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ANALYSIS OF ADVANTAGES AND DISADVANTAGES OF OPTICAL NETWORKS OF SUBSCRIBER ACCESS

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ABSTRACT

This article describes the technical characteristics of optical subscriber access networks widely used today. The main purpose of the article is to analyze the advantages and disadvantages of these optical subscriber access networks. Based on the analysis, conclusions were drawn and appropriate recommendations were made.

Introduction. Passive optical network (PON) is the most promising broadband multi -service technology for transmitting data to many subscribers using optical fiber.

This networking method has become popular due to the obvious advantages in terms of speed, transmission volumes, and opportunities for improvement.

The main difference between PON and other optical systems is the use of only passive equipment

throughout the entire length from the main module, which transmits and receives information flows, to the end user. That is, no active switches, routers, media converters, multiplexers and other equipment that requires additional power and maintenance[1].

In order to split one stream into many subscribers in a PON system, an optical splitter (splitter , multiplexer , PLC) is used. With its help, one transceiver module (distribution box, distribution cabinet, OLT) can distribute a signal to an unlimited number of consumers - it all depends on its power and speed indicators.

Any passive optical network includes three main components [2]:

- station terminal OLT (optical line terminal);
- passive optical splitter ;
- Subscription ONT (optical network termination) terminals or ONU devices (optical network unit).

The OLT transceiver connects PON with external networks and receives a stream that is transmitted to subscribers via a cable network. The splitter multiplies the signal to 8, 16, 32 or 64 subscribers. Each fork slightly narrows the transmission channel, which gives some attenuation of the signal and reduces its throughput.

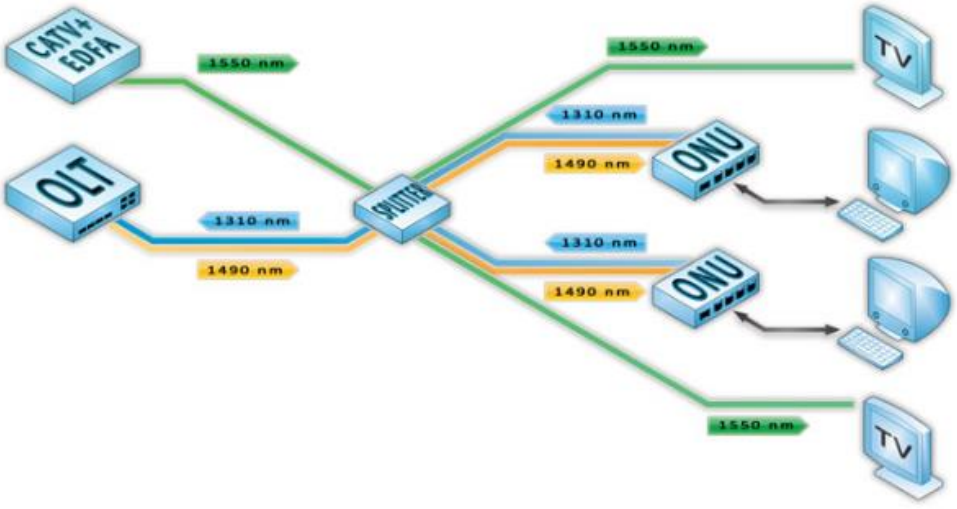

Fig.1. Architecture of optical subscriber access networks based on PON technology

The end user equipment ONT is equipped with interfaces necessary for the user, including outputs for IP-telephony, Ethernet and Wi-Fi.

Most often, a tree-like PON network topology is used for residential premises. It allows you to optimize the use of fiber by placing the maximum possible number of subscribers on one cable. Depending on the final number of users and the requirements of the network, the flow can branch out into one or more levels of cascades. The fewer of them, the easier it is to maintain the system, make the necessary repairs, and the less will be the loss in speed and data volume for the end user. On the other hand, a multi-cascade system allows fine-tuning, more sensitively adapting the network to the needs of the customer.

In general, the topology is selected from a variety of options based on the actual design conditions according to the principle of maximum convenience for subscribers [3].

Using PON networks, you can organize:

- analog and digital television, including IPTV;
- IP-telephony and fixed telephony;
- transfer of technological, organizational, financial information;
- internal data transmission networks of an office or enterprise ;
- home subscriber networks of general use in multi-apartment and private houses;
- fire extinguishing systems (used in the Ministry of Emergency Situations and the Ministry of Internal Affairs);
- security systems and video surveillance systems , including the protection of the communication centers themselves and the "safe city" system, etc.

Benefits of PON architecture:

1) High transfer rate PON supports speeds from 155 Mbps to 2.5 Gbps , which is currently the fastest way to transfer information.

2) Support for heterogeneous traffic The system can transmit any kind of information (data, video, voice), lead information flows of any origin to an apartment or office.

3) Large capacity . The system can process streams from several resources simultaneously without quality loss. Several computers, TVs, IP phones, etc. can be connected to one subscriber port.

4) Reduce maintenance costs. PONs use passive taps that do not require electrical power or additional maintenance.

5) Optimum use of material. Connecting the maximum number of subscribers to one fiber helps to use less cable, which can translate into significant savings.

6) Noise immunity and protection against voltage surges . Unlike systems using twisted pair (FTTh , etc.), PON is not affected from outside and is protected from voltage drops, interference and interference.

7) Ease of access. There is no need to place equipment for the PON network in outdoor cabinets, so the system is easily accessible for inspection, modification and repair during the cold season and saves on all-weather equipment.

8) Easy to connect. Connection of subscribers to the network occurs quickly and without interruption of communication.

9) Possibility of sealing. Compaction (multiplexing) of the signal allows, if necessary, to launch additional information flows through an existing cable - for this, light waves of a different length are used. Thus, an existing cable system can be used to add services, including security systems, video surveillance, security, fire protection, etc.

10) Continuous development of PON technologies . The growth of capacities, speeds and cheaper components make it possible to consider this data transmission technology as one of the most promising.

Disadvantages of PON Architecture

The need to encrypt the stream. PON is a technology with a common data transmission medium, so individual information flows have to be encrypted. This can reduce the useful transfer rate, and also does not protect information from hacking at the physical level.

The complexity of the system. It is difficult to detect problems in the system in the area between the splitters and the end point - ONT.

It is important to keep in mind that by choosing a professional installer who can install well, monitor

status, and provide a complete service, network problems are minimized.

Types of PON networks. The technology of passive fiber optic networks was put into practice in the mid-90s, initially in the modification of APON. After a number of improvements in the early 2000s, BPON technology appeared with better speed and a larger number of processed streams. The next in the line of passive networks was EPON on Ethernet technology. Currently, the most modern, convenient and promising system for creating large branched networks is the **GPON system [4]** .

GPON is based on the SDH platform (GFP protocol) and allows you to connect up to 64 subscribers to one transmission module at a distance of up to 20 km. The use of splitters and couplings allows you to increase the range up to 60 km. Transfer speeds average up to 2.5 Gb, although it is technically possible to develop a system that can reach 4–10 Gb/ s in each direction.

Another existing modification is GEPON technology. It can be called the most economical, but this advantage implies some overhead compared to GPON networks. In particular, it lacks specific TDM support, synchronization, and protection switching functions. Such a system works well for small operators focused on IP traffic, including IPTV.

In general, the choice of technology for creating or improving a passive fiber optic network depends on the conditions of the customer, the needs of subscribers and development prospects. The installer company should study the background data in detail to make a decision on the choice of technology and develop an optimal plan for the future PON.

Conclusions

Currently, passive networks based on optical fiber are becoming more widespread. Copper twisted pairs cannot compete with PON in terms of volume, speed and range of data transfer, noise immunity and scalability If initially twisted-pair cables were often preferred due to the high cost of optical raw materials and equipment, now the systems differ insignificantly in terms of capital costs and labor intensity of installation. Still popular is the construction of a combined type of networks - FTTH, where a copper pair is used only in the section from the switch to the subscriber. However, the dynamics are increasingly shifting towards PON, also due to the fact that the installation of a passive network allows modification without interfering with the system architecture and re-wiring.

However, installing a PON network is a capital-intensive and complex process, so it is important to entrust this work to trusted industry professionals. They will be able to create a thoughtful system configuration with the possibility of optimization for the needs of the customer and uninterrupted operation.

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