Service delivering Campus information and Entertainment Channel 	<ul style="list-style-type: none"> ◆ Improved bandwidth access to staff and Faculty ◆ Immediate realized cost savings ◆ Centralization of all access network enabled the simplified, effective network management for 24/7 network service support ◆ Significant improvement in network user satisfaction ◆ Eliminated the need to build and maintain a telephony copper infrastructure, including loop powering ◆ Eliminated the need for powering and cooling remote Ethernet switches and the associated space they take up in cabling rooms/closets ◆ Future proof fibre topology GPON- ODNs are XG-PON and NGPON2 ready