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Wireless Network Enhancement in the Arctic by Selection of Dielectric Materials of Rooms

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Abstract: ***The Arctic is of fundamental military-strategic importance for Russia. The development of the Arctic without an advanced telecommunication infrastructure is very difficult. To supply working in the Arctic employees with universal means of communication, it is the most efficient to use wireless communication band between 2.4 GHz and 5 GHz. Facilities, where radio telecommunication equipment in the Arctic works, have walls consisting of a multilayer structure. There is the problem of organizing communication of good quality. In such rooms, the best method is to use wireless networks using MIMO technology. We have developed a theory that allows us to determine the time Interflection T based on the determination of the dielectric constant of multilayer materials. In this case, problems arise in determining this coefficient. We propose to use the well-known method of short circuit and idling. We conducted a large number of measurements to determine the dielectric constant of various materials. We used this value to calculate the time T. In the future, we made adjustments to the premises by changing the size and amount of multilayer materials. Experimental results in the range from 2.4 GHz to 5 GHz showed that the data transfer rate increased by 5-10% when we performed the calculation of time Interflection and processed the room with multilayer materials. The proposed method is applicable indoors to build a wireless LAN standard IEEE 802.11 n.***

Keywords: ***dielectric materials, wireless, Arctic.***

I. INTRODUCTION

The Arctic is of fundamental military-strategic importance for Russia. The development of the Arctic without an advanced telecommunication infrastructure is very difficult. To supply working in the Arctic employees with universal means of communication, it is the most efficient to use wireless communication band between 2.4 GHz and 5 GHz. Facilities, where radio telecommunication equipment in the Arctic works, have walls consisting of a multilayer structure. There is the problem of organizing optimal communication. The most effective way is the organization with the application of MIMO technology (Multiple-Input Multiple-Output).

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MIMO uses a technique of spatial multiplexing and several antennas that send and receive signals simultaneously [1]. When transmitting two spatial streams, this technique can double the bandwidth of the wireless channel. It is capable of operating in a complex radio frequency environment, which may include various obstacles creating multiple-beam interference, which in turn is the cause of echoes and dead zones.

When using MIMO technology, the above problems, which are present in 802.11 a/b/g networks, have been resolved. The access point retrieves information by summing signals from all antennas. This information allows you to more accurately restore the original signal, which increases the bandwidth of the channel and increases the communication range.

The speed of information transmission in a wireless network significantly depends on the environment of propagation. A sufficiently large number of studies, in particular, studies [2-3], is devoted to the study of signal propagation in wireless networks. The authors describe in detail the propagation environment, interference from different devices, including Wi-Fi devices, and give methods to increase the speed of data transmission in the network.

However, these studies have not fully investigated the effect of wall materials on the characteristics of the network Wi-Fi in the rooms. We offer you to use the statistical theory of indoor radio wave propagation designed by one of the authors [4]. To use this theory, it is necessary to know the complex value · that is the dielectric constant of a particular material. Many researchers use the short circuit and idle method in waveguides [5]. This method allows you to determine the dielectric constant of the studied samples. Researchers direct the signal through the sample, determine the coefficient of the standing wave and phase.

The purpose of this study is:

- determination of the dielectric constant of materials commonly used in the Arctic;
- selection of materials for treatment of rooms;
- experimental determination of the quality of the wireless network in the treated area.

II. MATERIALS AND METHODS

A. The statistical theory of radio wave indoor propagation

The radio wave propagates from the 802.11 access point in all directions since a circular antenna is usually used.

It is reflected from all surfaces that it encounters in its path. Sometimes the radio waves may return back to the access point with a phase difference. This process is called interference. As a result, at some points, the signal may completely disappear, or its level will decrease significantly. Such interference significantly degrades signal reception.

We set ourselves the task of determining the time, let's call it the time Interflection T, during which the signal-to-noise ratio will not exceed the permissible value. Radio waves propagate randomly in the room, reflected from bounding surfaces. The electromagnetic field strength and the velocity vector at each point in space are determined as a result of the addition of these waves, taking into account the phase. This process makes it difficult to determine the level of the radio signal at each specific point, and in most cases, makes this impossible. The chaotic motion of the waves makes us think that we can apply the methods of mathematical statistics and probability theory. We can assume that the electromagnetic waves in our case are incoherent since the orientations, amplitudes, and phases of the waves are randomly distributed during interference. As a result, we have that the energy density of the signal at each point is equal to the sum of the energy densities of each of the waves that arrived at this point. This approach allows us to consider the statistical method to a certain degree of reliability true and can lead to the possibility of constructing a mathematical model, and then to practical application. Next, we consider the possibility of constructing such a mathematical model.

After sufficiently volumetrical mathematical calculation formula for T - time Interflection was found:

$$T = \frac{N_{S/N}}{\beta} = \frac{N_{S/N} \cdot 4V}{10 c_0 S \lg \dfrac{1}{1-\alpha}} = \frac{0{,}4 N_{S/N} V}{c_0 S \lg \dfrac{1}{1-\alpha}} \tag{1}$$

where:

NS/N — signal/noise ratio (dB);

V — room volume (m^3);

S — square of absorbed surface indoors (m^2);

C_0 — radio wave data transmission rate;

α - average coefficient of radio wave absorption indoor;

The average coefficient of radio wave absorption indoor is defined by the formula:

$$\alpha = \frac{1}{S}\sum_i \alpha_i S_i \,, \tag{2}$$

where • i − absorption coefficient of one of homogeneous surface Si bounded indoor.

We had difficulty using formula (2) since there is very little information in the reference literature on the coefficient α for materials that builders use indoors for 802.11 standard radio waves. We used the short circuit and idle method [5] to find the coefficient α. Next, we describe a method for obtaining such values for a three-layer medium in the 2.4 GHz band.

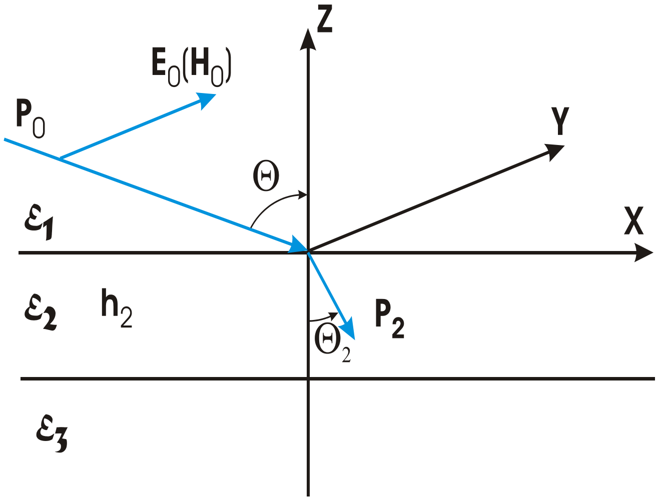

Fig. 1.The geometry of the problem. Vertical-E0 and horizontal-H0 polarization

We see Fig.1 that a plane electromagnetic wave is directed from the airspace (e* = 1, μ* = 1) into a medium consisting of several layers. All layers are dielectrics. Our task is to determine the reflection coefficient. Suppose that a radio wave has horizontal and vertical polarization. We will change the angle of incidence of the electromagnetic wave Θ. We will assume that the upper and lower layers of this medium have a semi-infinite thickness. At the same time, the layer thickness should be equal to the wavelength of the radio signal. We will change the values of e* of the second and third layers.

We assume that the first layer is air, and the second layer is the finishing material used in construction. The massive third layer is a solid wall of concrete or brick. We use the Brekhovsky mathematical theory of multilayer media [5]. Based on this theory, we obtain the reflection coefficient $K_{1,3}$ between the first and third layers (3). This formula uses the values of the reflection coefficient $K_{1,2}$ between the first and second and of the reflection coefficient $K_{2,3}$ between the second and third layers of the multilayer medium. We determined these coefficients for the horizontal (4,5) and vertical (6,7) polarization of the electromagnetic wave.

$$K_{1,3} = \frac{K_{1,2} + K_{2,3} e^{\gamma_1}}{1 + K_{1,2} K_{2,3} e^{\gamma_1}}, \qquad \text{where} \quad \gamma_1 = -j\frac{4\pi h_2}{\lambda\sqrt{\varepsilon_2}} \tag{3}$$

Then for horizontal polarization:

$$K_{1,2} = \frac{\sqrt{\varepsilon_1}\cos\Theta - \sqrt{\varepsilon_2 - \varepsilon_1(\sin\Theta)^2}}{\sqrt{\varepsilon_1}\cos\Theta + \sqrt{\varepsilon_2 - \varepsilon_1(\sin\Theta)^2}} \tag{4}$$

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$$K_{2,3} = \frac{\sqrt{\varepsilon_2}\cos\Theta_2 - \sqrt{\varepsilon_3 - \varepsilon_2(\sin\Theta_2)^2}}{\sqrt{\varepsilon_2}\cos\Theta_2 + \sqrt{\varepsilon_3 - \varepsilon_2(\sin\Theta_2)^2}},$$
$$where\ \Theta_2 = \arcsin\left(\frac{\sin\Theta}{\sqrt{\varepsilon_2}}\right) \quad (5)$$

for vertical polarization

$$K_{1,2} = \frac{\varepsilon_2\cos\Theta - \sqrt{\varepsilon_1(\varepsilon_2 - \varepsilon_1(\sin\Theta)^2)}}{\varepsilon_2\cos\Theta + \sqrt{\varepsilon_1(\varepsilon_2 - \varepsilon_1(\sin\Theta)^2)}} \quad (6)$$

$$K_{2,3} = \frac{\varepsilon_3\cos\Theta_2 - \sqrt{\varepsilon_2(\varepsilon_3 - \varepsilon_2(\sin\Theta_2)^2)}}{\varepsilon_3\cos\Theta_2 + \sqrt{\varepsilon_2(\varepsilon_3 - \varepsilon_2(\sin\Theta_2)^2)}} \quad (7)$$

where Θ - radio wave angle of attack to surface(from 0 to π/2);

h2 — thickness of the second thin layer;

λ — wavelength of a radio signal;

ε1, ε2, ε3 — dielectric constant of air, a thin layer, and a basis accordingly.

Average reflection coefficient K is defined by changing attack angle to surface in the range from 0 to π/2. Value K and α is connected by correlation for current surface:

$$K + \alpha = 1 \quad (8)$$

So, if we know K, we can find α for the current surface. For using formulas 1-7, it is needed to know the complex value ε that is specific material dielectric permittivity.

B. The dielectric permittivity measuring method

The usage of the waveguide method of short circuit and idle [4] is adopted for material dielectric properties optimally. The method is based on obtaining of standing wave ratio (SWR) and microwave signal phase passing through a sample. Firstly the microwave path calibration should be done, and it consists of choosing of reference plane while wave phase measuring. To obtain the latter, the shorted line standing minimum wave position should be found for that. Then we connect to the end of the line, a section of the waveguide that is closed at the end. Since the waveguide is long enough and significantly more than half the wavelength, the researcher must move the short circuit point so that an even number of half-waves of radiation fit in this section. We used the value of the minima determined for this test at the reference point.

After calibration carried out waveguide section with a sample is set to the microwave path. It causes shifting of standing wave minimum, which depends on researching dielectric properties and connected with electric characteristics by ratio obtained after the current electrodynamics problem solution, which leads to the complex transcendental equation. We did not begin to solve this equation since the solution turned out to be extremely complicated. We decided to use the waveguide method of short circuit and idle. Using this method, the researcher uses two main modes: no-load and short-circuit. Thus, we were able to obtain the value of the standing wave coefficient and the minimum shift relative to the base plane chosen by us for all measured samples. We will not give all the mathematical calculations, but give only finite formulas (9.10).

$$\varepsilon' = \frac{AC + BD}{A^2 + B^2}\cdot\left\{1 - \left(\frac{\lambda_0}{2a}\right)^2\right\} + \left(\frac{\lambda_0}{2a}\right)^2 \quad (9)$$

$$\varepsilon'' = \frac{BC - AD}{A^2 + B^2}\cdot\left\{1 - \left(\frac{\lambda_0}{2a}\right)^2\right\}, \quad (10)$$

where:

$A = 1 - S_1 S_2 tg(\beta\Delta x_1) tg(\beta\Delta x_2),$

$B = S_1 tg(\beta\Delta x_1) + S_2 tg(\beta\Delta x_2),$

$C = S_1 S_2 - tg(\beta\Delta x_1) tg(\beta\Delta x_2),$

$D = S_1 tg(\beta\Delta x_2) \cdot S_2 tg(\beta\Delta x_1),$

S_1, S_2 – SWR in regime short and free running accordingly;

$\beta = \frac{2\pi}{\lambda_w}$ – propagation constant in the air-filled waveguide (λ_w — waveguide wavelength);

$\Delta x_1, \Delta x_2$ – standing wave minimum shift to chosen reference plane at short and free running accordingly; in case of “half-infinite” layer $\Delta x_1 = \Delta x_2$ and $S_1 = S_2$;

λ_0 – wavelength in free space;

$2a = \lambda_{cr}$ – critical wavelength, where a – width (the big section side) waveguide.

We have assembled a measuring stand (Fig. 2). The signal from the generator 1 is fed to a ferrite insulator 2, which is necessary to ensure isolation of 20 dB. As a generator, you can use G4-79 with a range of 1.78-2.56 GHz and/or G4-81 with a range of 4-5.6 GHz. You can use any other generator that covers the 2.4 GHz and/or 5 GHz band. Next, the signal goes to the attenuator 3, which allows you to change the signal level. Elements 6 and 7 represent a waveguide line. In element 6, we put the studied material. Using element 7, we can create an idle or short circuit. This element has a movable piston. The signal level is monitored using a digital voltmeter 5.

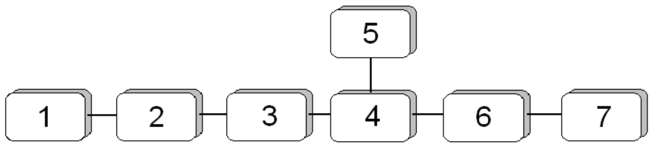

Fig. 2.Block-diagram of measuring stand for complex capacitive research

The absolute error of measuring ε' is less than 0.5.

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Measurements carried outlet to get ε' and ε'' value for used indoor different materials. It allows for obtaining an average absorption coefficient α value for different materials by formulas (3-8). Received values let to calculate the time T (time Interflection) for the specific room.

C. Practice of the theory at the development of Wireless Networks

We can use the method of optimizing the value of T when building a network with MIMO technology. Specialists can calculate the time T by the formula (1). The expert uses the calculation results for research in the room where the deployment of the wireless network is planned.

Estimation of the wireless double-band router work is quite difficult. We need to determine all the aspects of the routers in both frequency bands: 2.4 GHz and 5 GHz.

The basis of our testing is methodology [4]. Performance testing of each router was carried out in several stages. Conventionally, they can be divided into three groups: testing the wired network, wireless network segment testing, and subjective evaluation of the software.

It should be noted that at present, the majority of providers move or have already switched the user to VPN-tunnels and refuse NAT-routing with internal IP-addresses. They provide users with actual external IP-address. Given this trend, network equipment manufacturers have been actively producing different solutions supporting tunneling protocols of communication and dynamic domain name acquisition system (for example, DynDNS or No-IP). For this reason, our test set includes routers testing while working with common to many large providers PPTP-connection.

To define true maximum data rate both at the PPTP-connection and without VPN-connections, a small stand was formed consisting of several client computers that simulated various network segments and PPTP-server. One computer emulated server provider and local resources in the same subnet with the router and PPTP-server. That server was connected to a gigabit switch, which is also connected to the router and PPTP-server.

Other PC emulated server on the Internet and was connected only to the PPTP-server. Access to this computer was carried out only by VPN-channel that is through PPTP-server (transparent bridging and NAT for PPTP-server were disabled).

Another two computers (laptops with a gigabit network card and integrated modem Intel WiFi Link 5300 compatible with 3x3 technology) simulated user computers and were connected to the router via a wired (LAN-Port) and wireless segments. All the computers had a similar configuration and the same operating system - Windows 7. PPTP-server was based on Windows Server 2008. Practically all services were disabled on that server, except the main ones. For PPTP-MPPE-client encryption is optional - so you can work with encryption enabled, or without it, because not any router supports encryption. When a client connected to the PPTP-server, transparent bridging between the external network (Internet emulation) and the client switched on automatically. Thus, the computer that emulated an external Internet server was able to connect directly to internal customers of the router (the router had the function of blocking of incoming connections disabled or, if needed, a computer was placed in the DMZ-zone) and to the customers in the network which emulated provider local area network.

The internal network which is behind the router was assigned with IP-addresses in the range 192.168.0.h. LAN-port of router had IP-address 192.168.0.1, and clients were given by DHCP with LAN addresses. The network which emulated a provider local area network had a range of IP-addresses 10.0.0.h; WAN-port of researched router had IP-address 10.0.0.199; one of the interfaces on the PPTP-server had IP-address 10.0.0.1, which was appointed as a gateway to local clients. PC emulating one of the local servers obtained IP-address 10.0.0.2. Another interface PPTP-server got IP-address 172.22.0.1. The computer that emulated the Internet was assigned with IP-address 172.22.0.2. When connecting to a server for PPTP-VPN-tunnel, clients received IP-addresses of network 192.168.3.h and the gateway for them are IP-address 192.168.3.1.

Router test was conducted in several stages that can be divided into two groups: the definition of performance router with VPN-tunnel when working in the mode of the common router with wired clients and working with wireless clients of the integrated access point. Also, to estimate the performance of the access point and the wired segment, some tests were carried out together with a wireless client.

This model performance testing was carried out with the help of special software Ixia IxChariot version 7.30 [6], developed especially for testing network equipment. On researched network devices during the testing process, built-in speed control for wired and wireless network segments was disabled as they distorted the test results significantly [7].

Test 1. Router performance when exchanging traffic between clients of the internal wired and wireless network.

One test was to measure the maximum data rate between wired and wireless client router when transmitting information between the local network clients in the wired and wireless segment. One computer was connected to the LAN-port router. The second computer was connected wirelessly. Computers communicated with each other and the data transfer was in both directions simultaneous. Routing speed measuring was performed using Ixia Chariot. In the following tests, we also used the software Ixia Chariot 7.30.

Test 2. Router performance when exchanging traffic between clients of the internal wireless network.

It is often needed to transmit information between the local network clients, so this test was to measure the maximum data rate between two wireless clients of the router. Computers were connected

wirelessly and interacted with each other; at the same time, data transmission was in both directions.

Test 3. Speed of routing when working with local provider resources.

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The first test measured router throughput of data transfer between ports WAN and WLAN, for that reason, they were wirelessly connected to client computers emulating work of the external web server and that of the local client. Then, using software Ixia Chariot 7.30, we measured traffic over TCP between computers connected to the router. The measurement was carried out for 5 min when simulating data transmission in both directions. The data was transferred both from the WAN-port to LAN-port and in the opposite direction. Test 4. Data transmission rate from the Internet via VPN-channel. The test was conducted to determine the maximum rate as to the Internet as well as from it having access to the Internet via PPTP-tunnel. The researched router was configured to connect to the PPTP-server through the web-interface automatically. MPPC-compression was enabled on the server by default. Then the rate of exchanging data between the local router and the wireless client computer, which emulated a server on the Internet, was measured. Two previously described laptop was used as clients. Test 5. Simultaneous data transfer via VPN-channel and exchange with provider local resource. The following test was carried out only in case if the router supports simultaneous work with local provider resources and work on the Internet over PPTP-connection. It should be noted that it allows users to get a high-speed channel when working with local provider resources. This test was performed under the same conditions as the previous one, with one exception - together with the exchange of traffic over PPTP-connection, there was data exchange conducted between computer and wireless client emulating intranet server of the provider. During the test, we were controlling the frequency range using a complex for devices testing and wireless networks “PXI RFIC TST-4” [8]. The equipment supplied by National Instruments allowed us to ensure that each router uses the optimal channel and that there is no other device nearby that can cause interference during the test and also determine the wireless coverage. When testing the signal level, each router set itself to work on the sixth channel, various functions (limiting traffic, encryption, and authentication) were disabled. It is also remarkable that the testing took place with pre-installed software (firmware).At the first stage of the study, we performed mathematical modeling to calculate the room where the wireless network is used. At the second stage of the study, we conducted laboratory tests. In the first series of tests, the room was not subjected to any changes. In the second series of tests, we used multilayer materials. These materials had different values of dielectric constant. We chose access points with the following set of parameters for testing: Gigabit Wi-Fi access point, standard 802.11n, MIMO, speed of wireless connection is about 300 Mbit/s, router, switch 4xLAN, port WAN, supporting VPN. All routers use three antennas and work with technology MIMO (Fig.3).
With given parameters, we chose three access points:

a) b) c)

Fig. 3.Test equipment: a) ASUS RT-N66U; B) D-LINK DIR-855; C) TRENDNET TEW-672GR

During the testing, we chose the installation location of the equipment so that the connection was stable. There were no sudden jumps in the change in data transfer speed. After the measurements, the researchers analyzed the materials that were used indoors. Based on the analysis, we proposed multilayer materials with which it was necessary to process the room. Workers replaced materials in the room. After finishing work, we conducted another set of tests.

III. RESULT AND DISCUSSION

Test results are shown in Figs.4-7.

As test results have shown, there were virtually no differences in the data exchange rate when using wireless network resources inside the wired network and provider local resources. It can be concluded that the rate of exchange, in this case, is only limited by the rate of the wireless network. Therefore, for high-quality work with the resources of the internal wired network and provider local resources, including the resources of the Internet, it is necessary to provide a reliable link between the router and the computer wirelessly.

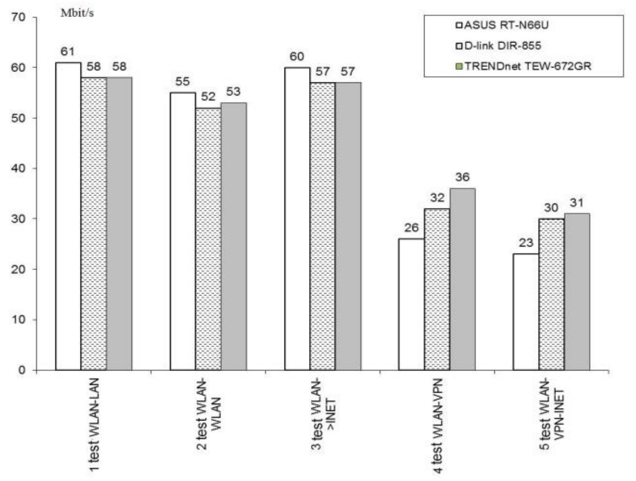

Fig. 4.2.4 GHz before processing

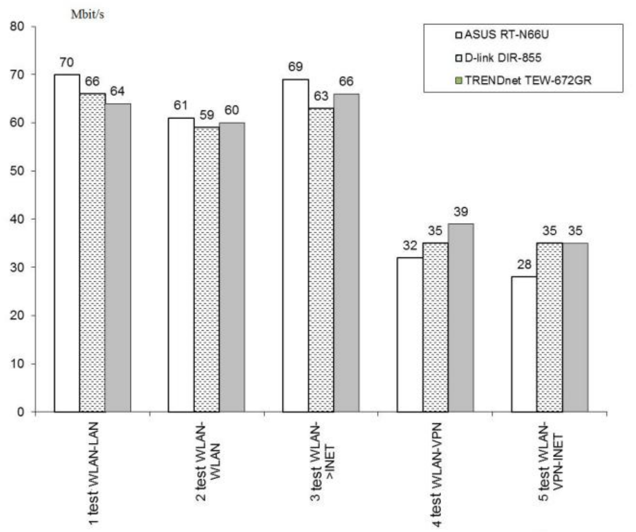

Fig. 5.2.4 GHz after processing

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The data transfer rate between the two wireless computers connected together is generally lower than the rate between wireless and wired clients. This does not contradict the existing research related to the quality of wireless data transfer. When there are a lot of customers, the data transfer speed of each one depends on the tasks. By increasing the load on the wireless channels (transferring more files, transferring large files, multicast), the rate is significantly reduced.

When working on a VPN tunnel, network "bottleneck" limiting the network traffic is a PPTP-tunnel. Communication support and traffic exchange provide a greater load on the processor in the router. Since data rates of VPN tunnel providers are most often limited by the speed of 20-30 Mbit/s for PPTP-tunnels, the routers provide acceptable performance with most providers offering Internet services over the VPN-connection.

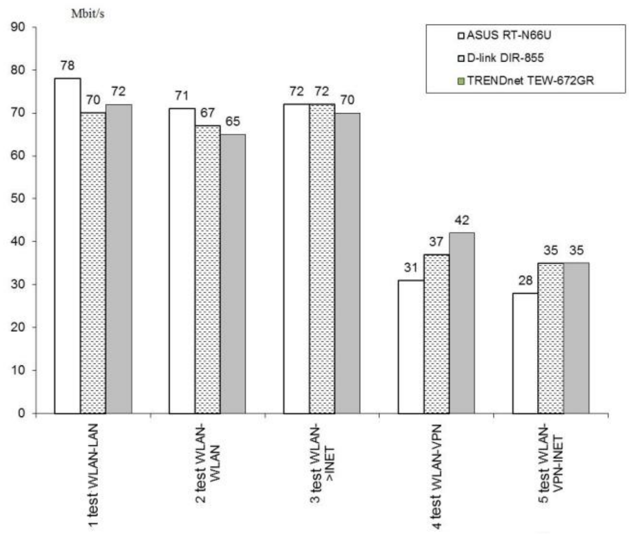

Fig. 6.5 GHz before processing

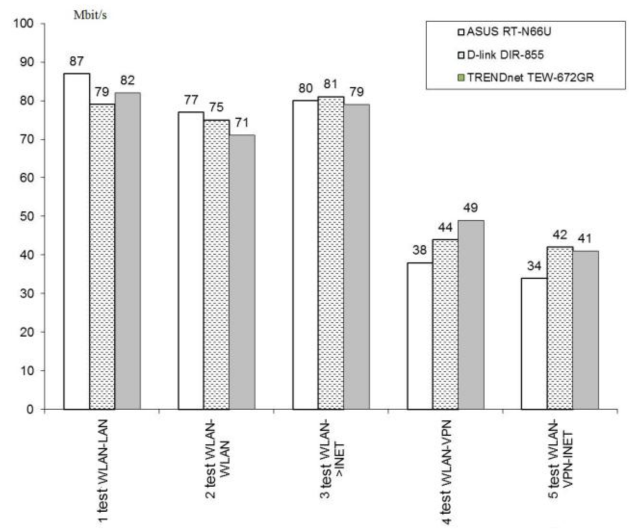

Fig. 7.5 GHz after processing

The average data rate of the range of 5 GHz is generally higher than the data rate in the range of 2.4 GHz. This is due to the fact that 5 GHz range is less overloaded with various appliances (microwave ovens, cordless of DECT standard, Wireless Access Point IEEE 802.11bg, and others).

According to the results of theoretical research, we made calculations on the materials that are used in the test room. Based on the data processing room was covered with additional materials that would provide efficient multipath propagation of electromagnetic waves in a room. This resulted in an increase in the data exchange rate within a given area by 5-10% compared to the uncovered room.

But the additional measurements showed that the signal level outside the study area decreased. That reduced data rate we were studying outside the room and in many cases, became unstable what led to disconnection.

We built a model of a layered medium taking into account vertical and horizontal polarization. Researchers determined the dielectric parameters of the medium based on the half-wave method. The authors conducted a large number of tests and model calculations. We found that in the 2.4 GHz and 5 GHz bands, the average signal transmission speed in the network increased by 5-10% after we performed surface treatment in the rooms with special materials.

Therefore, proposed by us method is applicable to the rooms where it is necessary to provide a stable high-speed wireless LAN of IEEE 802.11n standard, but outside the room, the connection may be unstable. It relates to the public access points to the Internet at cafes, restaurants, train stations, and other public places.

In general, the chosen instrument was stable. They allow setting up a communication channel quickly, had a number of user-friendly features. In all tests, ASUS RT-N66U presented the best results on the data rate. When working on a VPN channel, the best performance was shown by TRENDnet TEW-672GR.

IV. CONCLUSION

The Arctic attracts the attention of many countries of the world in that huge reserves of oil and gas are concentrated there. For the successful development of these reserves, specialists need to have a high-quality connection. We propose using wireless communication with MIMO technology for this purpose. This standard uses multiple reflection of radio waves from indoor surfaces. The problem with the application of this standard is the creation of such conditions that the time during which the wave gradually decays to the desired signal-to-noise ratio is as large as possible.

This fact required the study of processes occurring during the propagation of radio waves in a room. The statistical theory of the propagation of radio waves in a room allows you to determine the time of interflection T to achieve the desired signal to noise ratio. For networks using MIMO technology, it is necessary to increase the value of T. To achieve the level of interference required for the application of MIMO technology, additional processing of the premises is carried out by selecting large surface areas with a low absorption coefficient. These surfaces are positioned so as to increase the size at the locations of the wireless network clients. We conducted a large number of experiments to determine the absorption coefficient of radio waves by various building materials,

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which allowed us to create a database of information on building materials. When conducting the experiments, we used the idle and short circuit method in the waveguide section.

Our studies using National Instruments' PXI RFIC TST-4 equipment from Wi-Fi networks in the 2.4 GHz and 5 GHz bands showed that ceteris paribus, after processing a room with multilayer materials, the network speed increases by 5-10%. This is a fairly good result, which suggests that the application of the above methods when designing a wireless network in a particular room can increase the data transfer rate. This technique can be used to improve the quality of communication in premises located in the Arctic.

REFERENCES

1. K. R. Babidha, P. S. Smitha, “Implementation of both spatial diversity and spatial multiplexing technique in MIMO-OFDMA communication system,” International Journal of Multimedia and Ubiquitous Engineering, 9 (9), 2014, pp. 249-254, DOI: 10.14257/ijmue.2014.9.9.26.
2. A. Gureev, V. I. Selivantsev, T. Tun, Y. Pavlyuk, “Using experimental data for indoor wireless system planning,” Proceedings of the 2018 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering (ElConRus 2018), 2018, pp. 1731-1733, DOI: 10.1109/EIConRus.2018.8317439.
3. S. Chandra Sekaran, V. Saravanan, R. K. Nayak, R. Tripathy, S. Siva Shankar, “Human health and velocity aware network selection scheme for WLAN/WiMAX integrated networks with QoS,” International Journal of Innovative Technology and Exploring Engineering, 8 (12), 2019, pp. 198-205, DOI: 10.35940/ijitee.L3571.1081219.
4. A. Lagunov, “Expansion of wireless networks of standard MIMO indoors,” IEEE EUROCON 2009, N5167837, 2009, pp. 1487-1492, DOI:10.1109/EURCON.2009.5167837.
5. A. A. Brandt, “Dielectric study at microwave frequencies,” Publishing House of Physical-Mathematical Literature, 1963, 409p.
6. Ixia, IxChariot, Official site. Available: https://www.ixiacom.com/products/ixchariot.
7. Y.-C.Sung, Y.-B.Lin, R.-H.Liou, L.-F.Shieh, “NCTU-VT: A freeware for wireless VoIP performance measurement,” Wireless Communications and Mobile Computing, 12 (4), 2012, pp. 318-324, DOI: 10.1002/wcm.963.
8. National Instruments, Official site. Available: http://www.ni.com.

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