Use of ultra-wideband information transmission system in existing communication systems

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ABSTRACT

This article shows that ultra-wideband information transmission systems based on Radio-over-Fiber (RoF) technology are a promising and innovative technology that allows increasing the speed of information content transmission and improving the quality of services provided. And further use of the RoF system to solve radio engineering problems will improve the quality and range of wireless communications.

Keywords: Ultra-wideband information transmission, wireless communications

List of abbreviations and symbols

UWB-RoF - ultra-wideband information transmission system based on Radio-over-Fiber technology;
FTTH-fiber-to-the-home - “optics to the home”;
UWB- Ultra-wideband (ultra-wideband);
OCU-optical control device;
RAU- Remote antenna unit (remote access module).

Introduction

When implementing an ultra-wideband transmission system based on Radio-over-Fiber technology, it is of interest to use UWB-RoF technology in FTTH (fiber-to-the-home) networks. When using FTTH technology, the optical cable goes to the subscriber. This organization of the data transmission network allows for high transmission speeds for subscribers. Also, such networks are highly reliable, since there is no need to organize remote power supply via coaxial cable, and the additional fibers provided allow for redundancy. Since it is possible to organize high transmission speeds in FTTH networks, the use of UWB-RoF technology in these networks is appropriate.

Main part

When using UWB-RoF technology in FTTH networks, additional advantages arise, such as the absence of transmodulation in the optical cable and frequency conversion. This direction can be used to organize the transmission of several information channels in one fiber and wireless channel, which will be used to transmit various standards (LTE, HD and 4K digital television, Wi-Fi, UWB, etc.).

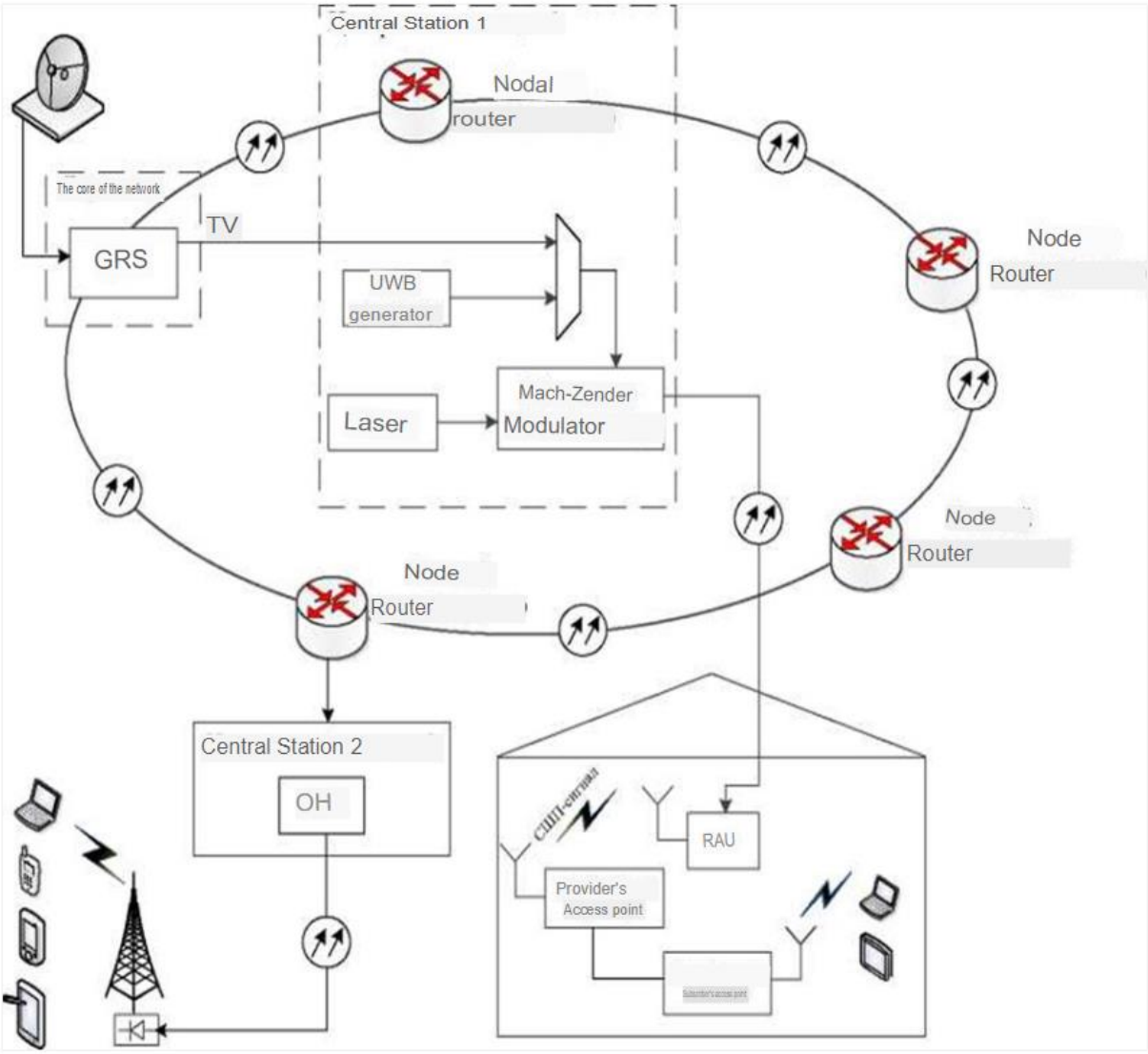

Figure 1 - Organization of an Internet traffic transmission system using UWB-RoF technology in FTTH networks

Internet data arrives at the hub router located at the central station. Further, the Internet data is transmitted via a copper cable to the quarterly switch, also located at the central station. Data from the quarterly switch is received by the multiplexer together with the UWB signal generated by the UWB generator. Next, the generated signal is sent to the electrical input of the Maxa-Sendera modulator. The generated RoF signal enters the optical line. Having passed through the fiber-optic communication line, the RoF signal arrives at the RAU module, which is located in the subscriber's apartment or cottage.

In the apartment, together with the RAU module, there is an access point for the service provider (provider) and a subscriber's access point (for example, a Wi-Fi router). Since the UWB wireless communication range is short (about 4 m), the UWB signal is used to communicate between the RAU module and the provider's access point. The provider's access point and the subscriber's access point are connected using a copper cable (twisted pair). From the provider's access point, Internet data arrives at the subscriber's access point and is transmitted to the corresponding electronic devices connected to the Internet (phone, laptop, etc.).

The use of UWB technology will increase the data transfer rate between the RAU module

and the provider's access point, which in turn will reduce the time for processing information and provide the subscriber with high-speed data transfer.

When using optical control of the antenna array's radiation pattern, the optical control device (OCD) is also located at the central station. The optical cable from the ODU goes to the photodetector located on the antenna match.

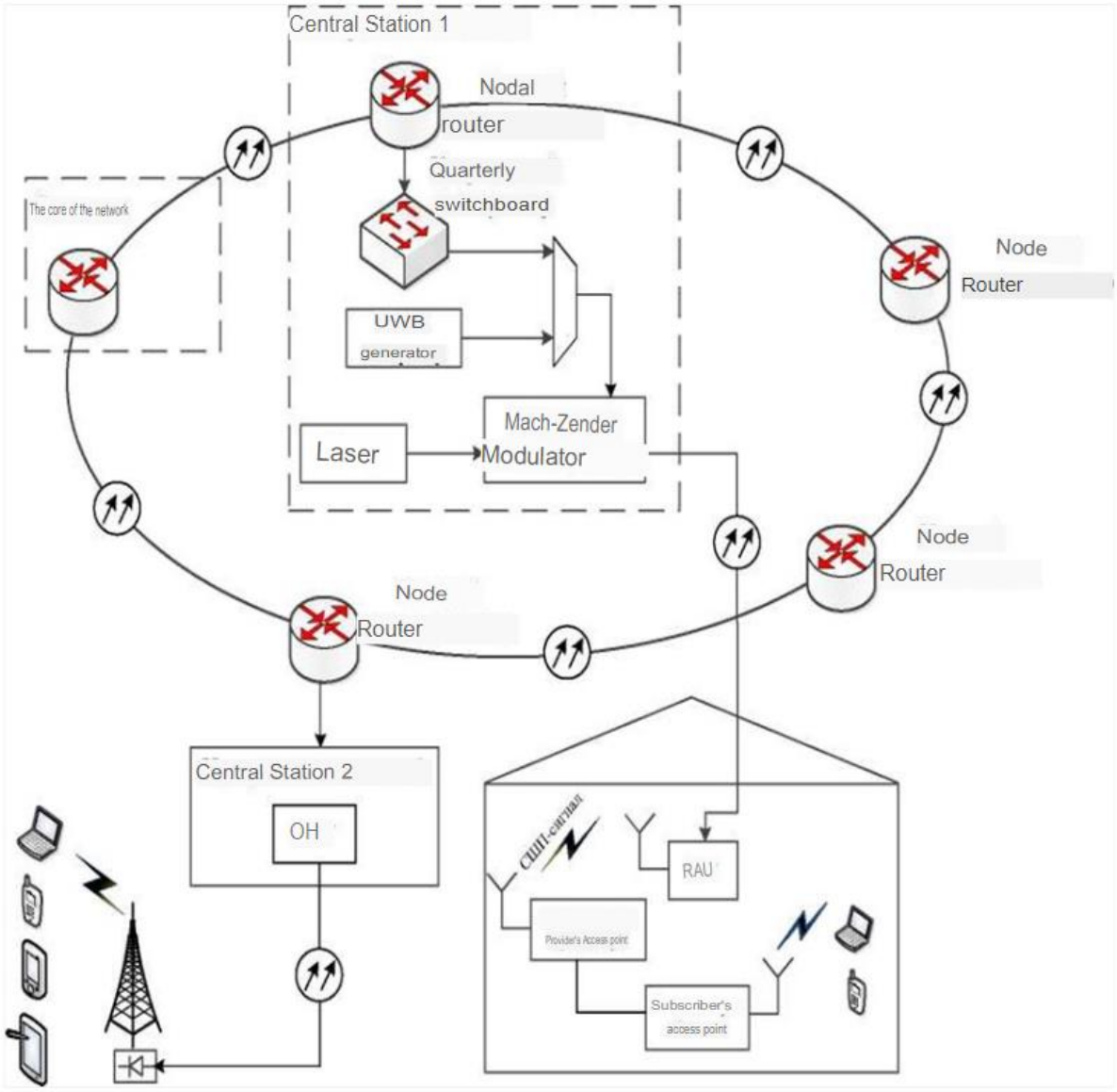

Figure 2 - Organization of a television content transmission system using UWB-RoF technology in FTTH networks

The television signal from the main distribution network (GDN) enters the multiplexer. The multiplexer also receives a UWB signal from the UWB generator. Next, the generated signal is sent to the electrical input of the Maxa-Sendera modulator. The electrical signal modulates the optical carrier generated by the fiber laser. The RoF signal, passing through a fiber-optic communication line, arrives at the RAU module located in the subscriber's apartment or cottage.

As in the first case, the UWB signal is used to communicate between the RAU module and the provider's access point. The television signal from the provider's access point is transmitted via a copper cable to the

subscriber's access point and then to the end devices (TV, computer, etc.).

UWB-RoF technology can also be used in departmental communication networks. The communication diagram is shown in Figure 3.

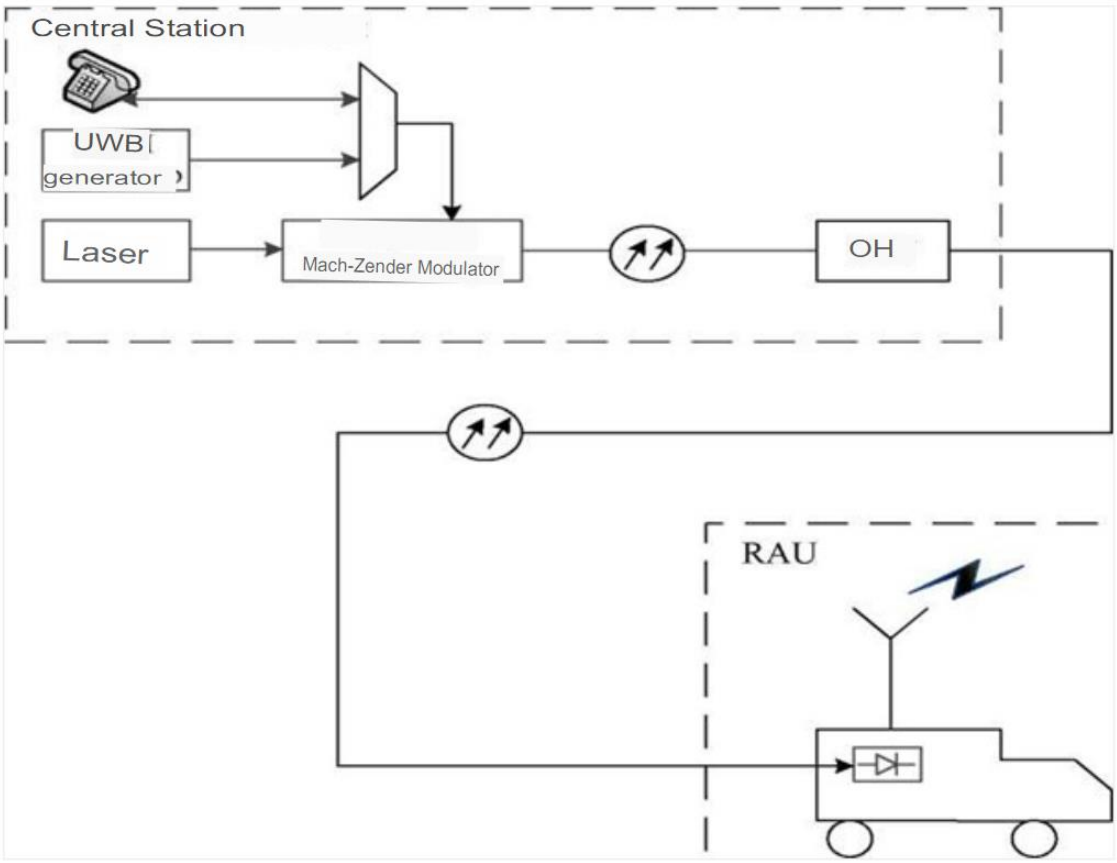

Figure 3 - Application of UWB-RoF technology in departmental communication networks

At the central station, which is located in the general headquarters, a UWB signal is generated. Together with the UWB signal, the Mach-Zehnder modulator can also receive a telephone signal. The optical carrier from the fiber laser is supplied to the optical input of the modulator. The electrical signal modulates the optical carrier. Next, the generated RoF signal enters the fiber-optic communication line.

The RAU module is a mobile station on which antennas and photodetectors are located. Since the UWB signal has low isotropic radiated power (-45 dBm/MHz), it is transmitted at a noise level, which makes it much more difficult to intercept.

Useful signals are transmitted via optical fiber, which allows increasing not only the transmission speed, but also the noise immunity of the communication line, and accordingly improving the quality of the services provided. The use of RoF technology in conjunction with UWB technology makes it possible to organize high-speed information exchange between the RAU module and the provider's access point, which in turn provides high-quality content for subscribers.

The use of the proposed scheme for constructing a fiber-optic segment of the UWB-RoF system in departmental communication networks will make it possible to move the mobile station far enough from the central station where the radio transmitting devices are located. Since the UWB signal is transmitted at a noise level, the likelihood of its interception is significantly reduced, which allows you to organize a reliable and secure communication line.

Conclusion

The use of Radio-over-Fiber systems makes it possible to provide broadband access services to all subscribers without exception. This direction is especially relevant in settlements remote from the city, where it is necessary to lay an additional cable line to connect subscribers to the operators' switching center. Radio-over-Fiber systems with a simple and inexpensive base station organization (remote access module - RAU) make it possible to solve this problem, since the cost of connecting such subscribers to the Internet information and communication network is significantly reduced

At the same time, RoF systems allow solving radio engineering problems, which makes them attractive for use in conjunction with wireless data transmission systems.

Recommendations are given for the use of the UWB-RoF system in existing communication networks. Options for using this system in FTTH networks and departmental communication networks were considered. Using the UWB-RoF system provides additional advantages, such as high transmission speed, lack of transmodulation and the inability to intercept the UWB signal.

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