Mobile Wireless 2G/3G/4G Service Provider

GPON for Mobile Backhaul (MBH) of Cellular Base Station traffic

- **High capacity 2.488Gbps Down /1.244Gbps Up**
- **Leverage GPON residential broadband deployments for MBH either on the same PON with other services or on a dedicated PON**
- **QoS Low--latency and minimal delay variation due to GPON's synchronous nature**
- **Option to use the fibre-lean linear bus ODN topology for MBH or stay with traditional**
- **Multi-stage tree and branch topology**
- **High Availability option with GPON Type B protection to 2xM splitters and/or Type C to redundant PON port ONTs**
- **Converged Packet Transport support – GPON can carry both TDM (eg. E1 w/PWE3) and packet traffic**

GPON optical access networks can be leveraged for mobile backhaul (MBH) and be used for connecting mobile operator's 2G/3G/4G cell site base stations to their network controllers.

It has already been shown optical Fibre more than microwave and copper has been shown to be the ultimate MBH medium from both a bandwidth, performance and a reliability perspective. Optical Fibre systems are deployed everywhere in today's in the core, aggregation and last mile broadband access networks.

The fibre last mile networks being predominantly GPON due to it higher bandwidth, synchronous nature and quality of service (QoS) capabilities, cost-effectiveness and better scalability over GE-PON and Carrier Ethernet that make it more suitable for delivering Triple-Play and Quadruple-play service bundles.

Mobile operator's can continue building out their Radio Access Network (RAN) with more expensive Ethernet-Over-SDH (EoSDH) or Carrier Ethernet Transport (CET) MBH networks or have GPON last mile broadband access networks do the MBH for them. And since GPON OLTs (Optical line terminals) are low-cost broadband aggregation platforms the mobile operators will see a reduction in the required numbered of ports in their switches and routers for the same number of cell base

station being served over EoSDH or CET MBH networks

FTTx Architecture

The FFTX architecture for MBH is FTTP where the premise is the Cell base station. The endpoint for the GPON drop fibre is the GPON ONT at the 2G Base Transceiver Station (BTS), 3G Base Station (Node B) or 4G LTE eNode B station.

Fibre Types

Standard practice is ITU-T G.652 fibre in the outside plant and bend-insensitive G.657 fibre at the cell base station.

Optical Splitting

Mobile wireless operators can stay with GPON's traditional Tree and Branch optical splitting topology. The typical GPON tree and branch for residential access consists of multi-stage split combination is a 1x4 followed by a 1x8 or 1x16 splitter for high-dense areas and 1x8 or 1x16 followed by a 1x4 splitter for less dense areas. Mobile wireless operators also have the option to use the fibre-lean linear bus ODN topology using asymmetrical 1x2 splitters which is normally used only for providing GPON to widely space endpoints such as railway gates and toll stations and associated sensors.

ONT Placement

The 'cell site gateway' ONTs are typically environmentally hardened and mounted ideally in the same enclosure as the equipment its UNI ports are terminating. The ONT terminates the GPON fibre and presents 4xFE/GE (UNI) ports for MBH. 1+1 equipment redundancy can be provided simply by using a 1x2

optical splitter to add a redundant ONT. Fibre redundancy can be provided using GPON Type-B or Type-C protection.
to which the user subscribes using IEEE802.1ad CoS.
At the ONT is the capability to monitor end points of

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 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

Depending on the model of ONT both packet and TDM Mobile backhaul (MBH) services can be provided to the 2G Base Transceiver Station (BTS), 3G Base Station (Node B) or 4G LTE eNode B station. The packet mobile backhaul connections being made using FE/ GE UNI ports, while the TDM mobile backhaul connections being made using TDM (eg.E1 PWE3) UNI ports.

QoS

GPON offers 2.488 Gbps on the downstream and 1.244 Gbps on the upstream; this bandwidth is distributed fairly among the end base stations attached to the PON. Within the total bandwidth allocation for a particular base station, the network operator/administrator can control the bandwidth allocated for each of the services

the MBH network in support of SLAs and for fault isolation.

Security

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

Synchronization

Alphion's GPON OLTs support Stratum3E local OCXO with automatic holdover on loss of reference and are IEEE1588v2 and G.984.3Amd2 ready. The AOLT-4200 also supports SyncE (G.8261,G.8262 EEC option 1, 2).

Core Network Connections

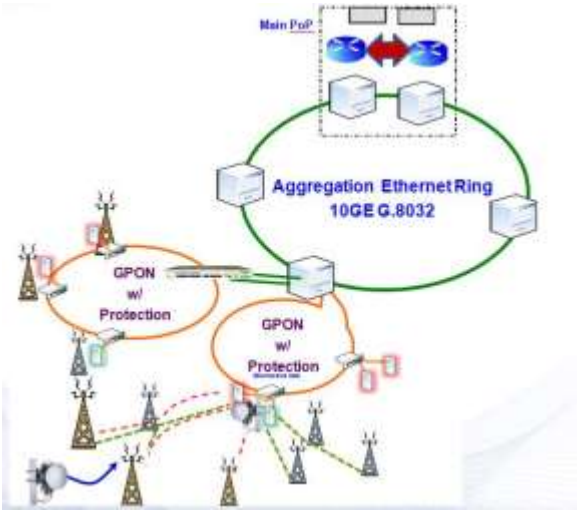
Alphion GPON OLTs can connect to the mobile operator's network with 10GE and 1GE SNI Ethernet Links. The SNI interfaces support link aggregation and 1+1 redundancy.

Management

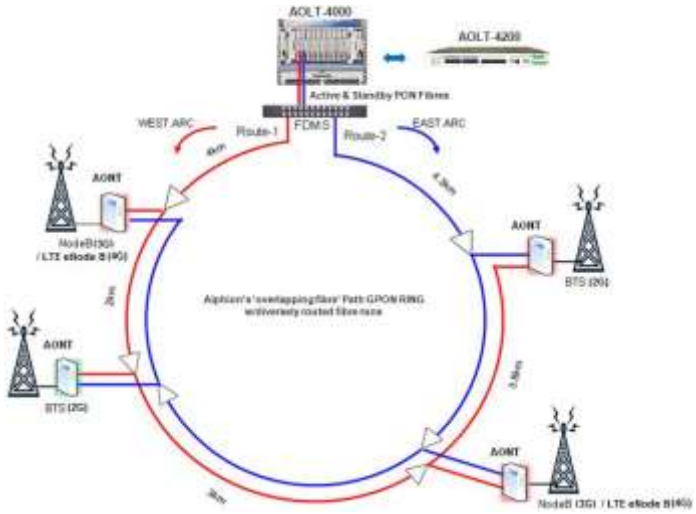
An Alphion GPON network is managed by Alphion's Element management system (AEMS) that communicates to Alphion's AOLT-4000/4200 series GPON OLTs over SNMP and to the network operators NMS in their NOC over a north-bound interface. The standard service provider practice is to have redundant NOCs, a main and backup.

Real-World GPON for Mobile Backhaul (MBH)

The figure below illustrates Alphion's GPON system being used for Mobile Backhaul (MBH) of cell base station packet and legacy TDM traffic as well as aggregating the packet traffic, which is facilitated by Alphion GPON OLTs supporting 10GE Ethernet Ring Protection Switching (ERPS) ITU-T G.8032 and having a large switching fabric.



The figure below is an illustration of a linear bus ODN topology based around the use of 1x2 asymmetrical splitters for mobile backhaul (MBH). This is the High Availability configuration where there are two diverse fibre routes to the 2G Base Transceiver Station (BTS), 3G Base Station (Node B) or 4G LTE eNode B station. Route -1, the 'WEST ARC' is the red fibre run, while Route-2, the 'EAST ARC' is the blue fibre run. For Type-B path protection and Type-C line protection, these Route 1 and Route-2 single fibres are connected to two PON OLT ports, either on the same GPON linecard or different linecards. If a different cards the lower number port is designated as Port A of the pair and the higher numbered PON OLT port is designated Port B of the pair. In Type-B GPON protection both GPON OLT ports are receiving but only the active port is transmitting on their PON. In Type-C GPON protection both GPON OLT ports are receiving and transmitting on their PON.



Solution

- Last mile fibre with GPON Technology 2.488Gps Down / 1.244Gbps Up
- GPON ONT , the 'cell site gateway' with GE ports for packet MBH
- GPON ONT , the 'cell site gateway' with unstructured E1 ports meeting jitter/wander requirements of ITU-TG.823 (for E1) for TDM MBH
- Synchronization of GPON per ITU-TG.984.3 with transports of an 8 kHz clock via GPON's 125 sµframe
- Passive tree and branch ODN with multi-stage splitting or more fibre efficient Linear Bus ODN
- Optional Type-BPath protection and/or Type-Cline protection depending on GON ONT.
- Exceeds delay and delay variation requirements

Benefits

- Leverage GPON network providing a lower operational expense of a shared
- Up to 1GE MBH capacity per ONT UNI port
- Future capability for Cell base-station synchronization
- Eliminate the need to build and maintain a separate MBH fibre network
- Future proof fibre topology GPON- ODNs are XG-PON and NGPON2 ready

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