Petrozavodsk State University and University of Helsinki

Departments of Computer Science
Twenty years of Cooperation

Iurii A. Bogoiaavlenskii and Timo Alanko

October 15, Petrozavodsk
The Establishers

Iurii A. Bogoiavlenskii

Twenty years of Cooperation

15 October 2013

[Images of six individuals]
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
Initial Point. 1993

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 culture 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.
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
ybgv@cs.karelia.ru
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 Bogojuvlenkskaia has defended Ph.D thesis at 1998 in PetrsSU; now she is a leading lecturer and researcher at CS Dept. of the PetrsSU

- 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 PetrsSU
Main results of the Cooperation. 2

- Andrei Gursov 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 Bogoiaavlenskaia, Markku Kojo, Matt Mutka, Timo Alanko

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
Petrozavodsk State University
ybgyv@cs.karelia.ru
Prof., Dr. hc Timo Alanko
University of Helsinki
alanko@cs.helsinki.fi
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
The Main Courses of the CCWSP, I

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Introduction to Programming (C, Pascal)</td>
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<tr>
<td>Introduction to System Programming (i8086 Assembly L.)</td>
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<td>Basics of Applied Software</td>
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<td>Introduction to DBMS</td>
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<td>Introduction to OS</td>
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The Main Courses of the CCWSP, II

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<td>DBMS Systems and project</td>
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<td>Operating Systems</td>
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<tr>
<td>Data Communication</td>
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<tr>
<td>Unix Programming</td>
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<tr>
<td>Software Engineering</td>
<td>5</td>
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<td>Network programming</td>
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<td>Distributed Systems</td>
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The Main Courses of the CCWSP, III

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<td>Computer Architecture</td>
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<tr>
<td>Formal Languages and Compilation</td>
<td>6</td>
</tr>
<tr>
<td>Scientific Writing</td>
<td>7</td>
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</tbody>
</table>
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 lecturers Prof. Kimmo Raatikainen (University of Helsinki) and Prof. Pekka Kilpeläinen and Marko Hassinen (University of Kuopio) gave short courses in Petrozavodsk State University.

Dmitry Korzun and Olga Bogoiaivlenskaia 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)
Software Engineering


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 Distributed Software Engineering Project

Проект DaCoPAn

Presentation produced by the DaCoPAn team (see below)
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
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
• 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.
DaCoPAn Distributed Software Engineering Project
University of Helsinki
Petrozavodsk State University

Project team

Idea
Timo Alanko
Yury Bogoyavlensky

Customer
Markku Kojo

Supervisors
Juha Taina
Yury Bogoyavlensky

Instructors
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Dmitry Korzun
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
• Team Wiki website
• Forum
• CVS
• E-mail
Analyzer

- Take 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
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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<td>Sini Ruohomaa</td>
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<td>University of Kuopio (11)</td>
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Twenty years of Cooperation

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Teuvo Laaksonen, *Metso Automation*
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Dr. Hannu Reittu, *VTT Helsinki*
Martti Forsell, *VTT Oulu*
Вычислительная система кафедры Информатики и математического обеспечения

<table>
<thead>
<tr>
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<tr>
<td>node1–node3 — хосты виртуальных машин</td>
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<tr>
<td>3 серверные ЭВМ</td>
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<tr>
<td>Хеон E5-2630, 2,3 ГГц, 2×6 ядер, 128 ГБ RAM, 12 ТБ HDD</td>
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Системные виртуальные машины:
- fs — файловый сервер: домашние каталоги и каталоги рабочих групп
- ldap — учетные записи пользователей
- mail — почтовый сервер кафедры
- web — веб-сервер кафедры
- support — система конфигурирования для классов и рабочих станций, прокси-сервер
- epsilon — вспомогательный системный сервер

Исследования и разработка:
- zeta — научный сервер: Web-SynDic, сбор данных netflow
- gettcp — сервер проекта GetTCP
- nest — сервер проекта Nest
- geo2tag — сервер проекта geo2tag
- sib-pub — публичный SIB для проекта smart-m3
- sib-smart — SIB для интеллектуальной комнаты (проект SmartRoom)

Учебные:
- kappa — студенческий сервер для работы из дома со средой разработки
- schools — заочная школа математики и программирования
- tppo — сервер поддержки дисциплины «Технология производства программного обеспечения»

Учебные для с/к по сетевому управлению:
- netlab1–netlab14

Разработка для платформы Maemo:
- maemo-ldap, maemo-m3, maemo-mail, maemo-web, maemo5, maemo6

Интернет ЛВС ПетрГУ

215 и 217 (ИМО)
- 10 рабочих станций
- мобильные устройства
- wlan-gw — беспроводная точка доступа

ИТ-парк, 403
- 18 рабочих станций
- мобильные устройства

Дисплейные классы 341 и 435
- 22 рабочие станции

ИТ-Парк, 103
- 2 серверные ЭВМ

ИТ-Парк, 403
- 18 рабочих станций
- мобильные устройства

Дисплейные классы 341 и 435
- 22 рабочие станции

ИТ-Парк, 103
- 2 серверные ЭВМ
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


- Iurii A. Bogoiaevskii 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.
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 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. 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
Linear Diophantine Models and Algorithms


- http://websyndic.cs.karelia.ru/
Peer-to-Peer Networking


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-...)
Smart Spaces


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
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