

PONTopology

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PON topology

The word topology came from the Greek word *topos* meaning *place* and *logos* meaning *study*. It is a description of any locality in terms of its layout. Topology is a branch of mathematics concerned with properties of geometric figures that are distorted without tearing or bonding together. A *network topology* is the pattern in which nodes (i.e., computers, printers, routers or other devices) are connected to a local area network (LAN) or other network via links (e.g., twisted pair copper wire cable or optical fiber cable). There are different types of topology like mesh, ring, bus tree and also PON, PON an abbreviation for passive optical network. It spreads in redundant configuration as double ring, double tree or redundancy may be added only to part of PON say the trunk of tree. PON is still working in high layer protocol (ETHERNET, IP) to complete the services.

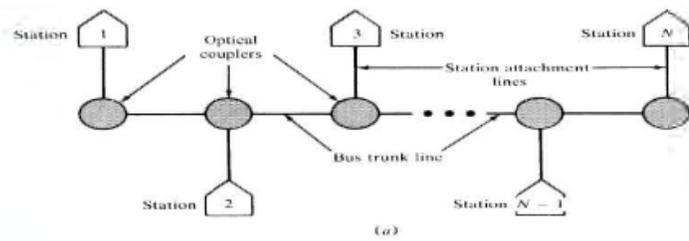
From 1990 the fiber is efficient to home network and starting in 1995, work on fiber to the home architectures was done by the Full Service Access Network (FSAN) working group, formed by major telecommunications service providers and system vendors. The International Telecommunications Union (ITU) did further work, there are two generations of PON the older ITU-T G.983 standard is based on asynchronous transfer mode (ATM), and has therefore been referred to as APON (ATM PON). Gradual falling out of favor of ATM as a protocol led to the full, final version of ITU-T G.983. It's referred to more often as broadband PON, or BPON. A typical APON/BPON provides 622 megabits per second (Mbit/s) (OC-12) of downstream bandwidth and 155 Mbit/s (OC-3) of upstream traffic, although the standard accommodates higher rates. The IEEE 802.3 Ethernet PON (EPON or GEAPON) standard was completed in 2004. EPON uses

standard 802.3 Ethernet frames with symmetric 1 gigabit per second upstream and downstream rates.

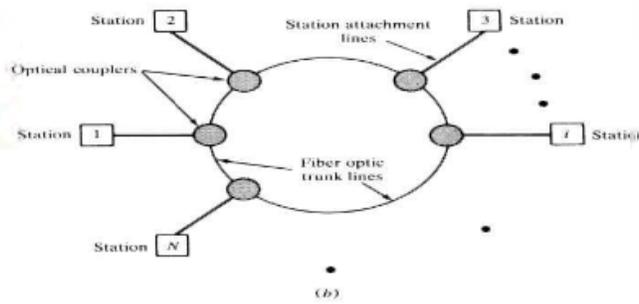
PON is applied to data-centric networks, as well as service voice, data and video networks. Recently, starting in early 2006, work began on a very high-speed 10 Gbit/s EPON XEPON or 10-GEAPON) standard.

Fiber-to-the-home (FTTH) gives the value measurement in the facilities of network testing, measuring and monitoring. FTTH technology also offers an attractive solution for providing high bandwidth from the central office to residences and to small- and medium-sized businesses. FTTH is cost-effective because it uses a passive optical network (PON). FTTH is a network infrastructure that is capable of supporting not only the services the cable operators can offer today, but also the services that will be offered in the future. ETHERNET PON EPON vendors are focusing initially on developing fiber-to-the-business (FTTB) and fiber-to-the-curb (FTTC) solutions, with the long-term objective of realizing a full-service fiber-to-the-home (FTTH) solution for delivering data, video, and voice over a single platform. We can classify FTTH technologies into groups. One is AON (Active Optical Network) which is a cheap solution, but it includes Active devices in the field causing high maintenance and operation cost. In case of PON an average bandwidth of a few 10's of megabits is offered, but a very high peak bandwidth can be offered (up to 2,5 Gbps).

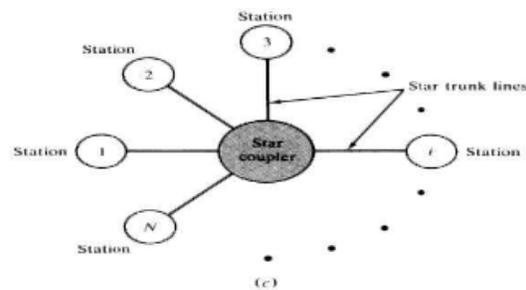
Passive Optical Network (PON) Topologies



BUS



RING



STAR

What is PON?

Is a passive optical network using fiber optic cables (optical fiber) It has a different topology from other network technologies; It uses a Point to Multi-Point (P2MP) topology. A single strand of fiber goes out to a passive optical splitter where its signal is multiplied to 32 different lines. It's up to the customer's system to determine what packets are for that customer, all other packets are discarded. It has downstream data rates up to 2.5Gbps. A Passive Optical Network (PON) is a network with no active elements in the signals' path from source (OLT) to destination (ONU).

Types of PON

There are four type of PON

1- APON

Also, they are known as ATM PON and they are based on asynchronous transfer mode (ATM) PON. It is considered first Passive Optical Network which was used primarily for business applications It has ITU-T G.983 standard. APON is a point-to-multipoint technology. As compared to point-to-point system, the point-to-multi-point system is comparatively cheap.

Advantages of APON:

In providing the same bandwidth, APON the fiber system is less expensive than copper cable based system. So carriers will be able to increase profit margins, reduce investment, and increase competitive capability, while users will reduce the service cost by

sharing the resource of the fiber and bandwidth. Longer range for data transfer. Immune electrical noise.

2- BPON

It is a standard based on APON whose name is Broadband PON. It adds support for Wavelength Division Multiplexing WDM, dynamic and higher upstream bandwidth allocation, and survivability. It also created a standard management interface, between the Optical Line Terminal OLT, enabling mixed-vendor networks.

Advantages of BPON:

In real-time live broadcasting, can be viewed with high quality. data for content services and Voice over IPVoIP are transmitted with higher priority than Internet access (Web access), Everyone can receive network services equally, without being disturbed by heavy users everyone can receive network services equally. However, it is also possible to give a higher priority to specific users

3- EPON

Ethernet for subscriber access networks, also referred to as “Ethernet in the First Mile” (EFM), combines a minimal set of extensions to the IEEE 802.3 Media Access Control (MAC) and MAC Control sub-layers with a family of Physical (PHY) layers. EFM also introduces the concept of Ethernet Passive Optical Networks (EPONs), in which a point to multipoint (P2MP) network topology is implemented with passive optical splitters, and optical fiber PMDs, that support this topology. In addition, a mechanism for

network Operations, Administration and Maintenance is included to facilitate network operation and troubleshooting.

Advantages of EPON:

Higher bandwidth: up to 1.25 Gbps symmetric Ethernet bandwidth. Lower costs: lower up-front capital equipment and ongoing operational costs. More revenue: broad range of flexible service offerings means higher revenues. 2.4

4- GPON:

In 2001, an effort for standardizing PON networks operating at bitrates above 1 Gbps which the FSAN group initiated. Apart from the need to support higher bit rates, the overall protocol had to be opened for reconsideration so that the solution would be most optimal and efficient to support multiple services and operation, administration, maintenance and provisioning (OAM&P) functionality and scalability. As a result of FSAN efforts, a new solution emerged in the optical access market place – Gigabit PON (GPON), offering unprecedented high bit rate support (up to 2.488 Gbps) while enabling the transport of multiple services, specifically data and TDM, in native formats and with extremely high efficiency. In January 2003, the GPON standards were ratified by ITU-T and are known as ITU-T.Recommendations G.984.1, G.984.2 and G.984.3.

Advantages of GPON:

To design a PON that operates at Gigabit and higher data rates .
To craft the physical layer specifications to suit these higher

speeds .To define the most bandwidth efficient protocol that reflects the data-centric trends in customer traffic.

5- Advanced PON

It consists of a standard GPON with novel wireless-enabled optical line terminal OLT and Optical Network Unit ONUs. At the optical line terminal OLT after worldwide interoperability for microwave access WiMAX symbols are generated by multiple transmitters they are upconverted to a subcarrier for each wireless-enabled Optical Network Unit ONU. The frequency division multiplexing FDM technique was used to ensure signal transparency for various radio signal formats and to avoid interference with the GPON spectrum. Each WiMAX transmitter at the OLT is serving a single radio cell at an Optical Network Unit/BaseStation ONU/BS that is divided into small parts called sectors in order to make the cell more efficient in terms of reduced co-channel interference and increased capacity

Advantages of Advanced PON:

Advanced PON capture the best attributes of each GPON and WiMAX seeking to facilitate ubiquitous connection together with the low deployment cost and mobility. The maximum EVMS of -30 dB in downstream was obtained as required by typical WiMAX transceivers while error free transmission of standard WiMAX rates have been demonstrated bidirectionally for extended link lengths up to 21 km

DVANTAGES OF PON :

- point-to-multipoint fiber-lean architecture Instead of running a separate strand of fiber from the central office to every customer. uses a single strand of fiber to serve up to 32 subscribers.
- It uses Optical Fibers so that the bandwidth would be high, and can reach longer distances
- Low cost of equipment per subscriber
- Additional buildings can be added to the network easily and inexpensively Supports a broad range of applications including triple play (voice, data and video).
- Offers a large amount of high speed bandwidth providing greater flexibility for adding future services
- Flexible and scalable bandwidth assignment

DISADVANTAGES OF PON:

- Installing an Optical Fiber requires special equipment
- it is difficult to find the location of the problem If a fiber breaks inside the plastic jacket
- Repairing a broken Fiber is difficult
- Cost of money and material
- Need to deploy new infrastructure replace copper with fiber.

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