STUDY OF THE QUALITY OF INFORMATION TRANSMISSION IN LTE NETWORKS

Dnipro University of Technology

Gulyakin Eduard Vitalievich
***Scientific adviser*: Ph.D. Phys.-Math. Sci., Gusev Aleksandr Yurievich**

The main directions of the evolution of mobile communication systems are to improve the quality of multimedia services, reduce subscriber costs and reduce operating costs [1].

Currently, the most popular technology that implements the modern concept of managing geographically dispersed objects is the LTE technology (the standard of the fourth generation of high-speed mobile networks) [2]. A high degree of manageability within the framework of this technology is achieved by using a new network infrastructure SAE [3], which provides comprehensive support for services based on IP technology, as well as continuous service for the subscriber when he moves between different wireless access networks.

The interaction of the LTE network with 3GPP networks (UMTS/GSM/HSPA+) is carried out both in the provision of roaming and handover. The interaction of the LTE network with other 3GPP networks to provide traditional telephony services is carried out using both traditional circuit switching technology (TDM) and packet switching technology based on the IMS service subsystem.

One of the main distinguishing features of the LTE standard, which allows to achieve high data transfer rates, is a change in the principles of building an interface from an eNodeB (base station) to a UE (mobile station) on the Downlink line (“down”).

Let's consider the main features of this interface and try to highlight the main qualitative differences that distinguish this standard from others.

Firstly, in LTE communication networks, Downlink uses the OFDMA - Orthogonal Frequency Division Multiple Access access principle - multiple access with orthogonal frequency division of channels, and also converts the signal from the time domain to the frequency domain. This is done thanks to the FFT - Fast Fourier Transform. These two procedures make it possible to achieve the closest possible placement of signals in the frequency domain and to reduce the guard intervals to a minimum.

In addition to using OFDMA in LTE, there is another important innovation: the mandatory (unlike UMTS) use of MIMO - Multiple Input Multiple Output - multiple input multiple output. In this case, the information flow is directed between the parties of information exchange in several "paths", which ensures more efficient use of the frequency-time resource.

These two important changes make it possible to achieve data transfer speeds in excess of 100 megabit per second in Downlink. Data transmission delays do not exceed 20 ms.

Since the transmission quality is quantified by the dependence of the bit error probability on the signal-to-noise ratio, we will evaluate this dependence for 2x2

MIMO antennas and 4x4 MIMO antennas for the following signal-to-noise ratios (dB): -15, -10, -5, 1, 5 , 10, 15, 20, 25, 30. The study was carried out in the Simulink MatLab environment for the Downlink line. The results are shown in Figures 1 and 2 for MIMO-2x2 and Figures 3 and 4 for MIMO-4x4.

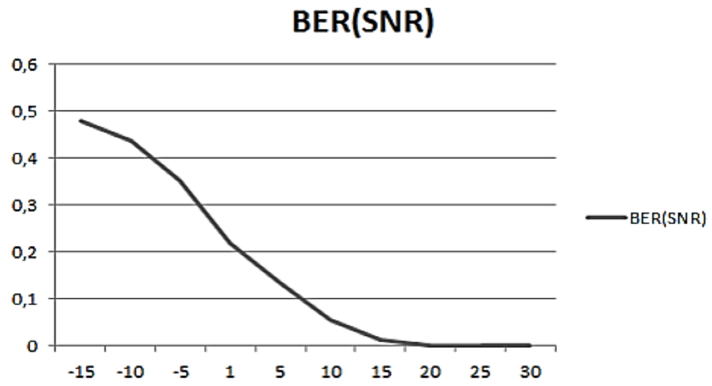

Figure 1 - Dependence of the bit error rate on the signal-to-noise ratio for the first stream (MIMO 2x2)

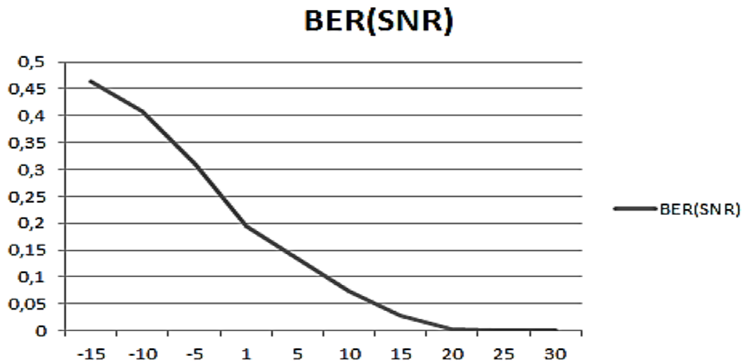

Figure 2 - Dependence of the bit error rate on the signal-to-noise ratio for the second stream (MIMO 2x2)

Figure 3 - Dependence of the bit error probability on the signal-to-noise ratio for the first stream (MIMO 4x4)

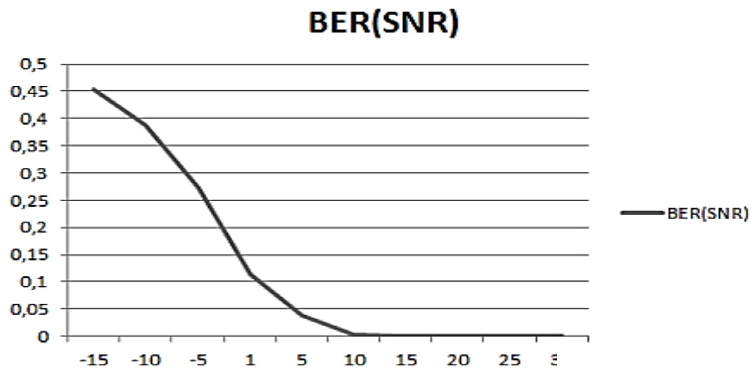

Figure 4 - Dependence of the bit error rate on the signal-to-noise ratio for the second stream (MIMO 4x4)

An analysis of the obtained values of the dependence of the bit error probability on the signal-to-noise ratio showed that with an increase in the signal-to-noise ratio, the bit error probability tends to zero faster in 4x4 MIMO than in 2x2 MIMO. Thus, the use of a larger number of transmit-receive antennas gives smaller errors.

References

1. Technology Transitions: GN Docket No. 13-5. Federal Communications Commission FCC 14-5. Washington, D.C. 20554 (rel. Jan. 31, 2014).

2. Cox Christopher. An introduction to LTE: LTE, LTE-advanced, SAE and 4G mobile communications. UK.: John Wiley & Sons Ltd, 2012 – 486 p.

3. The IEEE 802.16 Working Group on Broadband Wireless Access Standards [Електронний ресурс]. URL: https://www.ieee802.org/16/ (дата звернення: 17.04.2023)