FIBER OPTIC SYSTEMS

Maxmudova Dilafruz Xasanovna
Assistant of the Department of Natural Sciences,
Tashkent State Transport University,
Email: dilafruztayi@gmail.com

Sohibnazarov Lochinbek Ilhomovich
Tashkent State Transport University, student

ABSTRACT

The article presents the advantages of information transmission in modern technology, basic information about optical communication, information about optical signal.

Key words: *fiber-optic systems, world signals, optical communication, radiation induction*

Optical communication is a communication in which information is transmitted in the form of light along an optical fiber or in the atmosphere of open space. If the information is transmitted through fiber, it is called a fiber optic communication system, and if it is transmitted in the open atmosphere, it is called an open optical communication system.

In open optical communication systems, radiation sources radiate electromagnetic waves into open space, where the direction of radiation propagation is determined only by the antenna's directional diagram. The transmission environment of open optical communication systems, in turn, is divided into three types: atmospheric, space and underwater communication environments.

Wave propagation characteristics in open-atmosphere optical communication systems depend to a large extent on weather conditions. Electromagnetic waves are distorted due to the fact that the atmospheric and underwater transmission media are not of the same physical type and foreign particles in their content interact with the transmitted radiation wave. Particle sizes comparable to or larger than the wavelength increase the distortion. Therefore, atmospheric disturbances have a different character in the optical range. In this way, the analysis of transmission media is the most important issue that arises in the design of communication systems. Particles falling into the direction of propagation of waves mainly absorb and scatter optical radiation.

The degree of influence of these factors depends on the type of environment (underwater, fresh air, turbulent atmosphere, etc.)

The main direction of the optical communication system is the fiber optic communication system. Because currently, light transmitters with high transmission characteristics have been developed. However, open optical communication systems based on the transmission of information in open space, in the atmosphere, also show interest as a means of filling the frequencies reserved for radio optical communication. In fiber optic communication systems, special optical light transmitters-optical fibers are used to organize the path of propagation of electromagnetic radiation.

Fiber optic communication network is a communication network connected by optical communication lines between nodes. Transmission of information through fiber optic communication lines has several advantages over copper cables and other transmission media. Due to these advantages, the optical fiber communication system is widely used not only in the organization of telephone communication, but also in television, sound broadcasting, computer equipment, vehicles and other fields. Fiber optic connection

advantages of optical fibers used as a transmission medium in systems.

The width of the transfer interval. This carrier frequency is too high

$10^{14} - 10^{15}$ is explained by Gs. It is possible to transmit several terabits of information per second along one optical fiber. Bandwidth is the most important advantage of fiber optic communication over copper and other media.

Low attenuation of light signals in optical fiber. Optical fibers produced by many companies today have an attenuation of 0.2-0.3 dB/km at a wavelength of 1.55 μm per channel kilometer. Low noise level increases the throughput of optical fiber.

High protection against noise. Since the optical fiber is made of dielectric materials - quartz, multi-component glass, polymers, it is not affected by the external electromagnetic interference of the surrounding copper cable system and electrical devices (power lines, electromotive equipment, etc.) that have the property of inducing electromagnetic radiation.

Lightness, size and small size. Optical cables are lighter and smaller in size compared to copper cables. For example, 900 pairs of 7.5 cm diameter copper telephone cable can be replaced by a single 0.1 cm diameter optical fiber. If the optical fiber consists of several protective sheaths and the armor is covered with a steel tape, the diameter of such a fiber will be 1.5 cm, which is several times smaller than the diameter of the copper cable in question.

Fire protection. Non-sparking in optical fiber improves safety in chemical, oil processing plants, explosion and fire hazard buildings.

Economic efficiency. Optical fiber is made from quartz. Its basis is silicon dioxide SiO_2, widely distributed in nature. Therefore, rare colored metal is not used for the production of fiber optic cables. At a time when the world's reserves of copper and lead are limited, the transition to a non-unique product is an important factor for the future development of cable communication technology. As a result, the price of optical cables is lower than that of copper cables.

Having a remote power supply. In some cases, remote power supply of network nodes is required. This cannot be done over fiber optics. In this case, mixed cables equipped with a copper transmission element can be used together with optical fiber. Such cables are widely used in many countries.

The creation of new types of optical fibers (non-zero shifted dispersion), broadband quantum optical amplifiers makes it possible to build complete optical systems and optical tracts.

In optical communication, information is transmitted and processed in the form of light or optical signals The choice of the type of light radiation and wavelength for optical communication depends on the nature of the transmitted information, as well as the possibilities of radiation generation, signal formation from it, light wave transmission and processing, and finally, the reception of a signal with information.

The generalized structural scheme of the optical communication system is presented in figure. The scheme is made up of standard blocks (elements) specific to types of optical communication, fiber optic communication and open optical communication.

Continuous or digital signals are provided from the source of information. Then the signals modulate the electromagnetic oscillations of the light stream-carrier frequency.

An intensity-modulated optical signal can be fed directly to a photodetector and easily converted into an electrical signal that preserves the appearance of the original signal. This method of receiving optical signals is called the direct photodetection method.

Currently, digital transmission systems (RUT) are used as end devices of optical communication. Because RUT has the following advantages over analog transmission systems: noise tolerance, high signal transmission quality is less dependent on the length of the line tract, high technical and economic indicators, etc. Due to several disadvantages of analog transmission systems with channels divided by frequency, their use in optical communication is limited.

Fiber optic communication systems are divided into trunk, regional, local-city and rural communication systems according to the function and signal transmission

distance. Trunk fiber optic communication systems transmit signals to 1000 km, zone fiber optic communication systems transmit signals to 600 km, city fiber optic communication systems serves to thicken the connecting lines of the telephone network.

The advantage of the method of frequency intensification is that the length of the regeneration section due to such reception of signals is up to 200 km becomes longer and the utilization ratio of optical fiber increases.

One of the promising ways of increasing the utilization ratio of optical fiber is spectrum (wavelength) densification. It increases the possibility of transmitting signals of different speed and digital, analog and different modulation (telephone, television, telemetry, exposure control signals). This ensures the organization of economical multifunctional communication systems.

One of the most important advantages of this method is the somewhat full use of the spectral transmission range of the optical fiber. Currently, the range of 0.8...1.8 μm is studied. If the width of the spectral channel is 10 nm, then up to 100 spectral channels can be placed in the specified range.

Depending on the diameter of the core in relation to the wavelength, optical fibers are divided into single-mode and multi-mode. Single-mode optical fibers often have a core diameter of 7-10 μm, and multi-mode optical fibers have a core diameter of 50-62.5 μm. In both species, the diameter of the shell is 125 μm.

In practice, there are other values of multimode and single-mode optical fiber diameters. Only one mode (light carrier) is transmitted through a single-mode optical fiber. A multimode optical fiber can simultaneously transmit several hundreds of allowed modes entering the fiber at different angles within the aperture angle. All allowed modes have different propagation path and time. Stepped refractive index multimode optical fibers sharp (in the form of a step) change in refractive index at the boundary of two media (n_1 from n_2 ga) is characterized by Stepped refractive index optical fibers limit the transmission bandwidth, but are cheaper than gradient refractive index optical fibers.

Due to the absence of intermode dispersion in single-mode optical fibers, they have high throughput. However, the transmitter part requires the use of somewhat expensive laser diodes.

Dispersion is one of the most important factors affecting the quality of signal transmission in optical fiber. Dispersion is the stretching of the ends of the light pulses, that is, the broadening of the pulses. The pulses expand and cover each other, intersymbol interference occurs, and the useful information transmitted from the sequence of pulses cannot be distinguished during reception.

Dispersion limits the operating speed of optical systems by reducing bandwidth. Usually the dispersion is normalized per kilometer and is in ps/km is measured.

Conclusion

Advantages and areas of application of optical information transmission in modern technology were considered. The basic information about optical communication, open optical communication and fiber optic communication, structural principles of fiber optic communication systems were studied. Optical information transmitting sources, their types, description and parameters were studied. One of the important characteristics of laser diodes is that the watt-ampere characteristic depends on the ambient temperature. When an optical signal is transmitted through a fiber, the optical signal is attenuated due to the loss of signal power as a result of the linear and nonlinear interaction of light waves with the fiber medium.

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