Mathematical model for evaluation of interference dispersion for modern mobile communication systems

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Currently, telecommunication operators are implementing digital transformation to create a modern digital world. Providing enterprises and individuals with real-time high-speed data transmission requires an End-to-End (E2E) coordinated architecture with flexible, automatic and intelligent control during each phase. Comprehensive cloud adaptation of networks, operating systems, and services is a necessary condition for this long-awaited digital transformation.

The "All Cloud" strategy is the interconnection of hardware resources, distributed software architecture, and automatic deployment. Operators are transforming networks using a data center (DC)-based network architecture in which all functions and software applications run in the DC cloud, called the CloudNative architecture [1-3].

In the new era of 5G, new communication requirements create challenges for existing networks in terms of technologies and business models (Fig. 1). In connection with the increased demand for the quality of voice and data transmission by radio channels, there is a need to build a communication system, the parameters and structure of the physical level of which would change with the change in the characteristics of the signal propagation environment. This can be achieved with the help of tools that allow dynamic changes in their parameters or structure. Considering this, there is a need to develop adaptive systems that would allow adaptively changing their parameters with changing characteristics of the signal propagation environment. This requires information about the state of the communication channel.

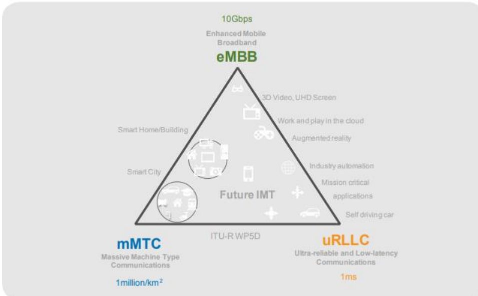

Figure 1 – 5G generation mobile communication network

Increasing the reliability of information can be achieved by using interference-resistant codes, for example: LDPC codes [8], turbo codes (TC) [9]. TC and LDPC codes are adopted by the fifth generation mobile communication standards 4G LTE and 5G, respectively. 4G and 5G systems use adaptive modulation, power, and coding techniques. In 4G, 5G systems, during adaptation, the coding rate R is adjusted in the range from 1/5 to 2/3. In 5G systems, LDPC code is used for high speeds, and polar codes are used for low speeds. FM-4, QAM-16, QAM-64, QAM-256 are used as OFDM modulations. To implement the adaptation principle, knowledge about the state of the data transmission channel during a certain period of time or the transmission interval of some test sequence on the service data transmission channel is required. It is generally accepted to take the signal-interference ratio in the channel or the ratio of the signal energy to the spectral density of the interference power as a quantitative assessment of the state of the transmission channel. If the signal energy is assumed to be a constant value, information on the interference power spectral density is needed to evaluate the channel. It is generally accepted to take the signal-interference ratio in the channel or the ratio of the signal energy to the spectral density of the interference power as a quantitative assessment of the state of the transmission channel. If the signal energy is assumed to be a constant value, information on the interference power spectral density is needed to evaluate the channel. It is generally accepted to take the signal-interference ratio in the channel or the ratio of the signal energy to the spectral density of the interference power as a quantitative assessment of the state of the transmission channel. If the signal energy is assumed to be a constant value, information on the interference power spectral density is needed to evaluate the channel.

The purpose of the research is to develop a mathematical model for estimating the dispersion of white Gaussian noise interference in 5G mobile communication systems by analyzing the results of calculating logarithmic ratios of likelihood functions during iterative decoding of multi-component turbo codes and using this estimate in automatic control systems.

Conclusions

1. The research proposes a mathematical model for iterative estimation of the dispersion of white Gaussian noise interference in wireless data transmission systems.

2. The difference between the developed mathematical model and the existing ones, which determines its novelty, is that the evaluation of the interference dispersion is carried out by analyzing the results of calculating the logarithmic ratios of the likelihood functions when decoding multi-component turbo codes, and taking into account the values obtained during iterative decoding.

3. The application of a mathematical model allows to reduce the error of channel state estimation and increase the reliability of information in wireless data transmission systems.

4. Development of algorithms for structural and parametric adaptation of multi-component turbo codes is considered the direction of further development.

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