Petrozavodsk State University and University of Helsinki

Departments of Computer Science
Twenty years of Cooperation

Iurii A. Bogoiavlenskii and Timo Alanko

October 15, Petrozavodsk






Outline

- Initial Point. 1993
- 2003. History and Results of Ten Years Cooperation
- 20 Years Co-authors
- 2013. Current R&D
- Expanding of International Cooperation
- Mobile Platform Applications

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Initial Point. 1993 I

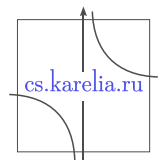
The CS world was very different from what it is today.

The education and research in Russia had been developed rather independently from the mainstreams of other world.

There were some strong areas whereas some other areas had been more or less neglected.

Also:

- the world-wide web was yet to be born (no access to publications anywhere) data communication connections existed but they were slow and unreliable;
- foreign textbooks were not readily available;
- availability of international scientific publications was limited;
- No PCs with Unix. Very weak networks;
- RTT of an e-mail messages was around day;



Initial Point. 1993 II

- No networking and modern software engineering competences;
- No young generation of lecturers and researchers.

But:

- High level of mathematical cultutre of staff and students as CS Department was (and is) at Mathematical Faculty
- High level of enrollees knowledge of programming. Since 1985 due to efforts of Academician Andrey P. Ershov the discipline "Informatics" was introduced in the secondary school Curriculum.

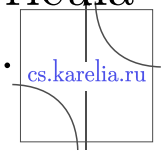
Univrsity of Petrozavodsk 20-05-93 Petrozavodsk Karelia

Meeting attended by

Professor Timo Alanko
Professor Gennady Sigovtsev
Professor Iouri Bogoiavlenski

Pro Memoria

1. Mr. Timo Alanko tries to collect information about teaching programs at secondary school level.
2. The idea of organization of "Finnish Data Processing Week"in Petrozavodsk State University will be discussed in both CS Departments: - needs, themes - schedules - interested partners - availablility of resources - possibilities of organizing the week on an annual basis - organization committee, program committee.
3. The CS Department of Helsinki gives a possibility to get a survey on available textbooks (in English). The CS Deptartment of Petrozavodsk examines the areas where there exist needs for textbooks in Russian.
4. The CS Departments will exchange mutually last versions of their CS curricula presented in as detailed a form as possible (Finnish versions are acceptable).



Universities of Helsinki and Petrozavodsk
Ten Years of Cooperation in Computer Science

Victor Vasiliev, Professor, Doctor of Science, Rector of the PetrSU
Rector@psu.karelia.ru
Dr. Yury Bogoyavlenskiy, Petrozavodsk State University
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1993 — The beginning

- Visit of Dr. Yury Bogoyavlenskiy to Helsinki
- Visit of Dr. Timo Alanko to Petrozavodsk with elective course “Performance Analysis”
- Arising of the idea of “Annual Finnish Data Processing Week at the Petrozavodsk State University” by 4 persons including former Vice-rector Andrei Pechnikov and Head of the local CS Department Gennady Sigovtsev

1994 — 1996 The Week of Invited Lecturers

- Visitors to Petrozavodsk: Timo Alanko, Harri Laine, Helena Ahonen, Vesa Halkka, Markku Kojo
- Courses:
  - Knowledge Bases
  - Computing Facilities of the University of Helsinki
  - Performance Analysis
  - Modern DBMS
  - Network Performance Analysis
  - Client-Server Programming in Unix

1997 – 2003 The Week of Scientific Seminars

- Six annual seminars have been arranged
- Four volumes of seminars proceedings have been published by PetrSU with financial support of the University of Helsinki
- Several tens of researches have given presentations on the seminars
- Forty five articles have been published in the Proceedings

Main results of the Cooperation. 1

- Olga Bogoiavlenskaia has defended Ph.D thesis at 1998 in PetrSU; now she is a leading lecturer and researcher at CS Dept. of the PetrSU
- Vadim Ponomarev works on Ph.D thesis; now he is a leading lecturer and system administrator of the computer system of CS Dept. of the PetrSU

Main results of the Cooperation. 2

- Andrei Gurtov has written Ph.Lic thesis at 2001 in Helsinki; now he is a postgraduate student and a lecturer at CS Dept. of the University of Helsinki and staff member of “Sonera” (Finland). At the moment he is a visiting researcher in USA.
- Dmitry Korzun has defended Ph.D thesis at 2002 in SPb State University; now he is a leading lecturer and researcher at CS Dept. of the PetrSU

Main results of the Cooperation. 3

- Joint pilot research project “Analytical Markovian Model of TCP Congestion Avoidance Algorithm Preformance”

  Authors: Olga Bogoiavlenskaia, Markku Kojo, Matt Mutka, Timo Alanko

http://www.cs.helsinki.fi/TR/C.html

Main results of the Cooperation. 4

- Computer System of the CS Dept. of the PetrSU has been developed. It is qualitatively fully equivalent to the one of the CS Dept. of the University of Helsinki (see the next slide)
- Common Core of Working Study Program is under development by CS Departments of the Universities of Helsinki and Petrozavodsk (to be presented later today)
- Specialization Area "Distributed Systems and Data Communication" similar to the one in Helsinki has been started at the PetrSU since 2001

Conclusion

At the Department of Computer Science of the Petrozavodsk State University a team of young lecturers and scientists has been created who conduct modern research in the networking area.

Common Core of Working Study Program in Computer Science

Dr. Yury Bogoyavlenskiy
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Prof., Dr. hc Timo Alanko
University of Helsinki
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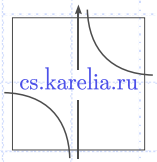

Goal

- To transform the Working Study Program of the direction “Applied Mathematics and Computer Science” in the Petrozavodsk State University to allow students to obtain skills necessary to work in such important areas as “Distributed systems and data communication” and “Software Engineering” on a modern international level

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The Main Courses of the CCWSP, I

Course	Term
Introduction to Programming (C, Pascal)	1,2
Introduction to System Programming (i8086 Assembly L.)	1,2
Basics of Applied Software	1
Introduction to DBMS	2
Introduction to OS	2

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The Main Courses of the CCWSP, II

Course	Term
Concurrent Systems	2
DBMS Systems and project	3
Operating Systems	3
Data Communication	3
Unix Programming	4
Software Engineering	5
Network programming	5
Distributed Systems	6

The Main Courses of the CCWSP, III

Course	Term
Computer Architecture	6
Formal Languages and Compilation	6
Scientific Writing	7

Results

- The Specialization Area “Distributed Systems and Data Communication” was created at the Dept. of CS of the PetrSU
- The CCWSP was accepted by the Council of the Mathematical Faculty of the PetrSU as an element of the Working Study Program for the area in May, 2001

Other Teaching Activities

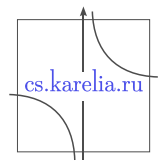
IMPIT - an international master's degree programme in information technology in Finland.

CBU - the Finnish-Russian Cross-Border University.

Series of Summer/Winter schools in Universities of Helsinki, Lappeenranta, and Petrozavodsk.

Invited lectureres Prof. Kimmo Raatikainen (University of Helsinki) and Prof. Pekka Kilpeläinen and Marko Hassinen (University of Kuopio) gave short courses in Petrzavodsk State University.

Dmitry Korzun and Olga Bogoiavlenskaia gave short lecture courses in Universities of Helsinki, Oulu, and Kuopio.



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)

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Software Engineering

- I.Verk7amo, 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

Web-SynDic System

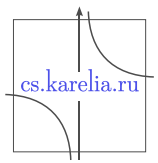
Web system for demonstrating, experimenting and testing syntactic algorithms for solving linear Diophantine equations
http://websyndic.cs.karelia.ru

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

Петрозаводский государственный университет

185640, Россия, Карелия, Петрозаводск, пр. Ленина, 33

UNIVERSITY OF HELSINKI

DaCoPAn Distributed Software Engineering Project

-

Проект DaCoPAn

Presentation produced by the DaCoPAn team (see below)

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Description of the problem

Motivation

- Internet protocols form the basis of data communication education
- Internet protocols are actively studied by researchers.
- There are almost no tools available for studying the behaviour of real network protocols
- Provide a tool that students can use at home, teachers can use in the classroom, and researchers can use in the laboratory
- Features: easy to use, powerful for visualizing, and extensible for future projects

Uses for DaCoPAn

Teaching

- Teachers can use scenarios to show the most important ideas.
- Save time preparing lectures.
- Can use the tool to assign exercises to the students.

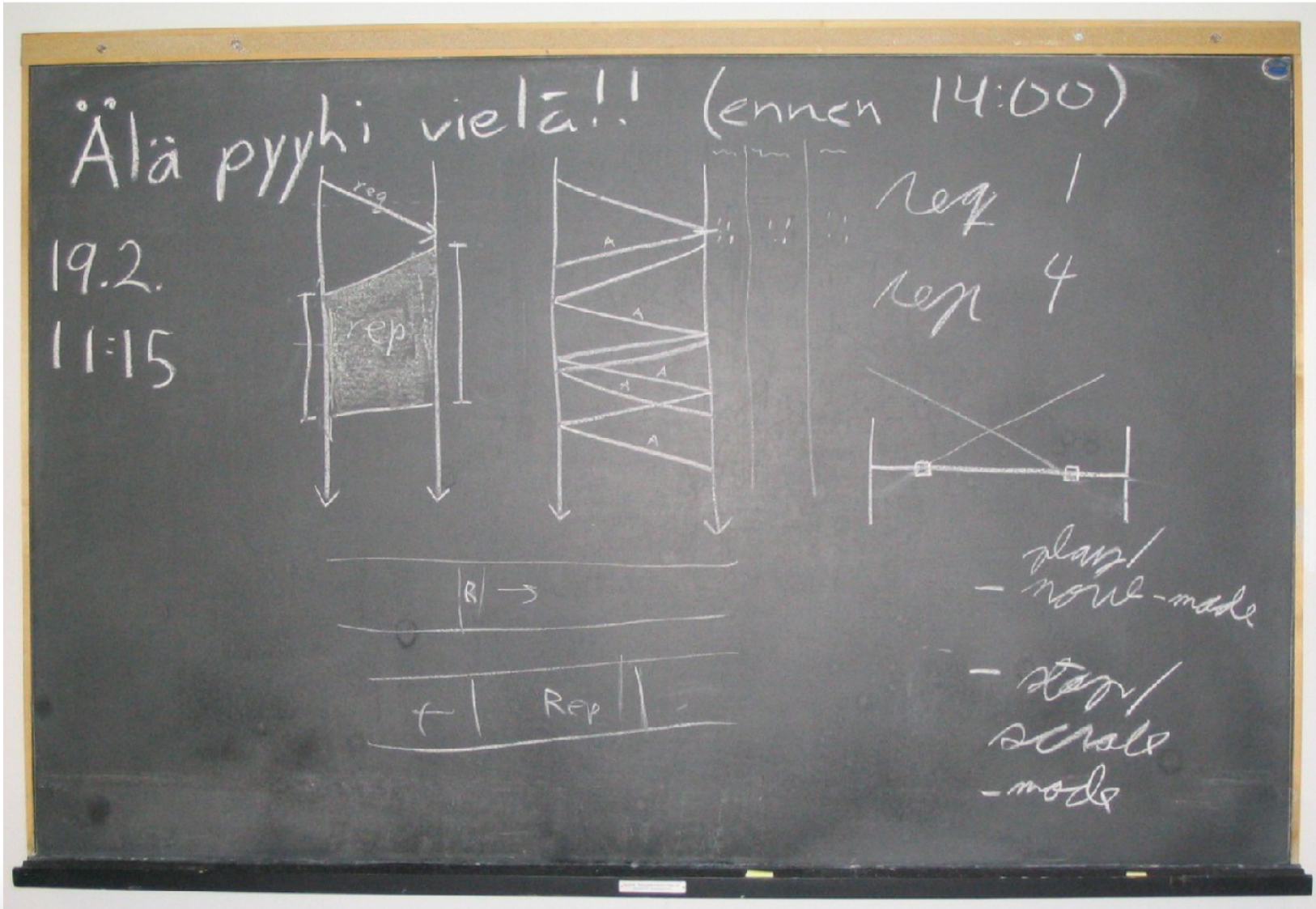
Students

- Can download DaCoPAn for home use.
- Used as personal e-learning tool.

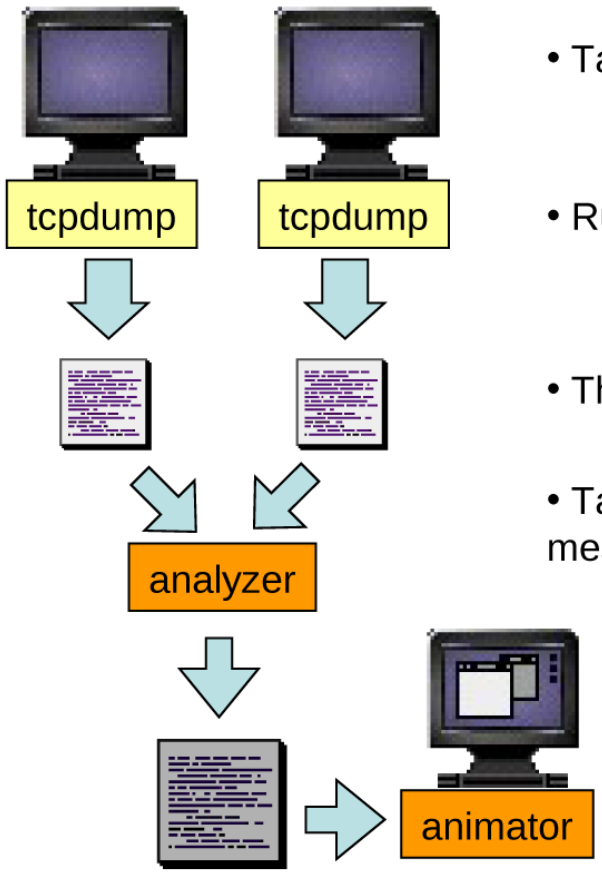
Researchers

- Can use real data to see complex situations in a network
- Useful for performance analysis

Traditional methods for teaching protocols



Description of the solution



- Take a network with two computers
- Run a program called "tcpdump"
- This program saves the network traffic into two files
- Take these files, and analyze them, to see what messages happen between the two computers
- A file is output from the analyzer
- This file acts as input for the animator.

Project team

Idea

Timo Alanko

Yury Bogoyavlensky

Customer

Markku Kojo

Supervisors

Juha Taina

Yury Bogoyavlensky

Instructors

Turjo Tuohiniemi

Dmitry Korzun

Project team

H-group

- Jonathan Brown, manager
- Alejandro Fernández
- Carlos Arrastia
- Jari Aarniala
- Jarkko Laine
- Vesa Vainio

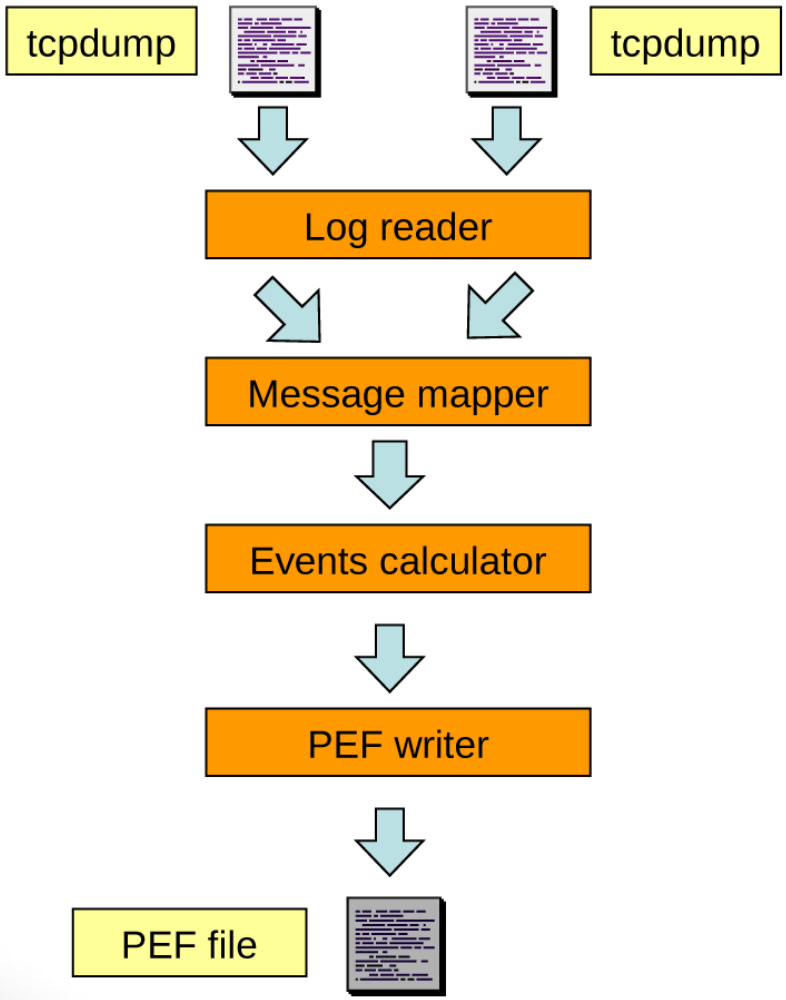
P-group

- Kirill Kulakov, group leader
- Andrew Salo
- Andrew Ananin
- Mikhail Kryshen
- Viktor Surikov

Communication

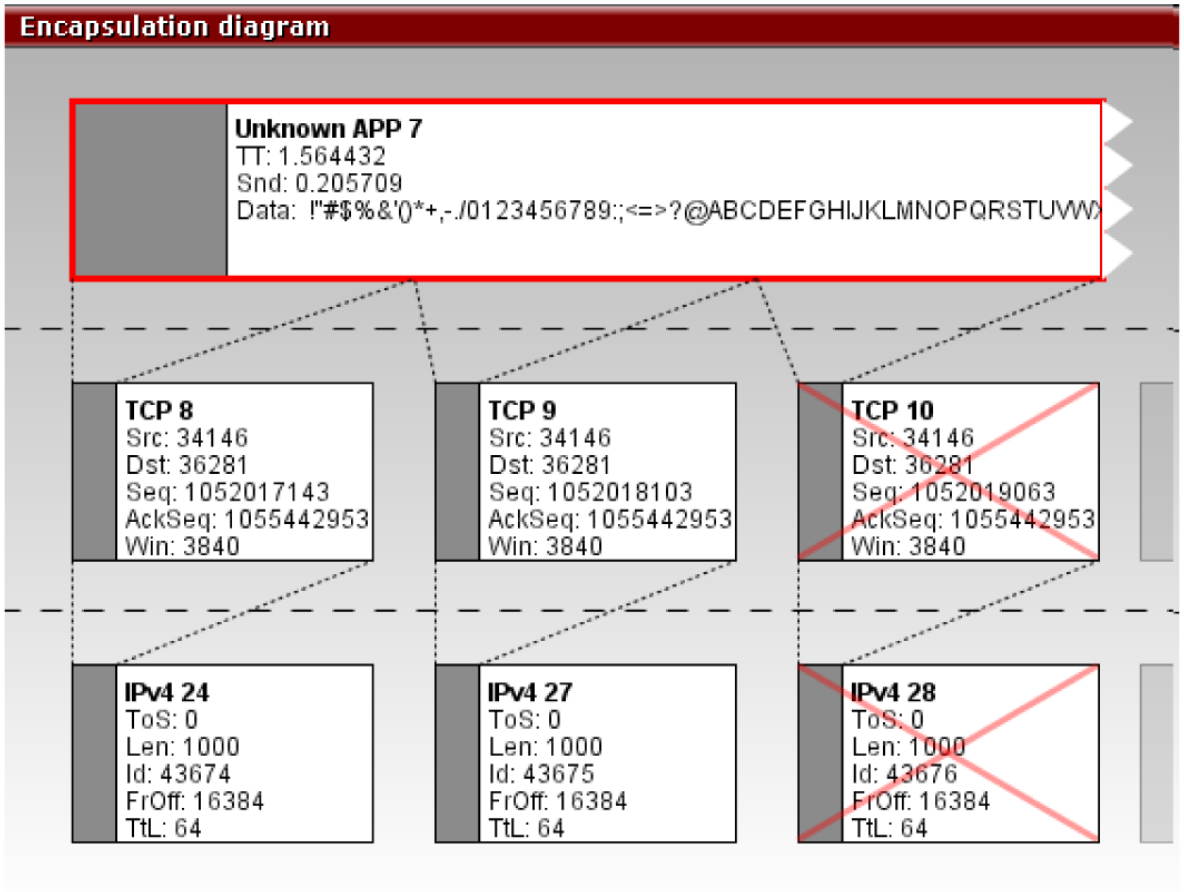
- Team Wiki website
- Forum
- CVS
- E-mail

Analyzer



- Take a two tcpdump files from two hosts
- Read each tcpdump file
- Find corresponding messages
- Merge messages into one message sequence
- Transform message sequence to the events sequence
- Calculate protocol variables and additional events
- Write events sequence into PEF file
- Produced protocol events file

Encapsulation diagram



DaCoPAn Metrics

- Work time – 134 days, 31 day of collaboration work
- Implementation – 12.000 lines of code, 5.500 lines of comment
- Documentation – 15 documents, 346 pages
- E-mails – 650 messages
- Forum – 46 topics, 296 messages
- Test plan – 126 different tests
- Integration testing – 25 errors

Twenty years - 184 co-authors

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Dr. J. Kurhila
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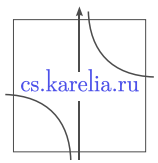

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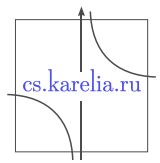

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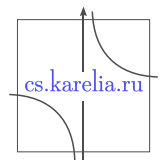
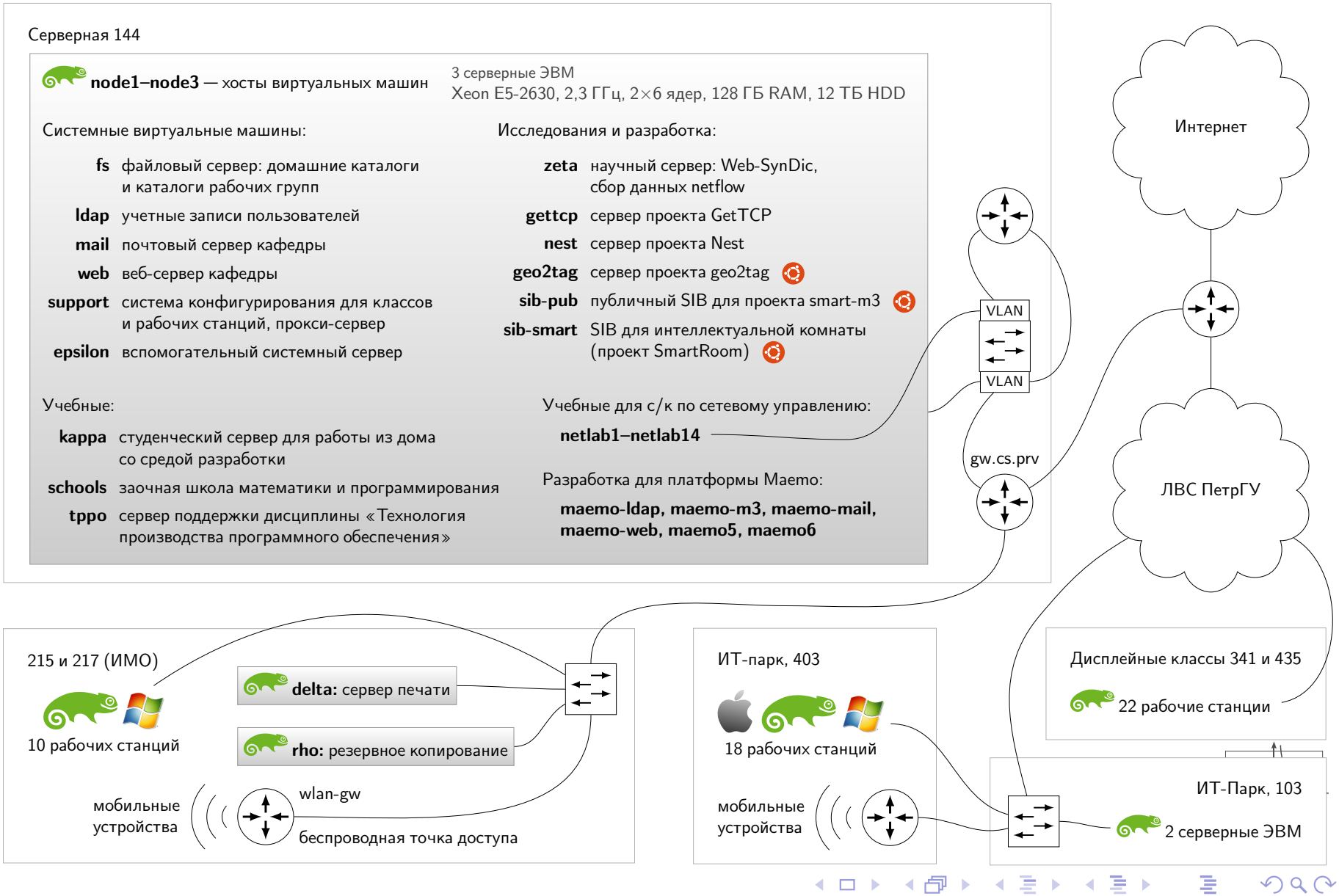


Вычислительная система кафедры Информатики и математического обеспечения



Our 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.

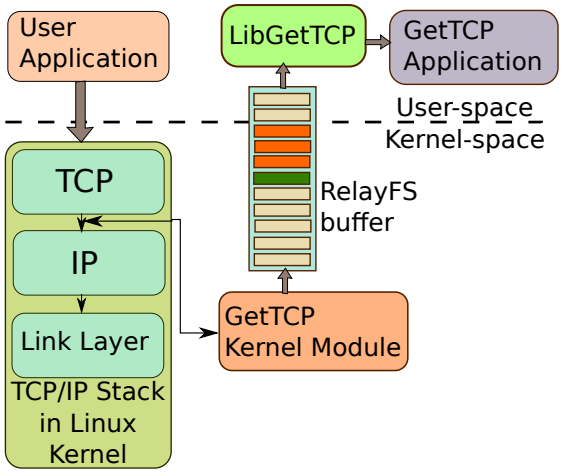
Reverse approach to curricular guidelines: corresponding engineering constituents are included in guidelines providing mathematical training of full value

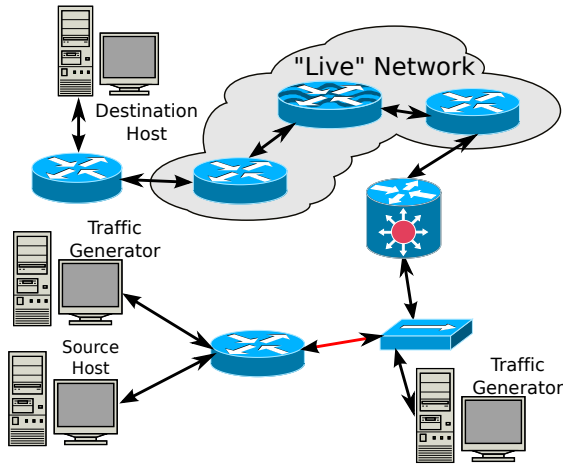
- Goldweber, M., Impagliazzo, J., Clear, A.G., Davies, G., Bogoiavlenskii, I.A., Flack, H., Mayers, J.P., Rasala, R.: Historical perspectives on the computing curriculum (Report of WG no. 7). Working Group Reports and Supplemental Proceedings of ITiCSE 1997, New York, USA, pp. 94–111. ACM Press, Uppsala (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

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.
- 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.
- Aleksandr A. Sannikov, Olga I. Bogoiavlenskaia, Iurii A. Bogoiavlenskii GetTCP+: Performance Monitoring System at Transport Layer // Internet of Things, Smart Spaces, and Next Generation Networking, Lecture Notes in Computer Science 8121, August 2013, pp. 236-246.

GetTCP: Linux networking analysis framework





- Fast and configurable tool for extraction of TCP-flows statistics
- Data provision for network path performance estimation
- Tested in real network enviroment

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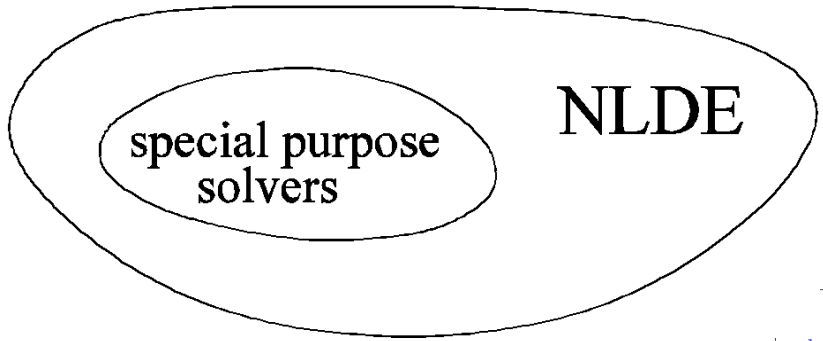
Linear Diophantine Models and Algorithms

- 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



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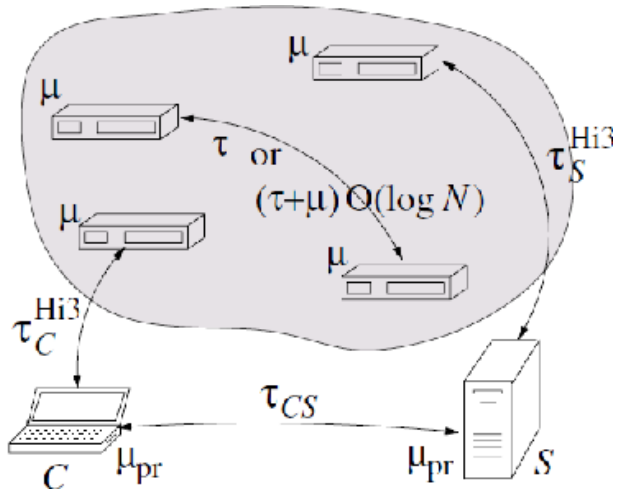
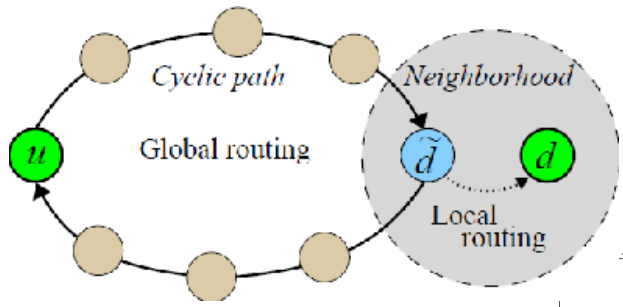
Peer-to-Peer Networking. Dmitry Korzun and Andrei Gurtov http://www.cs.helsinki.fi/u/gurtov/

- 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





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Linear Diophantine Models and Algorithms

- 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.
- 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
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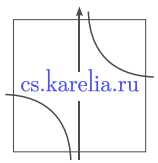

Peer-to-Peer Networking

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- 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, 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.
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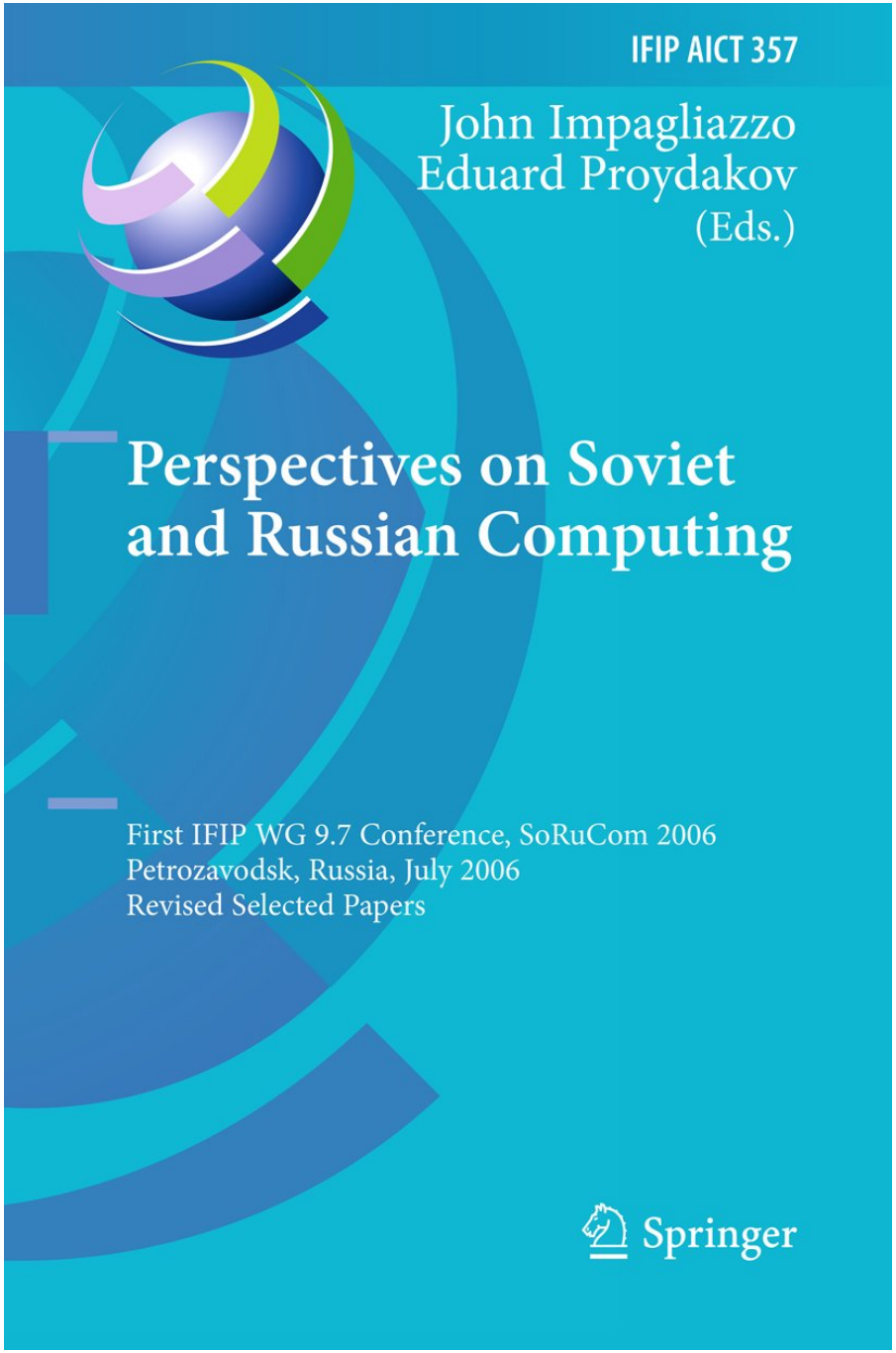
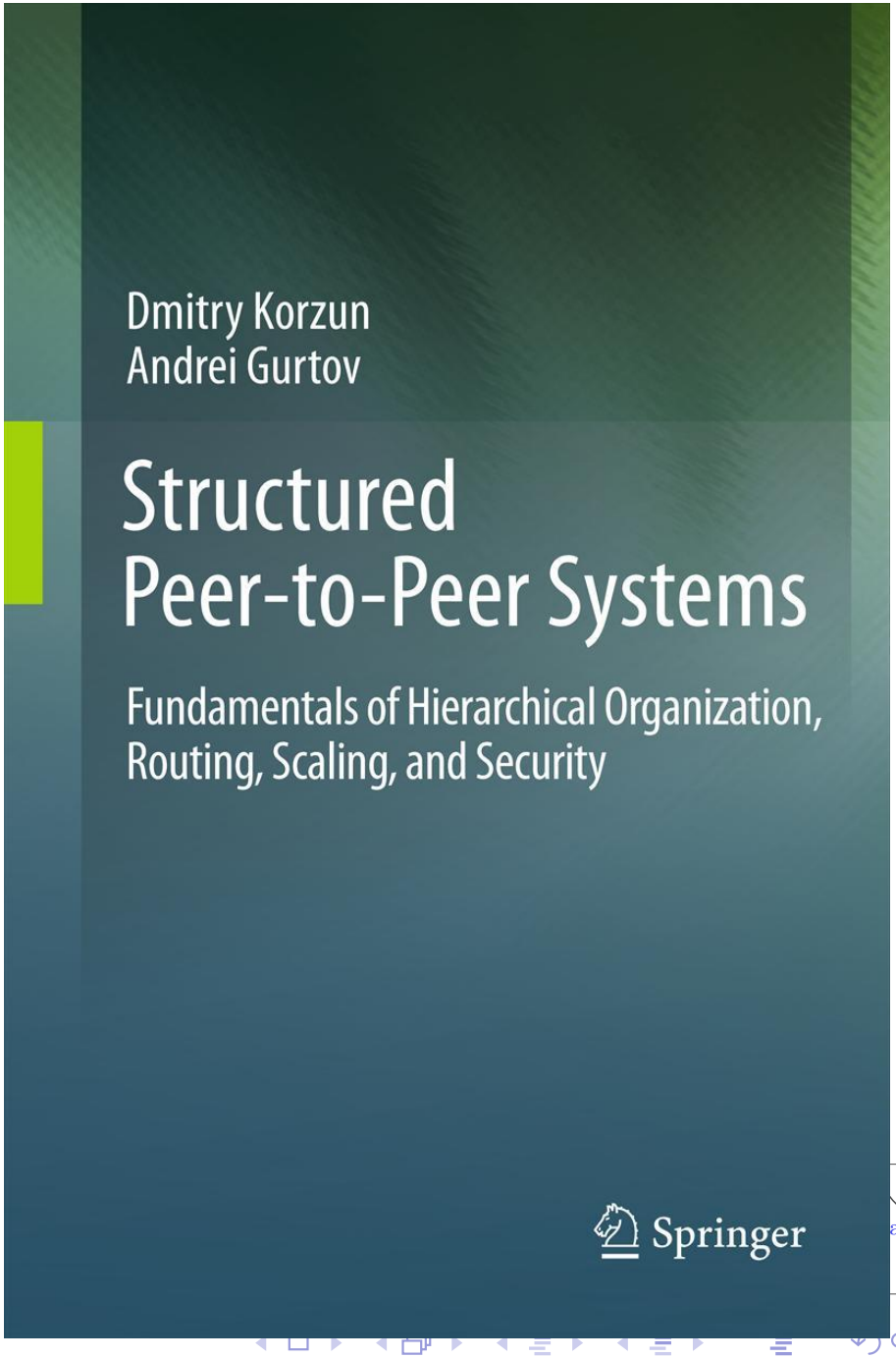

IFIP AICT 357
John Impagliazzo
Eduard Proydakov
(Eds.)
Perspectives on Soviet and Russian Computing
First IFIP WG 9.7 Conference, SoRuCom 2006
Petrozavodsk, Russia, July 2006
Revised Selected Papers
Springer


Dmitry Korzun
Andrei Gurtov
Structured Peer-to-Peer Systems
Fundamentals of Hierarchical Organization, Routing, Scaling, and Security
Springer

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

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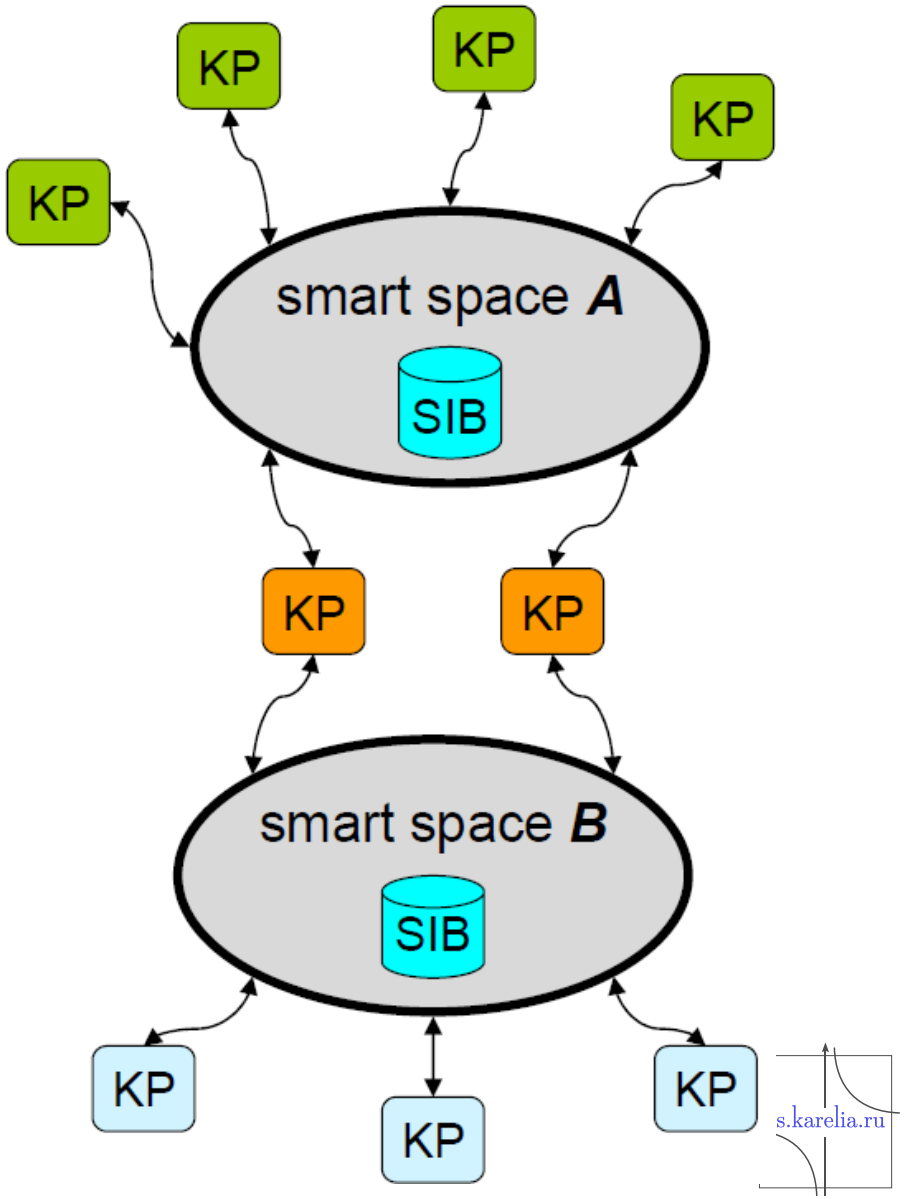
Smart Spaces: Our Projects

- 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-...)



Smart Spaces

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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.
- A.Lomov. SmartSlog Session Scheme for Smart-M3 Applications. Proc. 12th Conf. Open Innovations Association FRUCT and Seminar on e-Travel. Oulu, Finland, 5-9 Nov. 2012. pp.66-71.

Expanding of International Cooperation

Since 2008 the Department and PetrSU IT-Park are operating in frame of Open Innovations Association FRUCT http://www.fruct.org

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.
Financig - EU, Finland, Russian Federation.
Current projects:

- KA179 "Complex development of regional cooperation in the field of open ICT innovations"
- KA322 "Development of cross-border e-tourism framework for the programme region (Smart e-Tourism)"
- KA432 "Journey planner service for disabled people (Social Navigator) "

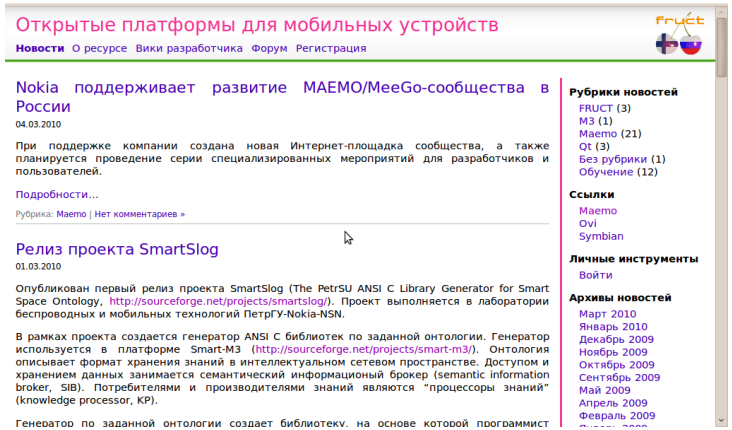
Mobile Platform Applications

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

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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

Thank you for your attention!

ybgv@cs.karelia.ru