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TRANSPORT TELECOMMUNICATION NETWORKS OF MOBILE COMMUNICATION FOR SHARED USE

Abstract. In this work, the creation of networks requires the use of modern hardware and software that meet the requirements, as well as the development of a new infrastructure for micromesh networks. At the first stage of 5G implementation for Fronthaul transport networks, in case of impossibility of laying fiber optics communication lines, it is considered expedient to use atmospheric optical communication systems.

Keywords: atmospheric optical communication systems, broadband access, Mobile Backhaul, backbone

The size of investments in modern telecommunication networks and the price of resources are constantly growing, at the same time, the cost of services for subscribers should be reduced. One possible solution to this problem is the sharing of telecommunications infrastructure by different providers. In this case, competitors become partners to reduce increased investment, and the reduction of duplication allows investment to be directed to underserved areas and innovative products, as well as to improve customer service. Therefore, the problem of joint operation of frequencies, network infrastructure and other resources required by telecom operators (Network Sharing) is becoming one of the most urgent today.

In order to ensure the widespread development of one of the most popular telecommunication systems, namely mobile broadband access (MBA), it is necessary to use modern principles and approaches to create favorable conditions for the expansion of such networks based on the sharing of telecommunications infrastructure [1]. To achieve this goal, which allows to reduce capital and operating costs for the deployment of mobile networks, it is necessary to combine the efforts of two or more operators in order to jointly create and/or use a network infrastructure to serve their customers.

Network Sharing is divided into two types - passive (Passive Sharing) and active (Active Sharing) components. The first type includes the sharing of sites (Site Sharing) and antenna mast structures (AMS), as well as transport networks (Mobile Backhaul). The second type involves the sharing of elements of the radio access network (RAN), as well as the possible sharing of elements of the core network (Core Network).

As radio access technologies improve (from networks of the second and third generation to the fourth), the sections of networks that are narrow in terms of bandwidth are shifting in the direction from the radio interface towards the transport network. The rapid growth of mobile MBA traffic in the transition to new high-speed HSPA+ and LTE networks is one of the main drivers for increasing investment in Mobile Backhaul networks.

The classical transport network of a mobile operator consists of two main segments:

- distribution network (backhaul) connecting base stations with controllers and mobile switching centers (Mobile Switching Center, MSC);

- backbone network, providing high-speed transport between switching centers.

The 5G C-RAN and 4G C-RAN high-level architectures

occupy the position of an intermediate link ("middle mile") between the core network and small subnets at the "edge" of the entire network (Fig. 1).

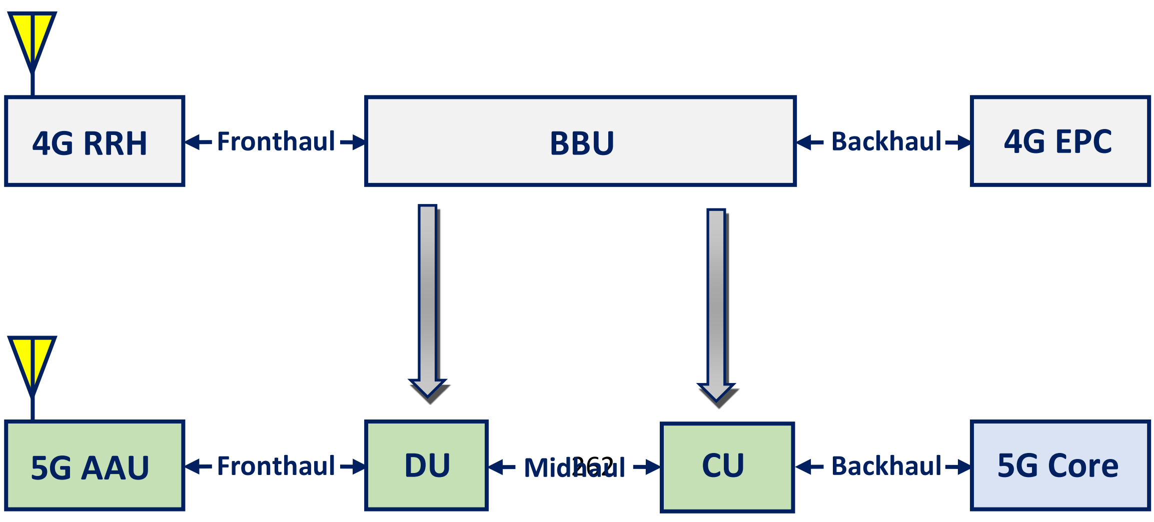

Fig1. High-level 5G C-RAN and 4G C-RAN architectures

When organizing microwave communication, there is a choice of two options: radio or optical communication. Currently, to reduce costs when bringing information to the consumer, radio communication is widely used. This is due to the fact that today radio engineering methods are quite well developed and there is a large set of technologically produced radio equipment (radio modems) produced by the industry, as well as the comparative cheapness of radio equipment. However, in some cases, radio communication is unacceptable:

- due to the limited frequency band of the radio range, the speed of information transmission is limited;
- unfavorable electromagnetic situation on the interval;
- the need to obtain the appropriate permission for the radio frequency;
- the ability to listen to radio channels.

Such cases are not uncommon, and then the use of atmospheric optical communication systems, devoid of the above disadvantages, can solve these problems.

The principle of constructing atmospheric optical communication systems atmospheric optical communication systems is known to be similar to fiber optic communication lines, except for the transmission medium used. The technology is based on the transmission of data by modulated radiation in the infrared part of the spectrum through the atmosphere. To connect atmospheric optical communication systems to consumers, each manufacturer uses its own interface. However, they all adhere to a common connection ideology, which is that the atmospheric communication line is an emulation of a cable segment (two twisted pairs or two cores of an optical cable). Thus, for all devices participating, for example, in the cable network of connected objects, the atmospheric optical communication systems is not “visible”, i.e. no restrictions are imposed on the equipment, no additional communication protocols or changes and additions are made to them.

The advantages of using atmospheric optical communication systems based on infrared semiconductor LEDs and laser diodes, compared to other wireless solutions, are as follows:

- air congestion associated with the limited radio range, and the use of the infrared optical range expands the possibilities of wireless information transmission;
- transmission by a narrow beam, in the absence of side radiation, provides high noise immunity and confidentiality of optical communication;
- high energy efficiency and low specific cost of a bit of transmitted information;
- compatibility with other digital information transmission devices.

It should also be noted that in recent years, atmospheric optical communication systems have been increasingly introduced into telecommunication networks and this is due to the following circumstances:

- stable laser radiation sources with a time between failures of up to several hundred thousand hours have been created;
- Simplified installation and connection;
- it became possible to organize communication between moving objects;
- high confidentiality of communication;
- no need to obtain permission to use;
- the possibility of providing high speeds of information transfer.

There are also situations where the use of atmospheric optical communication systems is not possible. Of these, the most significant is the limited communication range associated with the attenuation of the energy of optical waves during propagation in the atmosphere by molecular and aerosol absorption and scattering [2].

When calculating the atmospheric optical communication systems, it is important to consider the total attenuation created by the action of all these factors, as well as its statistical characteristics. It is known that energy losses consist of two components, a constant component and a variable, determined by changes in the transparency of the atmosphere, depending on changes in meteorological conditions.

Statistical data on MDR, collected by the authors in accordance with the recommendations of ICAO from weather stations of the airports of Tashkent, Urgench, Samarkand, Karshi, Fergana and Bukhara on the territory of the Republic of Uzbekistan, were processed and presented in the form of integrated distribution functions MDR - F(sm).

The results of processing the statistical data of the MDR for the regions of the Republic of Uzbekistan show that with the required accessibility of the atmospheric channel, the length of the interval is about 1-2 km. [3-5]. If we take into account that the distances between the base stations of cellular networks in urban conditions are within the same limits, then the length provided by AOSS for transport networks can be considered quite satisfactory. In addition, manufacturers, to increase the channel availability factor and increase communication reliability, use methods such as:

- production of equipment with several parallel emitting lasers (provides protection from flying birds, snowfall);
- the use of spatial stabilization systems (autotracking), which automatically direct the laser beam to the receiving device (failures of the optical line due to its misalignment often exceed the downtime due to bad weather conditions). The introduction of autotracking allows you to install transceiver modules on unstable grounds - wooden roofs, cell towers, etc., while maintaining the reliability of the communication line;
- implementation of a backup radio channel in atmospheric optical communication systems systems, which allows not to interrupt data transmission in bad weather conditions (heavy fog, snowfall, etc.).

Thus, the capabilities inherent in atmospheric optical communication systems stimulate today the intensity of their development and widespread implementation. Considering also the ability to provide high data rates required for 4G and 5G networks, of all possible options for organizing transport networks for sharing by mobile operators, the choice of atmospheric optical communication systems is preferable.

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