

**Name of the project:** AP14869840 «Research and development of ultra-broadband multi-antenna wireless transmission of information between interfaces»

**Relevance:**

Currently, the most widely used multi-core processors rely on an integrated system with packet switching for data exchange. This is a key factor in CPU performance that determines the performance of internal Crystal networks, and due to scalability issues, a large number of cores becomes a weak point. To solve this problem, it is recommended to use mm-wave wireless connections for internal communication, which support their system-level latency and adaptability due to their low-frequency transmission. This new paradigm can solve the scalability problem of modern multi-core architectures. We can assume that such a configuration provides speeds above 10 Gbit/s and efficiency close to 1pj/bit without misinterpreting the wireless internal channel. This project shows that such forecasts are economically profitable. In this regard, we use the normal nature of the system to design the channel, i.e. we need to optimize its frequency characteristic by carefully selecting the dimensions of the chip body. So, we use the bandwidth of the channel to adapt to it, expanding the efficiency and speed limits through simple parameters at the physical level. Our simulation methods are expected to reduce road losses and delay propagation on a commercial chip by 47 DB and 7.3 times, respectively, providing a wireless connection of more than 11 Gbit / s inside the chip and 3.2 DB from the scattered case.

**Purpose:**

To study the establishment of wireless communication between interfaces at high speed and high resolution using nanoantennas and to build an optimal mathematical model of the correct expression of the wireless internal channel.

**Expected and achieved results:**

As a result of the implementation of the project, the following results were obtained: 1) analysis of research results on optimization of parameters of inter-chip and intra-chip communication, analyzes methods of optimization of multi-wire/multi-antenna connections. chip-to-chip, justifies the use of special physical optimization methods, coding and signal processing, develops technical requirements for communication technology. 2) the structure and scheme of the mathematical model for optimization of communication parameters of ultra-wideband multi-antenna wireless transmission of information between built-in antenna interfaces was developed. 3) algorithm and program for optimization of inter-crystal and intra-crystal connection parameters of the built-in antenna. 4) Recommendations and requirements for optimizing the parameters of inter-chip and intra-chip communication, built-in antenna were developed.

As of 2022: An analysis of the current state of development of ultra-broadband multi-antenna wireless transfer of information between interfaces and a model of technical requirements (TT) for interface-to-chip communication technology was developed. Review article in 1 periodical, international scientific cooperation with the leading universities of the world was established, i.e. a senior researcher underwent an exchange of experience in science exchange.

As of 2023: The results of research on optimization of inter-chip and intra-crystal communication parameters are analyzed, optimization methods of on-chip and chip-to-chip multi-wire / multi-antenna connections are analyzed, the use of special methods of physical optimization, signal coding and processing is justified, technical requirements for communication technology are developed.

According to the results of scientific research, at least 3 (three) articles and (or) reviews in peer-reviewed scientific journals indexed in the Science Citation Index Expanded database in the Web of Science database and (or) in peer-reviewed scientific journals, at least 35 (thirty-five) CiteScore in the Scopus database with a percentile, at least one patent application for an invention or utility model was submitted: an application was submitted to the Patent Bureau of Kazakhstan, 6 diploma projects were completed, at least 2 master's theses were completed during 64 hours of research.

Six diploma projects were completed during studies. It is planned to expand international scientific cooperation with the world's leading universities, and an exchange of experience with the University of Jaen in the Kingdom of Spain has been implemented.

**Study group members:**

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