LABORATORY 17

Laboratory of Information Transmission Networks

Head of Laboratory – Dr.Sc. (Tehnology), Prof. Vladimir Vishnevsky
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The leading researchers of the laboratory include:

Dr.Sc. (Techn.)	V. Lazarev	Dr.	M. Levin
Dr.Sc. (Techn.)	A. Lyakhov	Dr.	D. Mironov
Dr.Sc. (Techn.)	I. Ovseevich	Dr.	E. Pijl
Dr.	I. Astafjeva	Dr.	V. Vorobiev
Dr.	N. Bakanova		

DIRECTIONS OF ACTIVITY

Basic directions of the Laboratory activity are development of theoretical foundation for analysis and synthesis of distributed information transmission networks, and practical implementation of large-scale projects concerning with distributed computer and communication networks.

The theoretical researches are carried in the following directions:

• Development of theoretical foundation for design of infocommunication networks including both terrestrial fiber-optic and copper channels, and wireless radio and infrared communication lines.

• Development of analysis and synthesis methods for wireless local area and regional networks controlled by IEEE 802.11x and IEEE 802.16 protocols.

• Development of design methods for integrated information systems, using visual modeling methodology.

• Development of methods and algorithms for topology synthesis and optimal routing in telecommunication networks.

MAIN RESULTS

In 2004, the Laboratory continued the fundamental researches related to extreme graph theory, queuing networks theory, and reliability theory. Moreover, the field experiments with various physical media (fiber-optical, radio, satellite communications), operational environments and various network architectures were carried on simultaneously.

The following main results have been obtained:

• Basing on original topology synthesis algorithms and methods for connectivity probability evaluation and optimal route choice, the Laboratory has finalized the first version of automated design system for information transmission networks.

• The Laboratory has developed novel analytical and simulation methods for modeling and designing broadband wireless networks, including:

– Stochastic models for comparative study of distributed and centralized control in regional wireless networks;

– Centralized control algorithm adaptive to experienced load for IEEE 802.11 networks and the algorithm optimization with usage of Markov models of network operation;

– Methods for performance evaluation of IEEE 802.11 local area networks and study of packet fragmentation mechanism efficiency in case of correlated channel failures.

• A novel method for integrated information system design has been developed on the base of visual modeling methodology and with usage of structural and object-based approaches. The method has become a foundation of large-scale organizational structures. Inter-document relation search algorithm has been developed on the base of shortest path search in large-scale graph.

Theoretical results in the area of distributed network analysis and design have been used as a basis for development of large-scale telecommunication network projects. Specifically, the scientific study results have been adopted in the following projects:

• Extension of the Radionet cellular radio-modem network to provide an access to Internet for Moscow institutions of science, culture, and education. The Laboratory has finalized the deployment of the terrestrial fiber-optic backbone network joining the Radionet network's base stations by implementation of two channels: IITP of RAS – Moscow State University – M9 and IITP of RAS – High-rise building at Kudrinskaya square with 100-Mbps information transmission rates. IITP-of-RAS routing node has been installed at M9 trunk exchange.

• Development of pilot versions of high-rate wireless routers for bundling regional wireless networks, which exceed present domestic and foreign analogues.

• Development and extension of telecommunication networks of Russian Ministry of Transport and Russian Road Agency. Development of an integrated information system for Presidium of RAS.

Such leading researchers of the Laboratory as N.B. Bakanova, V.M. Vishnevsky, V.G. Lazarev, A.I. Lyakhov, M.S. Levin, and D.V. Lakontsev serve as teachers in Moscow Institute of Physics and Technology (State University) – MIPT, Moscow Technical University of Communications and Informatics - MTUCI, and Moscow Humanitarian Institute. V.M. Vishnevsky, V.G. Lazarev, and A.I. Lyakhov supervise 15 PhD students of IITP of RAS, MIPT and MTUCI. Leading researchers of the Laboratory serve as supervisors for 8 Bachelor degree students and 10 Master degree students. M.S. Levin has developed electronic Internet-based textbook "System design: structural approach": http://www.iitp.ru/mslevin/SYSD.HTM.

GRANTS FROM:

• **Targeted Programme of RAS:** "Informatization of Scientific Institutions and Presidium of RAS".

• **Ministry of Industry, Science and Technologies of RF (State contract No. 37.053.11.0063):** "Methods for Design of Computer Networks".

• **Basic Research Programme of RAS (Division of Information Technologies and Computer Systems):** "New Physical and Structural Solutions in Info-telecommunications".

• **Research Collaboration Agreement** with Panasonic Digital Networking Laboratory (PDNL) of Panasonic R&D Company of America.

PUBLICATIONS IN 2004

<u>Articles</u>

1. Bakanova N.B. Hybrid Approach to Design of Document Flow. *Proc. Second International conference «Information and Telecommunication Technologies in Intelligent Systems», Barcelona (Spain),* 2004, pp. 119-122.

2. Bakanova N.B. Visual Modeling Tools for Docflow System Implementation. *Proc. 5th Int. Workshop "Information networks, systems and technologies," Moscow, Russia,* October 21-24, pp.118-120, 2004.

3. Baranov A.V., Lyakhov A.I. IEEE 802.11 protocol performance evaluation under normal load. *Proc. 5th Int. Workshop "Information networks, systems and technologies," Moscow, Russia,* October 21-24, pp.121-125, 2004.

4. Baranov A.V., Lyakhov A.I., Matsnev D.N. Methods for IEEE 802.11 protocol performance evaluation. *Proc. 3rd Int. Sci. Conf. Workshop "New Design Methodologies", Vladimir, Russia,* December 10, 2004.

5. Lazarev V.G., Folomeev A.K. A Method for Dynamic Control of Transmission Rate and Cell Routing in ATM networks. *Proc. 5th Int. Workshop "Information networks, systems and technologies," Moscow, Russia,* October 21-24, pp. 113-117, 2004.

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9. Levin M.Sh**.**, Last M. Multi-Function System Testing: Composition of Test Set. *8th IEEE Int. Conf. on High Assurance Systems Engineering HASE'04, Tampa, FL,* pp. 99-108, 2004.

10. Levin M.Sh., Last M. Collection of Test Case Sequences: Covering of Function Cluster Digraph. *Proc. of IASTED Conf. "AI and Applications"*, Innsbruck, pp. 806-810, 2004.

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12. Levin M.Sh., Sokolova L.V. Hierarchical Combinatorial Planning of Medical Treatment. *Computer Methods and Programs in Biomedicine, 73(1),* pp. 3-11, 2004.

13. Lyakhov A.I., Vishnevsky V.M. Packet Fragmentation in Wi-Fi Ad Hoc Networks with Correlated Channel Failures. *Proc. 1st IEEE Int. Conf. on Mobile Ad-hoc and Sensor Systems ([MASS 2004](#)), October 24-27, 2004, Fort Lauderdale, Florida, USA,* pp.204-213.

14. Matsnev D.N. *Development of Methods to Study the MAC Protocol of Wirelesss RadioEthernet Regional Networks.* PhD thesis, Moscow: IITP of RAS, 2004.

15. Vishnevsky V.M. Methods, Algorithms, and Software and Hardware Tools for Broadband Wireless Networks Implementation. *Proc. Second International Confer-*

ence «Information and Telecommunication Technologies in Intelligent Systems», Barcelona (Spain), 2004, pp. 6-13.

16.   Vishnevsky V.M., Guzakov N.N. Development of Multi-Ray Antenna Systems for Base Stations of Multiple Access Digital Network. *Proc. Second International Conference «Information and Telecommunication Technologies in Intelligent Systems», Barcelona (Spain),* 2004, pp. 13-18.

17.   Vishnevsky V.M., Lyakhov A.I. Dynamic Polling in Centrally-controlled Wireless Networks. *Proc. Int. Scientific-Practical Conf. "(Communications-2004)", Bishkek, Kyrgyz Republic,* August 22-29, vol.2, pp.121-129, 2004.

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21.   Vishnevsky V.M., Vorobiov V.M. New Generation Wireless Technologies in Digital Disparity Problem Solution. *Proc. Int. Scientific-Practical Conf. "(Communications-2004)", Bishkek, Kyrgyz Republic,* August 22-29, vol.2, pp.115-120, 2004.

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1.   Levin M.Sh., Danieli (Danielashvili) M.A. Hierarchical Decision Making Framework for Evaluation and Improvement of Composite Systems (Example for Building). *International journal INFORMATICA*, Vilnus (Letuva).

2.   Vishnevsky V.M., Lyakhov A.I., Portnoy S.L., Shahnovich I.V. *Broadband Wireless Information Transmission Networks.* Moscow: Technosphere, to be published.