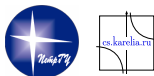


Петрозаводский государственный университет  
Математический факультет

Научная работа на кафедре Информатики и  
математического обеспечения

Ю. А. Богоявленский



Семинар "Научные исследования Математического факультета". 15.04.2015



# Содержание

- Вероятностные модели насыщения ТСР
- Базис Гильберта и Диофантовы модели
- Модели сетей P2P
- Модели динамических структур данных
- Имитационные модели
- Международное сотрудничество
- Интеллектуальные пространства
- Мобильная диагностика сердечных паталогий
- Учебные планы: “Обратный подход”
- Избранные публикации
- Вычислительная система



# TCP Congestion control modeling

Olga Bogoiavlenskaia (PhD of CS)

Aims:

- Evaluation of TCP performance
- Revealing the factors at the bottom of TCP behavior

Results:

- Analytical Markovian Model of TCP Congestion Avoidance
- Model validation on real data
- Distributions of congestion window size and throughput for TCP obtained in analytical form

Future:

- Fast algorithms predicting TCP performance metrics and QoS

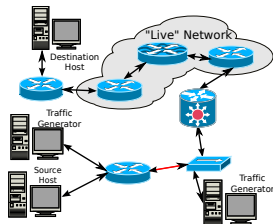
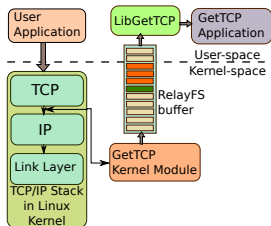


# TCP Congestion control modeling

- Model of AIMD flow control: distribution of congestion window size and AIMD throughput distribution
- Model input parameters
  - ▶ Packet loss probability
  - ▶ Upper window limit
  - ▶ RTT distribution
  - ▶ Capacity limit, if available, or sender's link capacity.
- Model relaxes restrictions accepted in recent literature and applicable for more generic settings. Model defines bounds of algebraic estimations usability.
- Model is experimentally validated and provides reliable and consistent results with relative error 5-15%.



# GetTCP+: Linux networking analysis framework

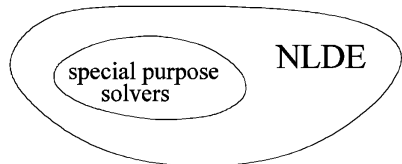


- Receives TCP connections data from Linux Kernel (v2.6.38 - v3.1.10)
- Use Linux Kernel Tracepoints tool
- Fast and configurable tool for extraction of TCP-flows statistics
- Storage for compressed and detailed data of TCP flows
- Data provision for network path performance estimation
- Tested in real network environment



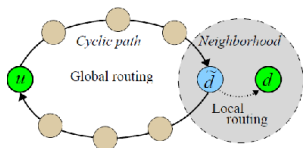
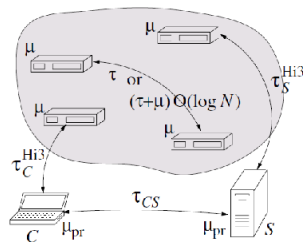
# Linear Diophantine Models and Algorithms

- Linear systems with integer coefficients and solutions in non-negative integers – NLDE systems
- Hilbert basis
- Models for applications
  - ▶ Aggregate scalable structure of network link traffic
  - ▶ Route structure in P2P networks
  - ▶ Route restoration in MPLS networks
- NP-complete or overNP problems
- Universal solvers aren't adequate for practical use
- Polynomial algorithms
  - ▶ Syntactic: parsing in a formal grammar
  - ▶ Transformation: Gauss-like iterations



# Peer-to-Peer Networking

- Cooperation with Helsinki Institute for Information Technology (HIIT), Aalto University and University of Helsinki
- Host Identity Protocol: Connectivity, Mobility, Multi-homing, Security, and Privacy over IPv4 and IPv6 Networks
  - ▶ Host Identity Indirection Infrastructure (Hi3)
- Distributed Hash Tables (DHT): Fundamentals of Hierarchical Organization, Routing, Scaling, and Security
- Internet of Things and security in healthcare networked applications



# Mathematical models and algorithms for optimal control of dynamic data structures

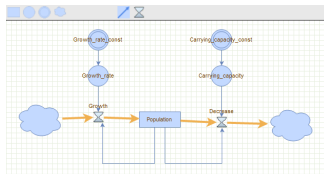
- Mathematical models and optimal algorithms of FIFO-queues, LIFO control and priority-queues for some methods presented in single-level memory
- Two different ways of operating with dynamic data structures: consecutive and linked representation
- Representation of queues with  $n$  priorities in single-level memory as  $n$  consecutive FIFO queues
- Solution of problem of optimal stacks top control in the two-level memory





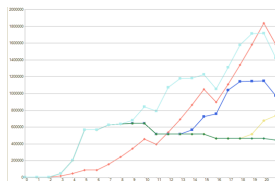
# Simulation modeling: fuzzy cognitive maps and system dynamics

- Fuzzy cognitive maps modeling
- Impulse modeling
- System dynamics models calculation
- Model parameters variation
- Model optimization by genetic algorithm



Fields of application:

- Modeling business processes in ERP systems
- Socio-economic problems modelling
- Simulation of Ecology problems



We are looking for partners for cooperation in the field of simulation modeling in various subject areas



# International Cooperation: Finnish Universities

Since 1997 annual scientific seminar “[Advances in Methods of Modern Information Technology](#)” (AMICT) is organized by Departments of Computer Science of the Universities of Helsinki and Petrozavodsk. 11 volumes of the seminar Proceedings is published.

Since 2005 the Department participates in joint research with [Helsinki Institute for Information Technology \(HIIT\)](#), Aalto University and University of Helsinki.

- The focus is on models, algorithms, protocols for large-scale P2P-based systems and their applications in future Internet with ubiquitous computing. Now this cooperation expands to PetrSU IT-park and Karelian Centre of Russian Academy of Sciences.



## International Cooperation: European Relations

Since 2008 the Department and PetrSU IT-Park are operating in frame of [Open Innovations Association FRUCT](#) (Finnish-Russian University Cooperation in Telecommunications).

The FRUCT program focuses on arranging an international group of students supervised by creditable experts which would push forward R&D work related to advanced ICT.

Since 2011 the Department and IT-Park of PetrSU execute grants of the [Karelia ENPI CBC Programme](#): regions Kainuu, North Karelia and Oulu in Finland and in the republic of Karelia in Russia.

Current projects:

- “Complex development of regional cooperation in the field of open ICT innovations”
- “Development of cross-border e-tourism framework for the programme region (Smart e-Tourism)”



## Karelia ENPI CBC

### KA179 “Complex development of regional cooperation in the field of open ICT innovations” (2011-2014)

- Partners: University of Oulu, FRUCT
- Planning lecture topics, lectures and experts
- 2 large and 15 small applications
- Smart Room

### KA322 “Development of cross-border e-tourism framework for the programme region (Smart e-Tourism)” (2012-2015)

- Partners: University of Oulu, SPIIRAS, FRUCT, Tourist Information Centre of the Republic of Karelia
- 10 services, 2 web portals
- Integration with Smart Room
- Pilot implementation e-tourism identity of the programme area



# Smart Spaces: Mission

Open data embedded in various devices for user applications and create personalized and localized services in millions of places ...

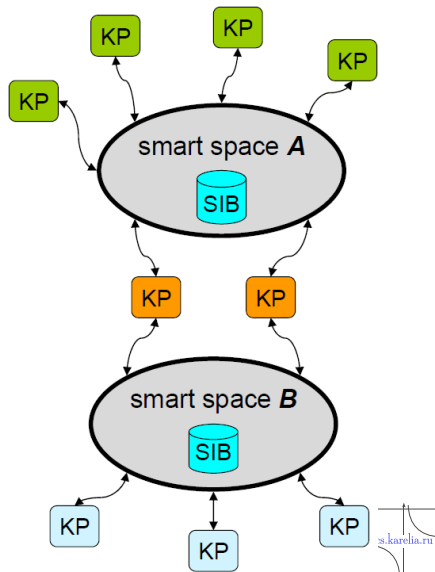


...and monetize it by using the web tools and business models



# Smart Spaces: Our Projects

- Smart-M3 Platform
  - ▶ SmartSlog SDK: ontology-based automated development (2010-...)
- Smart-M3 apps
  - ▶ M3-Weather (2010)
  - ▶ SmartScribo (mobile multi-blogging, 2010-2012)
  - ▶ Smart Room: in PetrSU for conferences, meetings, seminars, lectures, etc. (2012-...)



Mobile Health Care: <http://www.fruct.org/node/38927>

## ECG Compression Library for Long-Term Monitoring of Heart Function in Mobile HealthCare Systems

- Development of a cross-platform ECG compression software solution on the base of available algorithms, taking into account mobile computing constraints.
- The solution is developed in the form of easy-to-use library that provides lossy compression method based on discrete wavelet transform with following features:
  - ▶ High compression ratio;
  - ▶ Reconstruction possibility of important medical features of initial signal;
  - ▶ Phone battery tolerance.



## Mobile Health Care: <http://www.fruct.org/node/325566>

### The Cross-platform Application for Arrhythmia Detection

- Within the projects the application for detection patient's cardiac abnormalities is developed.
- If some kind of arrhythmia is detected, the application submits pieces of patient's electrocardiogram to the doctor and alarms emergency services if it is needed.
- The application is originally developed and tested for smartphones with Symbian OS.





# Mobile Platform Applications

## Mobile platforms:

- Nokia Maemo
- Nokia Symbian
- Nokia Harmattan/MeeGo
- Nokia S40 "Asha"
- Android
- Windows Phone

## Application Stores:

- Nokia Store
- Google Play Store
- Microsoft MarketPlace

<http://oss.fruct.org/projects>

Открытые платформы для мобильных устройств

Новости | О ресурсе | Бюро разработчиков | Форум | Регистрация

**Nokia поддерживает развитие MAEMO/MeeGo-сообщества в России**  
04.02.2011

При поддержке компании создана новая интернет-площадка сообщества, в также планируется проведение серии специализированных мероприятий для разработчиков и пользователей.

Подробнее...

Рубрика: [Новости](#) | [Все новости](#)

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**Релиз проекта SmartSlog**  
04.02.2011

опубликован первый релиз проекта SmartSlog (The Petrosi ANSI C Library generator for Smart Space Ontology, <http://oss.fruct.org/petrosvs/SmartSlog/>). Проект выполняется в лаборатории Беспроводных и мобильных технологий ПетГУ-Нokia-NIS.

В рамках проекта создается генератор ANSI C библиотеки по заданной онтологии. Генератор использует формат хранения знаний и антологизированном сетевом пространстве. Доступен и архивные данные, заключены в специализированный формат (бинарный, бинарный, XML). Потребителями и производителями знаний являются "процессоры знаний" (Knowledge processor, KP).

Генератор по заданной онтологии создает библиотеку, на основе которой программируют

**Рубрика новостей**  
[Fruct \(2\)](#)  
[M3 \(1\)](#)  
[MeeGo \(21\)](#)  
[OS \(18\)](#)  
[Все рубрики \(1\)](#)  
[Обучение \(12\)](#)

**Ссылки**  
[Maemo](#)  
[Dvi](#)  
[Symbian](#)

**Личные инструменты**  
[Войти](#)

**Архив новостей**  
[Март 2010](#)  
[Февраль 2010](#)  
[Деканбрь 2009](#)  
[Ноябрь 2009](#)  
[Октябрь 2009](#)  
[Сентябрь 2009](#)  
[Май 2009](#)  
[Апрель 2009](#)  
[Февраль 2009](#)



# Published Mobile Platform Applications

Mobile games (Walk Around Me, Same Balls, Bubble Hunter, Explode Them, Protector)

Reference Applications (Mushrooms, Kinoman, Fishing in Karelia)

Healthscare applications (CardiaCare)

Tourist and walker applications (World Around Me, Firepoint)

- Free and Commercial versions
- Over 60 thousands downloads

<http://oss.fruct.org/projects>



# Teaching Strategy

ICT (Computing) field is rapidly expanding government and private companies invest in its development vast sums of money.

Computing Curricula 2005: division ICT onto five disciplines family:

- Computer Engineering
- Computer Science (CS)
- Information Systems
- Information Technology
- Software Engineering (SE)

It is possible (and expedient) to organize efficient ICT education for the four disciplines (besides Computer Engineering) in the framework of Russian state educational standards family “Applied Mathematics and Informatics”



# Teaching Strategy

The role of Mathematics in ICT formation and development is considered to be a fundamental one, as ICT professional deals with formal, abstract concepts and objects.

Applied Mathematics methods form the basis of CS discipline. The latter one in its turn is a IS, IT and SE disciplines progenitor.

Reverse approach to curricular guidelines: corresponding engineering constituents are included in guidelines providing mathematical training of full value

Comparative analysis of “Computer Science”, “Information Systems”, “Information Technologies” and “Software Engineering” disciplines Body of Knowledge Cores shows that these Cores are entirely accommodated in the study hours of Bachelor direction 010400 provided for ICT study.



# Software Engineering: History

- Cooperation with the University of Helsinki, CS Dept. (since 1993)
  - ▶ Unification in Computer Science education (Communication technology and Software Engineering)
  - ▶ Pilot team SE project in 2003 (Web-SynDic)
  - ▶ Joint team SE project in 2004 (DaCoPAN)
- Regular SE course for all ICT students of the Math. Faculty (2005)
- Cooperation with Nokia and FRUCT Association (since 2008)
  - ▶ R&D projects in mobile programming (2008), smart spaces (2009) and m-Health (2010)
  - ▶ SE projects for Karelia ENPI CBC Programme (2010)
  - ▶ Guest lectures exchange between participating Universities (Finland, Saint-Petersburg, Moscow, ...)
- A comprehensive set of advanced SE courses in the Faculty study programs (new generation study standards in Russia, 2010-2012)



# Web-SynDic System

Web system for demonstrating, experimenting and testing syntactic algorithms for solving linear Diophantine equations

<http://websyndic.cs.karelia.ru>

**Research:** Practice requires efficient algorithms. Web-SynDic demonstrates the novel polynomial algorithms

**Education:** High level of training. The student team SE project meets international standards and technologies

**Software Engineering:** Distributed testing the syntactic algorithms, automating of testing

**Potential:** Combination of theory and practice, application to industry, software engineering



# DaCoPAN Project

**Data Communication Protocol Analyzer.** The aim of developed software is illustration of basic functions and behavior of data communication protocols on real network data

## Motivation:

- Experimenting with a geographically distributed SE project
- Developing software for visualizing the behavior of data communication protocols through animation

**Education:** New level of student training – a joint project. Two student groups – in Helsinki and Petrozavodsk

**Software Engineering:** Distributed development via Internet

**Potential:** Support tool for teaching and research, distributed approach in SE



# Software Engineering: Scheme

- 1st & 2nd year students: Preliminary competences and background
  - ▶ Season schools
  - ▶ Optional courses
- 3rd year students: SE fundamentals, CASE tools, Quality assurance
  - ▶ Autumn: Basic course on SE, Team mini-project
  - ▶ Spring: Regular or Advanced team project with dedicated practice
- BSc. studies: Technology competences, Real-life project environment and management
  - ▶ PetrSU IT-park, Centers, Departments and Labs; Russian Academy of Sciences
- MSc. studies: Full-cycle research and development
  - ▶ Advanced courses for SE-specific areas
  - ▶ Related Thesis topics
  - ▶ International R&D Projects, Conferences and Contests





IFIP AICT 357

John Impagliazzo  
Eduard Proydakov  
(Eds.)

# Perspectives on Soviet and Russian Computing

First IFIP WG 9.7 Conference, SoRuCom 2006  
Petrozavodsk, Russia, July 2006  
Revised Selected Papers

 Springer

Dmitry Korzun  
Andrei Gurtov

# Structured Peer-to-Peer Systems

Fundamentals of Hierarchical Organization,  
Routing, Scaling, and Security

 Springer

# Teaching Strategy

- Goldweber, M., Impagliazzo, J., Clear, A.G., Davies, G., Bogoiavlenskii, I.A., Flack, H., Mayers, J.P., Rasala, R.: Historical perspectives on the computing curriculum (Report of WG no. 7). Working Group Reports and Supplemental Proceedings of ITiCSE 1997, New York, USA, pp. 94–111. ACM Press, Uppsala (1997)
- Iurii A. Bogoiavlenskii Information and Communication Technology Education Based on the Russian State Educational Standard of “Applied Mathematics and Informatics” Perspectives on Soviet and Russian Computing, IFIP Advances in Information and Communication Technology Volume 357, 2011, pp 243-250



# Software Engineering

- I.Veriamo, J.Taina, T.Tuohiniemi, Y.Bogoyavlenskiy, D.Korzun. Distributed Cross-cultural Student Software Project: a Case Study. Proc. 18th Conf. on Software Engineering Education and Training (CSEE&T 2005). April 18-20, 2005. Ottawa, Canada. IEEE. pp.207-214
- Y.Bogoyavlenskiy, A.Voronin, D.Korzun, A.Borodin, A.Kolosov, M.Kryshen. Programming for Open Platforms at Universities: Experience of Joint Activity of Petrozavodsk State University and Nokia University Cooperation Program. Proc. CEE-SECR2009. <http://dx.doi.org/10.1109/CEE-SECR.2009.5501163>. IEEE



# Linear Diophantine Models and Algorithms I

- Iurii A. Bogoiavlenskii, Dmitry G. Korzun General Form of Solution of Linear Diophantine Equation Systems Associated with Context Free Grammar, Roceedings of Petrozavodsk State University, Series “Applied Mathematics and Informatics”, Issue 6, PetrSu Press, 1997, PP. 98-109 (in Russian)
- D.Korzun. Grammar-Based Algorithms for Solving Certain Classes of Nonnegative Linear Diophantine Systems. Proc. of Annual International Seminar Finnish Data Processing Week at Petrozavodsk State University (FDPW'2000): Advances in Methods of Modern Information Technology. Vol.3. pp. 52-67.



## Linear Diophantine Models and Algorithms II

- K.Kulakov, D.Korzun. Generating Homogeneous Systems of Equations for Testing and Experimental Analysis of Linear Diophantine Solvers. Proc. of Annual International Seminar Finnish Data Processing Week at Petrozavodsk State University (FDPW'2003): Advances in Methods of Modern Information Technology. Vol.5. pp. 259-278.
- D.Korzun. Syntactic Methods in Solving Linear Diophantine Equations. Proc. of Annual International Seminar Finnish Data Processing Week at Petrozavodsk State University (FDPW'2004): Advances in Methods of Modern Information Technology. Vol.6. pp.151-156.
- D.Korzun, A.Gurtov. A Diophantine Model of Routes in Structured P2P Overlays. SIGMETRICS Performance Evaluation Review, Vol. 35, Issue 4 (March 2008), pp.52-61. ACM Press
- <http://websyndic.cs.karelia.ru/>



# Peer-to-Peer Networking I

- D.Korzun, A.Gurtov. On scalability properties of the Hi3 control plane. Computer Communications. Vol.29, Issue 17, Nov.2006, pp.3591-3601. Elsevier.
- A.Gurtov, D.Korzun, A.Lukyanenko, P.Nikander. Hi3: An efficient and secure networking architecture for mobile hosts. Computer Communications. Vol.31, Issue 10, Jun. 2008, pp.2457-2467. Elsevier
- D.Korzun, B.Nechaev, A.Gurtov. Cyclic Routing: Generalizing Look-ahead in Peer-to-Peer Networks. Proc. 7th IEEE/ACS Int. Conf. on Computer Systems and Applications (AICCSA 2009), May 2009. pp.697-704.
- D.Korzun, A.Gurtov. A Local Equilibrium Model for P2P Resource Ranking. SIGMETRICS Performance Evaluation Review, Vol.37, Issue 2 (Sep.2009), pp.27-29. ACM Press.



## Peer-to-Peer Networking II

- D.Korzun, A.Gurtov. Survey on hierarchical routing schemes in “flat” distributed hash tables. Peer-to-Peer Networking and Applications, Vol.4, No.4, Dec.2011, pp.346-375. Springer.
- B.Nechaev, D.Korzun, A.Gurtov. CR-Chord: Improving lookup availability in the presence of malicious DHT nodes. Computer Networks. Vol.55, Issue 13, Sep.2011, pp.2914-2928. Elsevier.
- D.Korzun, A.Gurtov. Hierarchical Architectures in Structured Peer-to-Peer Overlay Networks. Accepted for publications to Peer-to-Peer Networking and Applications. Springer.
- D.Korzun, A.Gurtov. Structured Peer-to-Peer Systems: Fundamentals of Hierarchical Organization, Routing, Scaling, and Security. ISBN 978-1-4614-5482-3, ISBN 978-1-4614-5483-0. Springer, 2013. 366p.



# Markovian Model of Internetworking Flow Control (AIMD Algorithm)

- Bogoyavlenskaya O. Yu. Teaching Networking Congestion Control. ACM SIGCSE Bulletin, Vol. 36, No. 4, 2004, December pp. 35-41.
- O. Yu. Bogoyavlenskaya Analysis of the Random Flow Generated by the Feedback Transport Protocol in a Data Transfer Network, Automation and Remote Control. December 2003, Volume 64, Issue 12, Springer, pp 1882-1889.
- Bogoiavlenskaia, O., Kojo, M., Mutka, M., and Alanko, T., Analytical Markovian Model of TCP Congestion Avoidance Algorithm Performance, Report C-2002-13, Dept. Comput. Sci., Univ. of Helsinki, 2002.
- O. Yu. Bogoyavlenskaya Probabilistic model of the algorithms of distributed control protocol in the internet network, Automation and Remote Control. January 2009, Volume 70, Issue 1, Springer, pp 107-117.





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- D.Korzun, A.Lomov, P.Vanag, S.Balandin, J.Honkola. Generating Modest High-Level Ontology Libraries for Smart-M3. Proc. of the 4th Int'l Conf. on Mobile Ubiquitous Computing, Systems, Services and Technologies (UBICOMM 2010), Florence, Italy, 25-30 Oct.2010, pp.103-109.  
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- D.Zaiceva, I.Galov, D.Korzun. A Blogging Application for Smart Spaces. Proc. 9th Conf. Open Innovations Community FRUCT and 1st Regional MeeGo Summit Russia-Finland. Petrozavodsk, Russia, 25-29 Apr. 2011. pp.154-163.



## Smart Spaces II

- D.Korzun, I.Galov, A.Kashevnik, N.Shilov, K.Krinkin, Y.Korolev. Integration of Smart-M3 Applications: Blogging in Smart Conference. Proc. 11th Int'l Conf. on Smart spaces (ruSMART 2011) and 4th Int'l Conf. on Next generation wired/wireless networking (NEW2AN 2011). LNCS 6869, St.Petersburg, Russia, 22-23 Aug.2011. pp.51-62. Springer.
- D.Korzun, S.Balandin, V.Luukkala, P.Liuha, A.Gurtov. Overview of Smart-M3 Principles for Application Development. Proc. Congress on Information Systems and Technologies (IS&IT'11), Conf. Artificial Intelligence and Systems (AIS'11). Black Sea Coast, Divnomorskoye, Russia, 2-9 Sep. 2011. Moscow: Physmatlit, 2011, Vol.4, pp.64-71.
- A.Lomov, D.Korzun. Subscription Operation in Smart-M3. Proc. 10th Conf. Open Innovations Association FRUCT and 2nd Finnish-Russian Mobile Linux Summit. Tampere, Finland, 7-11 Nov. 2011. pp.83-94.



## Smart Spaces III

- P.Vanag, D.Korzun. SmartSlog knowledge patterns: initial experimental performance evaluation. Proc. 11th Conf. Open Innovations Association FRUCT. St.-Petersburg, Russia, 23-27 Apr. 2012. pp.176-182
- D.Korzun, I.Galov, S.Balandin. Proactive Personalized Mobile Mutli-Blogging Service on Smart-M3. Proc. 34th Int'l Conf. on Information Technology Interfaces (ITI 2012), June 25-28, 2012. Cavtat / Dubrovnik, Croatia. pp.143-148.  
Extended version: D.Korzun, I.Galov, S.Balandin. Proactive Personalized Mobile Mutli-Blogging Service on Smart-M3. Journal of Computing and Information Technology - CIT. 2012. Vol.20. No 3. Special Issue: Selected Papers from ITI 2012 Conference. pp.175-182.



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- Y.Korolev, D.Korzun, I.Galov. Smart Space Applications Integration: A Mediation Formalism and Design for Smart-M3. Proc. NEW2AN/ruSMART 2011, LNCS 7469, Saint-Petersburg, Russia, 27–28 August 2012. pp. 128–139. Springer.
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# Mobile Health Care

- A. Borodin, A. Pogorelov, Y. Zavyalova, The Cross-platform Application for Arrhythmia Detection. Proc. 12th Conf. Open Innovations Association FRUCT and Seminar on e-Travel. Oulu, Finland, 5-9 Nov. 2012., SUAI Univ. press, pp. 26-30
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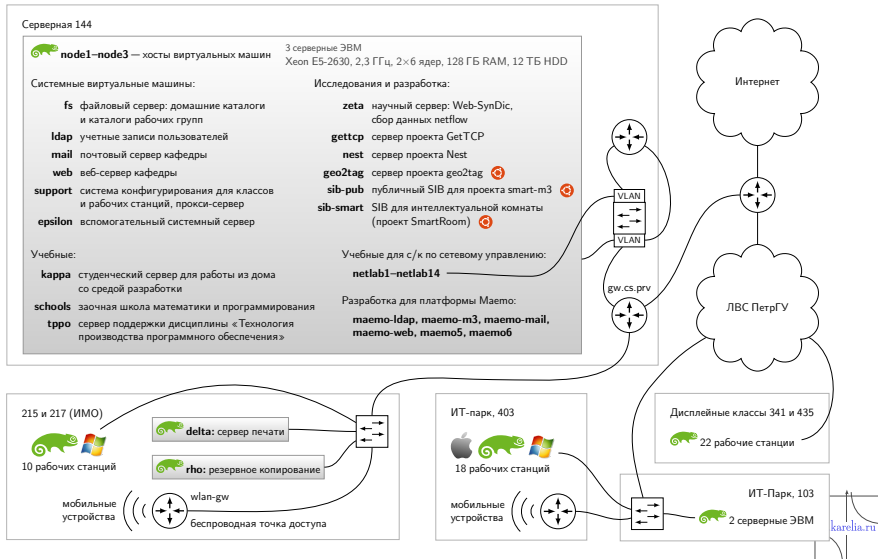


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- Aksenova E. A., Lazutina A.A., Sokolov A.V. Study of a non-markovian stack management model in a two-level memory. Programming and Computer Software. 2004. Vol. 30. No.1. pp. 25-33
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Вычислительная система кафедры Информатики и математического обеспечения



## Computing Facilities: Servers

Main servers (main PetrSU building):

- Three servers, switch, router, UPS
- Each server has 12 computing cores, 128 Gb RAM, 12 Tb disks
- Purchased recently (2012Q4) - Small and compact (12U in rack) but powerful and efficient (power supplies are certified 80 PLUS Platinum)
- Supermicro, Intel, Hitachi, Samsung, HP, Cisco, APC
- Currently in transition from “traditional” virtualized computing environment to private cloud

“Branch” servers (IT-park building):

- Two servers, switch, UPS
- Each server has 8 computing cores, 16 Gb RAM, 6 Tb disks
- Purchased in 2008, upgraded in 2012
- “Traditional” virtualized environment (multiple virtual machines to serve developers needs, backup of main servers data, etc.)





# Computing Facilities: PCs

CS Department (two rooms in the PetrSU main building):

- 14 PCs, some notebooks, other mobile devices (Android, iOS)
- Wired and wireless LAN
- Two printers (one in each room), scanner

Student classrooms (currently two classrooms in PetrSU main building):

- 20-30 PCs - Linux (openSUSE) supported by department staff and MS Windows (supported by PetrSU computing center staff)

Developers (IT-park building):

- 15 PCs, some notebooks, other mobile devices - Wired and wireless LAN



# Computing Facilities: Software

- Linux (openSUSE) and MS Windows
- Xen, LDAP, NFS, Samba, ISC bind
- OpenSSH, PuTTY
- nginx, Apache, PHP, MySQL
- Bugzilla, MediaWiki, WordPress, Redmine, Roundcube Webmail
- Android SDK, Symbian SDK, Maemo SDK, Harmattan SDK, Qt SDK, Qt Creator, MS Visual Studio
- LibreOffice, OpenOffice and MS Office



Спасибо за внимание!

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