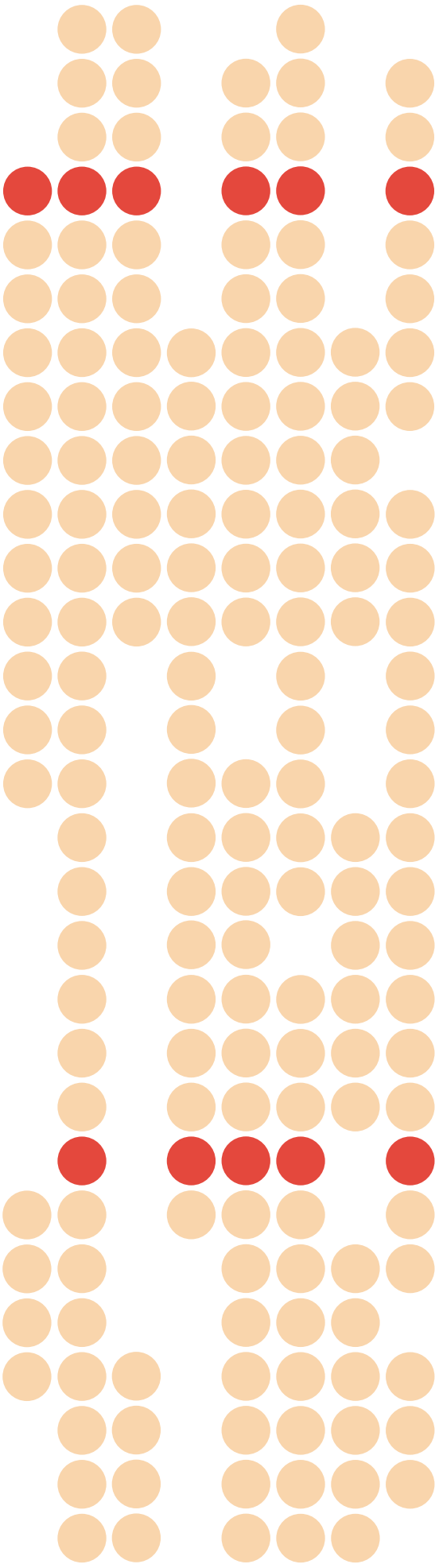

SWEDISH INSTITUTE OF COMPUTER SCIENCE 2007

SICS – PART OF SWEDISH ICT

SICS

SICS 2007
Production: Kersti Hedman, SICS
Graphic Design: TheyGraphics
Photo on pages 4, 7, 10–13, 18–20, 22 and 24 by Lars Nyman
Cover inspired by the Lyra installation described on page 17

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INTRODUCTION

SICS HIGHLIGHTS IN 2007

In 2007, SICS continued to develop exciting new technology in cooperation with Swedish industry and academy. One example that we highlight this year is the work we have done with Ericsson on the next generation of AXE systems. We performed an independent verification of core protocols in the new system and discovered errors not found during Ericsson's internal testing. Elimination of the discovered errors will directly improve the reliability of future systems. This is an excellent example of how we combine leading edge theoretical research capability with a sound engineering understanding of complex industrial systems.

In addition to working with existing companies, we also create new companies based on our research results. In 2007, the new company Peerialism was formed based on our research in distributed systems and P2P algorithms. The company's PeerTV technology offers radically improved ways of distributing media over the Internet – an area that tops MIT's Technology Review's list of exciting technologies for 2007. Long term research from SICS helps Peerialism bring its new products to market in record time!

Working with industry is one important aspect of our work, and influencing society is another. We do this e.g. by acting as advisors to the Swedish government; Kia Höök from SICS and Bo Dahlbom from Interactive Institute are both members of the new IT Advisory Board created by the Swedish Minister of Infrastructure and IT. SICS is also actively working with the Royal Swedish Academy of Engineering Sciences on charting the future of Internet use and research in Sweden. In efforts like this, our technical know-how, balanced view on technology vs. humanity and creative visions are important to guide Swedish policy and politics.

In last year's introduction to SICS Annual Report, I mentioned globalization as one of the drivers for our research. One good example of this is the work we have initialized during 2007 on research collaboration with India. SICS has assisted VINNOVA in identifying relevant areas for collaboration between Swedish and Indian researchers, and we are also starting a large project within this program. We will develop a robust, scalable, distributed database system and our Indian colleagues will use that to implement a health journal system capable of keeping track of India's vast population.

During the last decade, Europe has been the focus for our international research collaborations. Europe will continue to be important, but strong Asian economies like India, China, Singapore, and Japan are likely to be increasingly important in the years to come. Not only because a lot of technology and innovation is coming from this direction, but also because an understanding of these markets is important if SICS is to assist Swedish industry in research aimed at developing new products for these markets. Even if SICS is a small institute in an international comparison, our world leading reputation helps us open the doors to international research both for us and our partners!

Staffan Truvé, Managing Director

WHO IS SICS?

Swedish Institute of Computer Science (SICS) is a non-profit research organisation with the goal of contributing to the competitive strength of Swedish industry and the quality and efficiency of Sweden's public sector. SICS carries out advanced and focused research in strategic areas of computer science, in close contact with Swedish and international industry and academia. The research is based on cutting-edge new technology and has a time horizon stretching beyond the companies' own R&D efforts. SICS is part of Swedish ICT, and the parent company of the SICS group also including Interactive Institute, Santa Anna IT Research Institute, and Viktoria Institute.

OVERVIEW

Funding, partners and customers

SICS receives base funding from its government controlled owner IRECO corresponding to approximately 10% of the total turnover, which in 2007 was 91 million SEK. The lion part of the revenues comes from competitive research sources, such as the Swedish Agency for Innovation Systems (VINNOVA), the Foundation for Strategic Research (SSF), and the European Commission. Approximately 25% of the revenues come from industrial customers and partners, including contributions from SICS' industrial partner association, Föreningen för Datorteknisk Forskning (FDF), contract research for companies and governmental agencies, and licensing revenues. Members of FDF for 2007 were ABB, Bombardier, Ericsson, FMV, Green Cargo, Saab Systems and TeliaSonera. Other notable customers during the year are Banverket, Siemens Industrial Turbo Machinery, Scania, and a number of Swedish SMEs.

From research to business

SICS develops technologies and prototypes in collaboration with academia and industry. Product development is normally not a part SICS' mission, instead it is carried out by existing companies or by spin-off companies. During 2007, two new start up companies have been founded by SICS researchers: Gavagai (page 9) and Peerialism (page 10). SICS also licenses software (as open source as well as commercially), contributes to standardization, and develops clusters of companies with a common technical interest. The flow of experienced researchers from SICS to existing and new companies contributes to the uptake of new ideas and technologies by industry.

Cooperation with universities and other research institutes

SICS researchers participate actively in national and international research collaborations which include Swedish universities. Moreover, several senior SICS researchers devote part of their time supervising master and doctoral students, and teaching courses. A number of university professors at the Royal Institute of Technology (KTH) and Stockholm University work part-time at SICS. During 2007 three new research centres where universities, research institutes and industry work together became operational, supported by multi-year funding from VINNOVA, SSF, KKS and industrial partners: SICS Center for Networked Systems, Mobile Life (led by Stockholm University), and Wisenet (led by Uppsala University). A number of projects have also been run in collaboration between SICS and its sister institutes within Swedish ICT. During 2007, two researchers from SICS received their Ph.D. degrees, from Uppsala University and Mälardalen University and one researcher received Licentiate degree from KTH. Around 20 students completed their master thesis work at SICS. A total of 49 scientific publications, thereof 36 reviewed articles in international scientific journals (8), conferences and workshops (28), one book as well as one chapter in an edited book.

International cooperation

SICS research collaboration and contacts within Europe are well developed. SICS is the Swedish member of the European Research Consortium for Informatics and Mathematics (ERCIM). During the past year SICS participated in thirteen European projects in the Sixth Framework programme, coordinated two of them (EVERGROW and IPerG). There is also a steady flow of visiting researchers from abroad to SICS and SICS researchers visiting and working with our international partners.

Management

Managing Director: Staffan Truvé
Chief Scientific Advisor: Seif Haridi
Business Manager: Janusz Launberg
Financial Manager: Charlotta Jörsäter

The laboratories of SICS

Communication Networks and Systems Laboratory (NETS)
Computer Systems Laboratory (CSL)
Industrial Applications and Methods (IAM)
Interactive Collaborative Environments (ICE)
Interaction Laboratory
Security, Policy and Trust Laboratory (SPOT)
UserWare Laboratory (USE)

Directors of the Board

Hans Hentzell, Swedish ICT (Chairman)
Olle Viktorsson, Ericsson
Göran Olofsson, TeliaSonera
Sigvard Brodén, Saab Systems
Lars-Olof Bäckman, Lobema AB
Bernt Ericson
MariAnne Karlsson, Chalmers
Björn Gambäck, SICS
Björn Grönvall, SICS
Kersti Hedman (deputy), SICS
Martin Nilsson (deputy), SICS

HIGHLIGHTS

ADAM DUNKELS AWARDED CHESTER CARLSON PRIZE

Dr. Adam Dunkels, senior scientist at SICS, has been awarded the 2007 Chester Carlson Prize, the most prestigious prize for the information sciences in Sweden, for his prominent work on network-connectivity for small, low-cost embedded systems. The Chester Carlson Prize was founded in 1985 in memory of Chester Carlson, the Swedish-American inventor of the copying machine and founder of the Xerox Corporation. The prize winner is selected by Xerox and the Royal Swedish Academy of Engineering Sciences. The prize sum is 100 000 SEK.

Over 98% of all microprocessors that are sold today are used in embedded systems, most of which have less than one millionth of the memory of a modern PC. By developing the lwIP and uIP embedded TCP/IP stacks and the Contiki operating system, Adam Dunkels has established that even such very small embedded systems can be connected to the Internet. He has released his research results as open source software that today is used by hundreds of companies in products ranging from car engines and oil-pipeline monitoring equipment to airplanes and satellites.

The jury's motivation is: "For the development of operating systems and communication software that enables cost-effective Internet connectivity for new product classes, for example car engines, weather stations, and film production equipment."

"It is a great honour to be awarded the Chester Carlson Prize", says Adam. "It is very important for me that research results are put to good use. This prize not only gives recognition to my results but also to experimental computer systems research at large, to open source software as a dissemination tool for research results, and to everyone that has contributed to lwIP, uIP, and Contiki."

The prize ceremony was held at the Utsikt 2008 conference in Stockholm, Sweden, in February 2008.

Xiaoxi Zhang and Niclas Finne at SICS Open House.

SICS EVENTS

SICS Open House 2007

SICS annual Open House in April had a lot on the menu. As Interactive Institute moved in with SICS in Kista in the beginning of 2007, we arranged the day jointly and exhibited results from both institutes. Invited speakers were Olle Wästberg, director-general of the Swedish Institute, who talked about Second Life, and Sten Minör, software manager of SonyEricsson who talked about mobile telephony. The rest of the day offered short seminars in four tracks: future energy in every day life, networks and computer systems, electronic services and industrial IT.

Utsikt 2007

Utsikt is a conference on applied IT research which is arranged by SICS annually in February in Folkets Hus, Stockholm. The conference attracts a lot of participants from industry as well as universities, institutes and governmental agencies. Over the years the conference has developed into a meeting point for the IT research business. This year about 400 people registered for the event. The theme was Innovation and we discussed how IT research can influence innovation, what impact art and design can have on it, how innovation and entrepreneurship relate, and how we can create a better climate for IT innovation regarding both development and use.

Jfokus

In January 2007 the annual Java conference Jfokus was arranged for the first time. The conference, which took place in Electrum, Kista, was an immediate success with over 450 paying participants. It was arranged by the Swedish Java community Javaforum with SICS, Sun and Ciber as active partners.

If you want to make sure you will be invited to SICS events please register at www.sics.se/signup/

SICS Alumni meeting

SICS first Alumni Get Together was arranged in December 2007. The afternoon started with presentations by past and present SICS:ers and was followed by a cheerful Christmas dinner, entertainment and a long night of sweet memories. SICS encourages researchers to move freely between academy, industry and SICS. Keeping in touch with former employees is an important tool to strengthen relations between the communities.

SICS INITIATES RESEARCH COLLABORATION WITH INDIA

Early in 2007, SICS was contacted by VINNOVA (The Swedish Governmental Agency for Innovation Systems), regarding an initiative by the Swedish and Indian governments aimed at establishing research collaboration between the two nations. Following discussions between the former Ministers of IT of the respective nations, it had been agreed that the focus area for the collaboration would be in electronic health. Since it was seen as important that the research should lead to applicable results, VINNOVA asked if SICS, with its track record in applied IT research, could assist in identifying good candidate projects, and also to possibly contribute with project proposals of its own. On the Indian side, the Department of Information Technology (DIT) at the Ministry of Communications and Information Technology appointed C-DAC, The Centre for Development of Advanced Computing, to have the corresponding role.

In June, representatives from DIT and C-DAC visited Sweden on a trip organized by SICS, and paid visits to several Swedish research groups. This led to concrete proposals, which were developed over a few months, in preparation for a large workshop that was held at C-DAC's facilities in Noida in early December. At this workshop, more than 25 representatives from both Indian and Swedish research groups met and discussed the different proposals, together with representatives from VINNOVA and DIT. Based on these discussions, DIT and VINNOVA identified one project they were ready to fund, and four that were given a smaller grant to develop full proposals.

The approved project is a collaboration between C-DAC and SICS, and has the ambitious goal of developing a scalable, reliable database for electronic health records, with the capacity to scale up to *one billion patients*. For SICS, having the project approved and funded is very gratifying, but we are perhaps even more enthusiastic about being given the role by VINNOVA to assist in preparing and launching the Swedish-Indian research collaboration as a whole. Such strategic work is not part of SICS' every day business, but our research experience and international credibility make us well suited for tasks like this as well.

HEALTH NEW FOCUS AREA AT SICS

Recognizing the increasing volume of research and development at SICS within the application area of health, a new focus area was established at SICS at the end of 2007 – SICS Health. The purpose of establishing SICS Health is to provide a common infrastructure for the involved researchers at SICS, to facilitate communication with external contacts, and to compile and coordinate all the competence at SICS that is relevant to applications in this area, regardless of SICS internal organisation.

Our definition of health applications is broad – we include, among many other things, algorithms in the area of bioinformatics that are relevant to the pharmaceutical industry, applications that support clinicians in their interaction with patients, systems that improve patient safety in hospitals, tools that assist medical research on clinical data, assistive technology for people with disabilities, and applications that help preventing health disorders. An initial survey shows that 25% of SICS' researchers do, or plan to do, research and development within this wide area.

By initiating Health as a focus area for SICS research, we expect SICS to become an attractive research partner in the growing field of e-health, for the pharmaceutical industry, for the public sector, for healthcare providers, and for medical research.

Kristofer Franzén, Carlo Pompili, Ali Ghodsi and Seif Haridi, all from SICS, in discussions with C-DAC in India.

MOST PROMINENT SCHOLARY ACHIEVEMENT

Magnus Sahlgren's Ph D dissertation "The Word-Space Model: Using distributional analysis to represent syntagmatic and paradigmatic relations between words in high-dimensional vector spaces" was designated the most prominent scholarly achievement of 2006 at the Stockholm University Faculty of Humanities. A prize, consisting of 20 000 SEK, was awarded at the annual Research Days at Stockholm University in October 2007.

Sahlgren's dissertation deals with a computational model of word meaning called The Word-Space Model, which utilizes distributional patterns of words collected over large text data to represent semantic similarity between words in terms of proximity in high-dimensional vector space. The model has been used extensively at SICS during the last decade for research in cognitive modelling, machine learning, information access and natural language processing.

Sahlgren's main contribution in the dissertation is to analyze the theoretical foundations of The Word-Space Model, and to demonstrate theoretically and empirically that the model can be used to acquire and represent both paradigmatic and syntagmatic relations between words. The Word-Space Model continues to be used in cutting-edge research at SICS, and is also the foundation for the spin-off company Gavagai described below.

Magnus Sahlgren. Photo by Fredrik Olsson.

NEW SPIN-OFF KEEPS TRACK OF THE INTERNET BUZZ

Buzz monitoring is the task of finding and tracking consumer-generated discussions on the Internet. It is widely understood that such word of mouth phenomena play an important role for informing and affecting consumer decisions, and in building and destroying brand reputation. Marketing strategists are increasingly becoming aware of the importance of such information.

User generated data such as blogs and forums pose complex challenges for text analysis tools. Besides the fact that attitude analysis itself is complex for traditional knowledge-intensive methods, informal and unedited text often does not conform to standard usage and needs new and robust mechanisms for analysis.

Gavagai, the latest SICS spinoff company started by Jussi Karlgren, Magnus Sahlgren and SICS, will take on this challenge head on by using statistical mechanisms designed for maximum throughput but sensitive to known facts about language and language usage. Gavagai will be active in the field of blog text analysis, building and refining the algorithms experimentally developed by Sahlgren in his recent well-received dissertation, "The Word Space Model", and further developed in the research project "Attitude in text". Gavagai's mission is to mine blogs and web forums for mentions of e.g. consumer products and services to track consumer attitudes to them, allowing market analysts to keep tabs on how products and services are received by their consumers.

VISITING RESEARCHER AT YAHOO!

Jussi Karlgren of the Userware laboratory spends the winter of 2007-2008 at Yahoo! Research in Barcelona as a visiting researcher, studying user preferences in image retrieval.

Jussi Karlgren, who at SICS mainly works on language technology for information access, has been awarded a mobility grant by Swedish Foundation for Strategic Research (SSF) to visit Yahoo! Research for six months. He will study how users tag and comment images in Flickr, the popular photo sharing site, to design new ways of ranking images for search and retrieval. Content analysis of images is difficult, except for specific cases, and often shoots beside the mark since people understand images emotionally or affectively rather than topically. Flickr provides a ranking of "interestingness" which is based mainly on popularity and social network analysis. An alternative way of finding images would be to organise them by affective qualities. Jussi Karlgren will investigate the possibilities of mining for such qualities in the comments and tags provided by users.

Jussi Karlgren

NEW SPIN-OFF: P2P TV

New peer-to-peer technologies developed by SICS enable more cost-efficient distribution of TV and video over the Internet. These results are brought to the market by Peerialism AB, a new SICS spin-off. Peerialism's live video streaming product substantially reduces the costs for the broadcaster by applying the peer-to-peer philosophy.

Current solutions to live streaming require a central server to broadcast the video stream to each viewer. This requires enormous amounts of bandwidth at the central source. Today, most solutions are based on over-provisioning bandwidth at the source, enough to accommodate the maximum number of simultaneous viewers. In Peerialism's product, viewers instead share the video streams that they are watching. Consequently, the broadcaster can save bandwidth at the source.

"In the future, live video streaming (TV) and on-demand video will merge. We will be able to watch any program live", says Ali Ghodsi, SICS researcher and Peerialism co-founder. "And if we arrive 5 minutes or 5 hours later, we'll be able to watch that or any other program, from the beginning, just like we could if we had recorded them all on a harddisk."

The peer-to-peer technique for video streaming involves many technical challenges. For example, most home users have higher download bandwidth than upload bandwidth. Peerialism has focused on solving these problems, and the product will be tested by customers in the summer of 2008.

Access to long term research from SICS will help Peerialism to create and maintain a competitive advantage in the market. In the beginning of 2008 SICS and Peerialism have started a joint research project, funded by VINNOVA, which will address future Internet video streaming services. The project, named PeerTV, will address both live video streaming, and on-demand video. The latter is more challenging, as it requires a solution how to distribute the enormous amounts of video material that is made available to the viewers.

KNOWLEDGE TRAVELS BEST IN HEADS

One efficient way to disseminate and encourage the use of new technology in industry and society is personnel mobility between academy, SICS and industry. Researchers at SICS are encouraged to bring their knowledge and ideas to the industry by starting new companies based on their results, or by moving on to jobs in existing companies.

Lars Albertsson, Erik Klintskog and Martin Svensson are examples of researchers, who decided to bring their expertise to large companies.

Lars Albertsson worked at SICS 1997-2007, primarily researching new methods for testing parallel software. He now works for Google in Stockholm and is part of Google's European Test Engineering team. Lars's knowledge in development and testing techniques for distributed and multithreaded software is highly valuable for testing Google's products, which have high availability requirements and need to scale to millions of users.

Erik Klintskog, Ph. D, who used to work with distributed systems at SICS has recently moved to Saab Systems where he is working with data distribution in Combat Radio Networks for Battalion level Battle Management Systems. Erik is bringing his expertise in distributed systems to Saab Systems' strategic program for developing the next generation C4I systems. Before joining SAAB Systems, Erik worked at Appear Networks, responsible for three European research projects. The experience he gained in EU research projects during his time at SICS was key to the success of Appear Networks' research program.

Martin Svensson joined SICS in 1996 where he did his Ph. D. work in Social Navigation and Recommender Systems. In recent years Martin has worked on mobile end user applications such as the Mobitip service and Affective Diary system. In 2007 he left SICS to join Ericsson Research where his expertise is used for developing industrial solutions for collaborative filtering functionality.

Lars Albertsson

STAFFAN TRUVÉ NEW MEMBER OF THE BOARD OF THE SWEDISH FILM INSTITUTE

SICS´ CEO, Staffan Truvé, has been appointed new member of the board of the Swedish Film Institute. The Swedish Film Institute plays a leading role in Swedish cinema. Its aims include the promotion, support and development of film in its cultural and broader contexts, the allocation of grants for the production, distribution and public showing of Swedish films at home, and the promotion for Swedish cinema at international level. The Institute is also extensively involved in the preservation and promotion of Sweden's cinematic heritage. Staffan's broad experience will help the institute prepare for future technical challenges in film production and distribution, and with influences from the gaming and interactive storytelling activities at SICS and Interactive Institute he hopes to broaden the scope of what areas the Swedish Film Institute is active in.

ACADEMIC APPOINTMENTS IN 2007

Björn Gambäck appointed professor in Norway

Björn Gambäck has been appointed full professor in Language Technology at the Department of Computer and Information Science, at the Norwegian University of Science and Technology (NTNU), Trondheim.

Björn will share his time between NTNU and SICS where he is leading the European project COMPANIONS on embodied conversational agents (ECAs), with 15 partners in Europe and the US. The project concerns ECAs as persistent companions for users in carrying out activities within their personal digital space, such as organising image and text records of their lives as coherent narratives.

New docent: Thiemo Voigt

Thiemo Voigt has been appointed docent at Uppsala University.

Docent lecture: Towards real-world wireless sensor networks

Wireless sensor networks consist of tiny nodes with sensing, processing, and wireless communication capabilities. These nodes form networks through which sensed data is transported to a base station. Wireless sensor networks enable numerous sensing and monitoring services in areas of vital importance such as efficient industry production, safety and security at home and in traffic, as well as environmental monitoring. In his talk, Thiemo Voigt introduced the concept of wireless sensor networking and presented some exciting applications. He discussed remaining research challenges and some research efforts that pave the way towards real-world wireless sensor networks.

New docent: Annika Waern

Annika Waern has been appointed docent at Stockholm University.

Docent lecture: Socially expanding games

Pervasive games, reality games, are games that are not played on a computer screen or a playground but in the real world. In reality games the players often meet and interact with people who are not playing themselves and who may not even be aware that there is a game going on; the game has expanded socially. Using several examples as a starting point Annika Waern discussed what makes these games exciting – and problematic. She also suggested how activity design can help us design games that are socially expanding.

Thiemo Voigt

Annika Waern

New doctor: Stina Nylander

In February 2007 Stina Nylander defended her thesis for doctoral degree at Uppsala University.

Ph.D. thesis: Design and Implementation of Multi-Device Services

Stina Nylander presented a method for developing multi-device services which allows for the creation of services that are adapted to a wide range of devices.

The challenge of designing and implementing multi-device services has been addressed in two ways in the present work: through the study of real-life use of multi-device services and through the creation of a development method for multi-device services. Studying use of multi-device services has generated knowledge about how to design such services to give users the best worth. The work with development methods has resulted in a design model building on the separation of form and content, thus making it possible to create different presentations to the same content. In concrete terms, the work has resulted in design guidelines for multi-device services and a system prototype based on the principles of separation between form and content, and presentation control.

Stina Nylander

New doctor: Adam Dunkels

In February 2007 Adam Dunkels defended his thesis for doctoral degree at Mälardalen University.

Ph.D. thesis: Programming Memory-Constrained Networked Embedded Systems

This thesis focuses on three topics pertaining to programming memory constrained networked embedded systems: the use of the TCP/IP protocol suite even in memory-constrained networked embedded systems; simplifying event driven programming of memory-constrained systems; and dynamic loading of program modules in an operating system for memory-constrained devices. Adam showed that the TCP/IP protocol stack can, contrary to previous belief, be used in memory-constrained embedded systems but that a small implementation has a lower network throughput. He presented a novel programming mechanism called protothreads that is intended to replace state machine-based event-driven programs. Protothreads provide a conditional blocked wait mechanism on top of event-driven systems with a much smaller memory overhead than full multithreading; each protothread requires only two bytes of memory.

The software Adam developed as part of this thesis, lwIP, uIP, protothreads, and Contiki, is currently used by hundreds of companies in embedded devices in such diverse systems as car engines, oil boring equipment, satellites, and container security systems. More about Adam's work on page 6: Adam Dunkels awarded Chester Carlson prize.

Adam Dunkels

SWEDSOFT: AN INDUSTRY NETWORK FOR SWEDISH SOFTWARE

Swedish industry needs to cooperate and become more productive in the software technology area, in order for us to keep our place as one of the leading industry nations. Swedsoft is a new industry initiative aiming to support this by providing an operative network for software technology and by acting as a catalyst to start cooperation.

Many products developed by Swedish industry are to a significant part based on software technology, both with regards to the development costs and the functionality of the products. Most of these products are not obviously software based. However, when considering the fact that advanced cars can contain in the region of 100 processors, an advanced mobile phone contains over 10 million source lines of code, and even washing machine models compete and differentiate with the help of advanced software solutions, it becomes clear how fundamentally important software technology is for Swedish industry.

There has been an exponential growth in global competition over the last decades. In particular, countries such as China and India have shown how they can progress from primitive agriculture to advanced technical production and development in impressively short time. Some of the reasons for this exceptional development are a huge and focused investment in education, technical knowhow, development and cooperation in these countries.

We draw the conclusion that Swedish industry needs to become more productive and cooperate in the software technology area, to keep its place as one of the leading industry nations.

Swedsoft – cooperation and increased productivity

Swedsoft is an industry initiative to strengthen Swedish competitiveness regarding research and development of software intensive systems, services, and products.

The founders and financiers include ABB, Ericsson, Saab Group, SICS, Blekinge Institute of Technology, the IT University of Göteborg, Linköping University, Mälardalen University and the real-time expert Arcticus Systems. SICS has a leading role as main financier and coordinator of the operations.

Swedsoft has the mission to, with relatively small resources, act as a catalyst in an operative network with a common vision and the goal to produce results in the short-term perspective. Many and relatively small efforts are required to start cooperation and to keep it going.

Multicore disruption

One specific software technology area that Swedsoft is focusing on is a consequence of the general introduction of multicore processors as opposed to of the traditional single CPU processor. Some people refer to multicore as the biggest revolution in computing since object-oriented programming. It will require rethinking of the way we structure and program our systems.

SICS contribution to this area is a tool called Embla which helps programmers identify independent program parts that can be executed in parallel, thus easing the burden of porting legacy software to multi core processors. Embla records dependencies while the program is running and is independent of the source language(s) the program is written in.

There is a lot to discuss regarding multicore programming and in August 2007 SICS arranged the first Multicore Day, in cooperation with Uppsala University and Chalmers University of Technology. The program included representatives for international industry Sun Microsystems, Intel and IBM.

The auditorium at Kista Science Tower was filled to the last seat at Multicore Day 2007.

SELECTED PROJECTS

On the following pages a selection of projects are described to give you a general idea of the activities at SICS. Many other projects have been carried out during 2007, but are not mentioned here. For more information, please see www.sics.se.

PIMP MY WORLD, MAKE IT INTERACT AS I WANT

Pervasive Interactive Mobile Platform, PIMP, is a software platform which empowers users with more control and flexibility of pervasive and ubiquitous applications.

Developing interactive applications or services that are truly distributed and integrated in our daily life and surrounding environment is challenging. These pervasive and ubiquitous applications have to work in a living context in constant change. They need to be adaptive, and not only to the users needs. It is impossible to predict every context, where they will be used, or every change that will be desired. Therefore these applications need to allow easy changes and adaptations by the users.

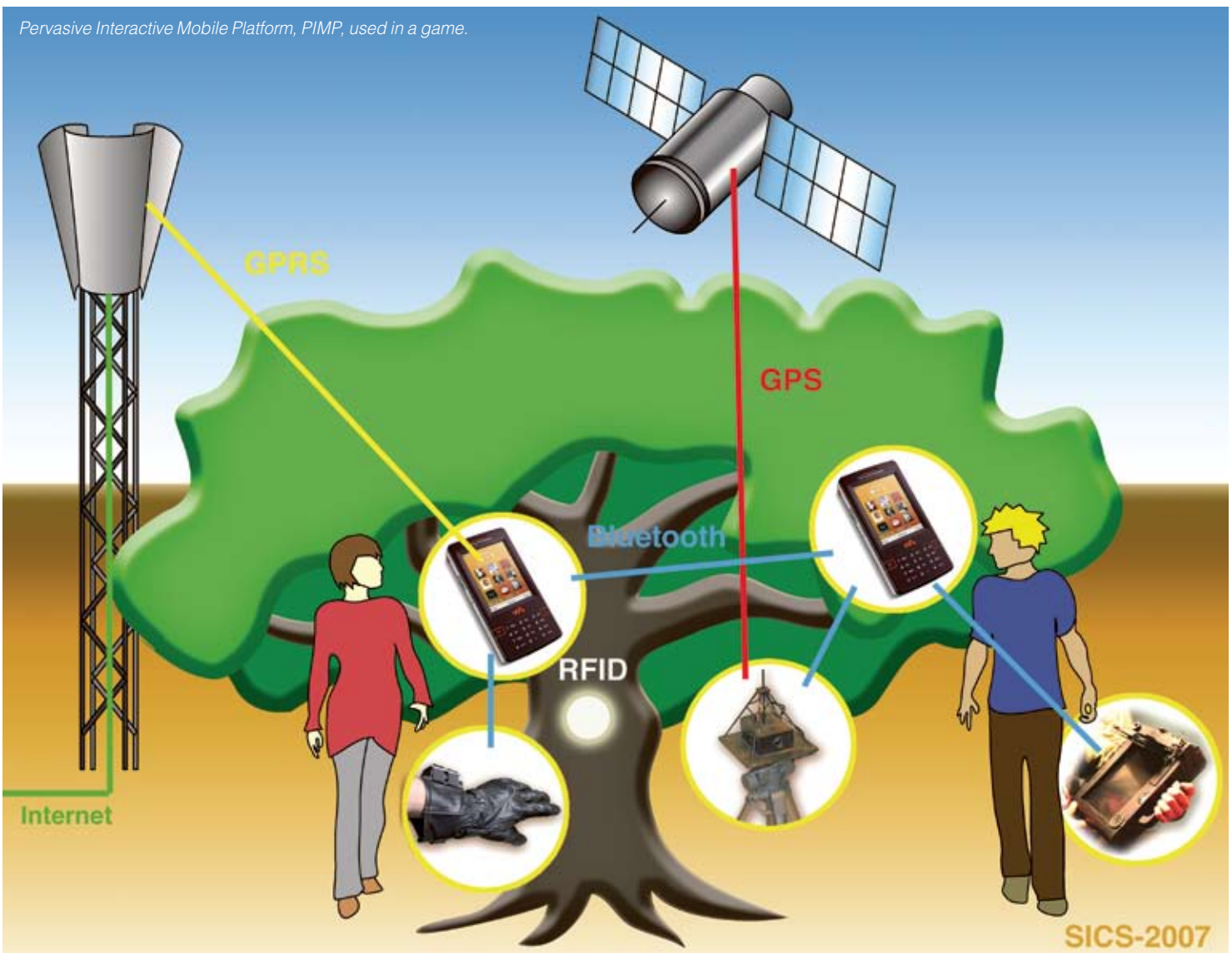
SICS has developed Pervasive Interactive Mobile Platform, PIMP, a software platform to empower users with more control and flexibility of pervasive and ubiquitous applications – without making them harder to use or understand. The design is motivated by observations of end users designing ubiquitous computing services and applications in a variety of earlier SICS projects, ranging from smart houses to computer games.

PIMP is a Java library which can be used to build distributed ubiquitous computing applications that support various devices, and typically also include sensor and actuator hardware. The underlying idea is to enable functionality in an object oriented manner, declaring the obvious dependencies and supporting rapid and simple re-configurability.

PIMP has mainly been developed within IPerG, a very large European project on pervasive gaming, lead by SICS, and used there to establish computer supported wide-area long-term games. The focus was on supporting users in creating their own physical interactive games, and defining their game behaviour. The picture shows how PIMP was used in a game where each player was equipped with a mobile phone dynamically connected to different gaming artifacts currently in the vicinity of the player, such as a RFID reading glove, a GPS and a TabletPC. PIMP was used to model and represent each of these devices and to connect them to the game-server.

The software along with tutorials has been made available in a public release which can be accessed at http://pimp.sics.se.

Pervasive Interactive Mobile Platform, PIMP, used in a game.



TAKE PART IN DISTRIBUTED APPLICATION DEVELOPMENT

PART is a Java based middleware for developing distributed applications. It runs on ordinary PCs and handheld devices like mobile phones and PDAs as well as on microcontrollers and sensor boards.

A small memory footprint makes PART especially suited for small, constrained devices. PART is based on an ad-hoc, peer-to-peer connection model, and also supports synchronised data sharing. In the last year, PART has been ported to the SNAP platform from Imsys Technologies and the Sun SPOT platform from Sun Microsystems.

PART has been developed by the ICE laboratory within the IPerG project on pervasive gaming, where it has been used to build games based on ubiquitous computing principles and the use of sensor and actuator hardware. Another example of the use of PART is in a project where PART software running in Sun SPOT devices are used to control and measure the energy consumption of various electrical appliances.

PART is available as open source from Sourceforge under a BSD license, http://part.sourceforge.net.

WORK OF ART OR ENERGY METER?

With Lyra we show how art and technique can be combined to visualise concealed information and create awareness for invisible structures and activities.

During many years the ICE-lab, Interactive Collaborative Environments, at SICS has built software and artefacts combining advanced technology with concepts such as social interaction, design and aesthetics. When the Interactive Institute moved in with SICS in Kista in the beginning of 2007, organisationally as well as physically, it was natural to involve both institutes in an initial cooperation.

Design

It was decided from the very beginning to focus the work on the institutes' common physical location, and to have it reflect or express the ongoing activities in the Electrum building. There was also an expressed interest in involving some kind of tagging technology, either RFID or bluetooth detection. The concept took the shape of a display hanging from the ceiling, receiving information from four Bluetooth detectors covering the entrances of the building. The work was finally called Lyra, with its shape borrowed from the Lyra star constellation.

The customer

An interactive public adornment of the Electrum atrium is of course in the end an issue for the landlord to take a position on. Akademiska Hus was very supportive of the project and contributed on several occasions to constructive discussions and concept development. They also committed to financing the hardware and construction. Also, it turned out they had an interest in another research theme that the groups had in common - energy.

Energy meter

During the course of a couple of years, several projects at SICS and Interactive Institute have developed prototypes to raise consumer energy usage awareness and control. Perhaps it could be of interest to add such functionality to Lyra as well?

At the Swedish National Energy Convention 2008 our work appeared as an energy sculpture. In this incarnation Lyra, with its hundreds of LED lamps interplaying with colours, forms and movement, was reflecting the energy consumption of a building or block. Lyra visualised the total energy consumption as well as the consumption of singular appliances that was connected to it.

Lyra is also in itself an example of new power smart products, as it is built by power efficient LED lamps. The sculpture shows how this new lighting technique not only saves a lot of power but also finds a new aesthetic form of expression.

Lyra is partly funded by the Swedish Energy Agency in a research program aiming at new IT methods and product design for power efficiency in Swedish homes.

Six frosted Plexiglas tubes, four meters tall, suspended from the ceiling in an arrangement borrowed from the Lyra star constellation. There are 50 led-based RGB lights in each tube. The construction can be seen as a 300 pixel display with 900 control channels conducted by our own software. As Lyra floats in the Electrum space in May 2008, its behaviour will reflect activities in the building. We will also produce an interface giving visiting artists the possibility to design their own graphics and animations.

DYNAMIC TIMETABLING AT THE SWEDISH RAILWAY

SICS proposes that the key to on-time delivery in the railway business is to make a clear distinction between what you commit yourself to deliver, i.e. departure and arrival times according to the time table, and the production plans that are used to meet these deadlines. The point is that deadlines can be better met with flexible production plans.

How to deliver on time in an ever-changing planning environment? This is a crucial question for many industries today. At the Swedish Railway Administration, the traditional answer to this has been to "plan in great detail to gain certainty and stability". But when the actual time table is executed, many assumptions that the plan relies on have changed. The performances of the trains might differ significantly, the status of the infrastructure can change, and the weather can affect the daily traffic in different ways, just to name a few things that are subject to change over time. All the details then clutter the plan and instead become a burden when re-planning must take place. In the end, the dispatchers have to solve the problem on the spot and today they get little support from the existing time table.

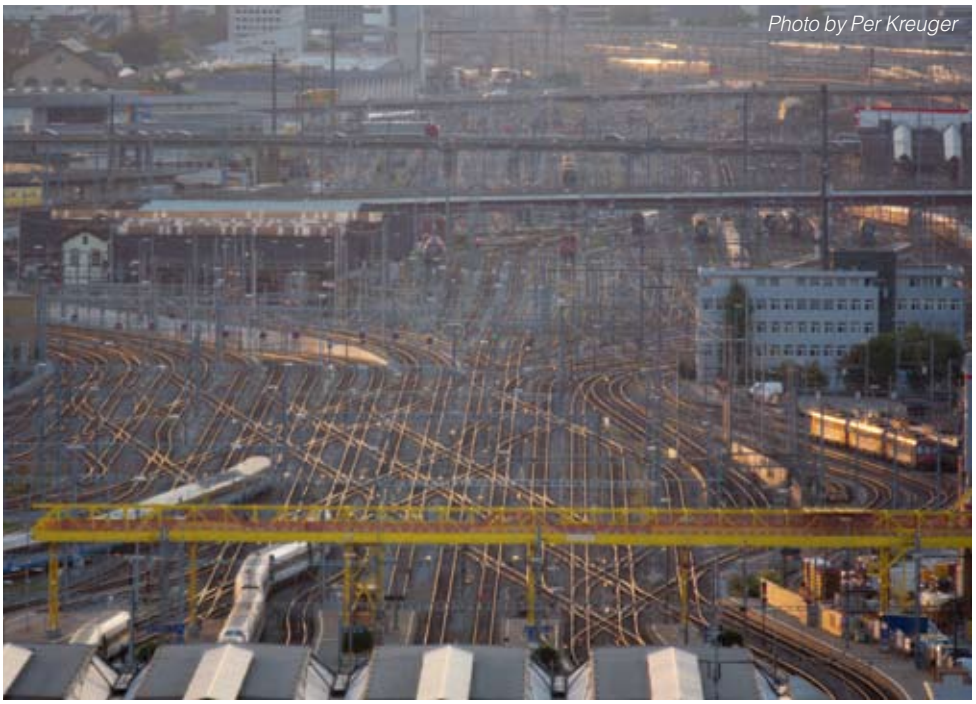


Photo by Per Kreuger

In the "Dynamic Train Plan" project, SICS instead proposes to plan for flexibility and change. The key ingredient is to make a clear distinction between deliverables, i.e. what the Railway Administration commits itself to deliver, and production plans that are used to meet the deadlines. Trains are to be delivered on time at key places where the customers of the railway (the traffic companies such as SJ and their customers) need them, while all the other details in the plan continually should be decided when data is ready and, as often as needed, recalculated in order to optimize the traffic. To be able to do this, the planning models must be chosen with great care, and advanced and efficient computational support is crucial since the complexity of the task gets enormous.

The concept of "planning on demand" is taken from the process industry, and is one example of cross-breeding between industry sectors that SICS works with. However, the actual planning methods differ between different industry sectors. The IAM laboratory at SICS has many years of experience of various planning methods and styles, which when combined can solve very complex tasks.

Martin Aronsson

UNIQUE COMPETENCE IN DIAGNOSIS, MAINTENANCE AND PLANNING

In recent years SICS has gained a unique competence within data analysis and planning, and its industrial applications in a broad range of domains. With our unique combination of both practical and theoretical knowledge we have developed a large number of useful methods and tools applicable to diagnosis, maintenance and planning.

A general trend in all industry is the ever increasing demand for higher reliability and availability. As today's industrial systems are growing increasingly complex, this calls for advanced tools for monitoring and decision support.

The IAM laboratory has been involved in several projects around the themes of Diagnosis, Maintenance and Planning. In these projects we have utilized the laboratory's unique combination of competences within data analysis and planning.

Efficient tools are required at several steps, each invoking challenging research issues. First, a system should be monitored to detect anomalies or deviations that indicate approaching disturbances. When a disturbance is detected, there should be tools to help diagnose the problem and find the root cause. If there is no disturbance yet, we should try to predict the remaining lifetimes of components, to estimate when they would need maintenance. Such estimations can be used for dynamic planning of both maintenance and operation. As the production proceeds, the production plans have to be adapted to the changing situation, to optimize the resource usage, maintenance and deliverables.

We have developed useful tools for all these steps.

Anomaly detection

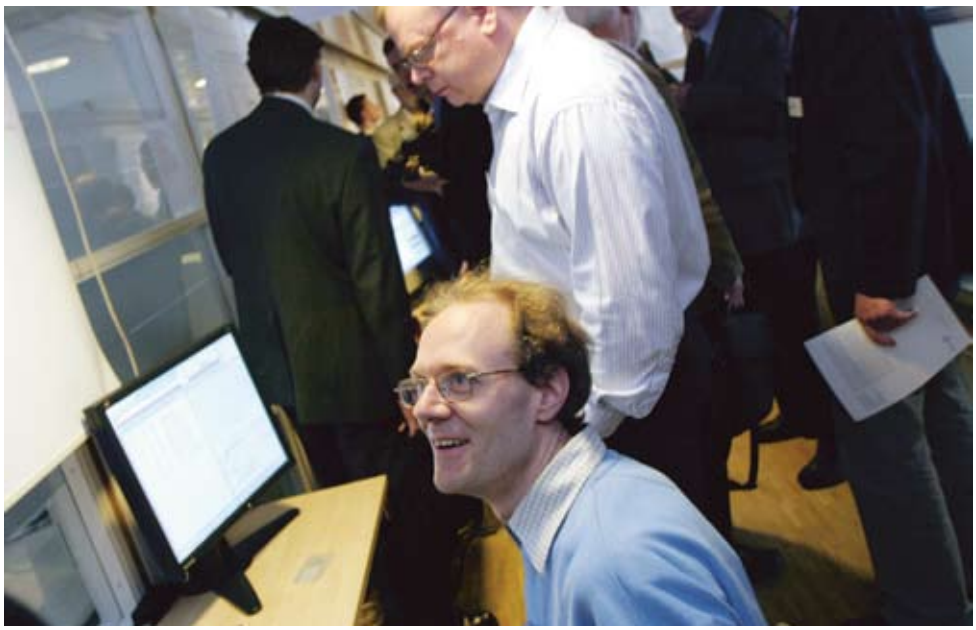
Our algorithms for anomaly detection can search through large amounts of data from various processes, and find components that behave different than the others, or change their behaviour over time.

Incremental diagnosis

Based on FMEA-documents, a diagnosis system can be generated which guides a technician through the troubleshooting, and in addition learns by the cases it encounters. Traditionally, construction of such diagnosis systems has relied either on expert knowledge or actual cases, both of which are usually scarce.

Life length analysis

Using Bayesian Statistics it is possible to make optimal use of the limited amount of available failure data when estimating the remaining life times for different types of components. It is also possible to get an estimate of both the expected value and the uncertainty of any one of a number of interesting entities, such as the total maintenance cost or the optimal maintenance interval.



Anders Holst

Resource Levelling

By adjusting the times for e.g. railway freight transports with up to 45 minutes, it is possible to level out the utilization peaks. We have shown that it is possible in this case to save 7% of the locomotives for Green Cargo.

Maintenance planning

To avoid both unplanned stops and unnecessary replacement of parts, maintenance of each component has to be performed at the appropriate time. However, to maximize availability, the total number of maintenance stops should be limited, and several components serviced at the same occasion. We have implemented several systems for dynamic maintenance planning in different domains, taking such constraints into account.

Over the years we have used and combined these tools in a broad range of industrial domains such as production, transport, process, and telecom industry.

INDUSTRY TURNS TO IP COMMUNICATION

Industry has long been plagued by a plethora of proprietary field buses, which has limited availability of devices, and raised system cost. Recently however, it has been widely recognized that IP communication offers an attractive alternative. Thanks to the enormous consumer market, IP technology has become inexpensive and highly standardized, and huge amounts of thoroughly tested software is freely available. There is one problem, though: Communication is "best-effort", meaning that the protocols offer no guarantee or measurement of the quality of service ("QoS"), such as the available bandwidth. This is where BART comes to the rescue.

BART (Bandwidth Available in Real-Time) is method for measuring available bandwidth, developed by SICS in cooperation with Ericsson Research. The method is based on sending a small amount of time-stamped probe packets along the path under test. By applying fast signal processing techniques to the time stamps, available bandwidth and narrow link capacity can be accurately estimated.

During 2007, SICS was somewhat unexpectedly contacted by several companies not in the consumer market, but about to begin using IP solutions in industrial communication and control systems. These clients realized the need for QoS verification, an application ideally suited for BART. For one of these clients, SICS is now performing a joint pilot study together with Ericsson Research.

Martin Nilsson

IMPROVING NETWORK SELF-MANAGEMENT CAPABILITIES

Today management facilities of communication networks typically reside *outside* of the network itself in specialised management servers and stations. These perform FCAPS (Fault, Configuration, Accounting, Performance, and Security) functions by communicating with network elements through management protocols such as SNMP. This approach to network management has major intrinsic limitations with regards to scaling to large networks, response time to changing network conditions, and the need for extensive human supervision and intervention.

SICS participates in several network management oriented projects, e.g. the European 4WARD project mentioned on page 23 and the VINNOVA funded DiSC project, and network management is a central research area at SICS Centre for Networked Systems. A common theme across these projects is that they instead try to overcome the limitations described above by developing self-management functionality that is distributed *within* the network itself. This entails development of efficient and distributed protocols for monitoring and control, algorithms that can discover and diagnose faults and threats within the network in a decentralised manner, and at least a limited ability for the network to take measures against discovered problems.

Our contribution to this research is focused on anomaly and fault detection using statistical methods, and how to perform these tasks in a distributed manner. The basis for this detection can be both passive measurements and active probing of the network, both of which may be costly to perform in terms of bandwidth and computational resources. Therefore, the question of how to automatically select a relevant set of probes and measurements, based on current conditions, in order to quickly and efficiently isolate the cause or identity of a malfunctioning network node, becomes very important.

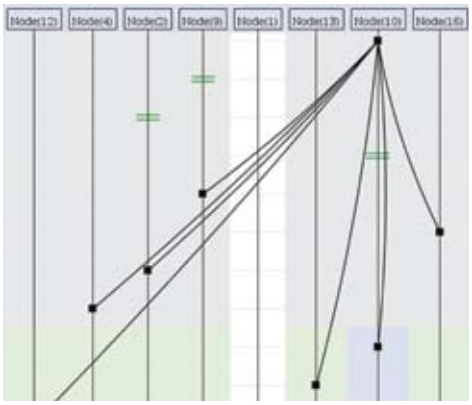
PROTOCOL VERIFICATION SUPPORTS ERICSSON'S PRODUCT DEVELOPMENT

During 2007 SICS has performed validation of a protocol in a product being developed by the APZ platform team in Älvsjö, Sweden. The product is a distributed system where a custom protocol maintains a consistent view of the state of its components. The main method used for validation has been simulation.

The first step in validating the protocol has been the development of a formal specification of the protocol corresponding to Ericsson's internal documentation. Correctness criteria for the behaviour of the protocol has also been formulated during the development of the formal specification. The formal specification has been converted to Java for linking with the simulator used for validation using a custom software tool.

The simulator developed in the project models the network environment of the product and supports injection of both network and node level faults. Being a simulation, it is possible to, at each time step, inspect the complete state of the system and verify it against the correctness criteria. If a violation is detected the simulator stops and a graphical tool (the figure) is used to determine the cause.

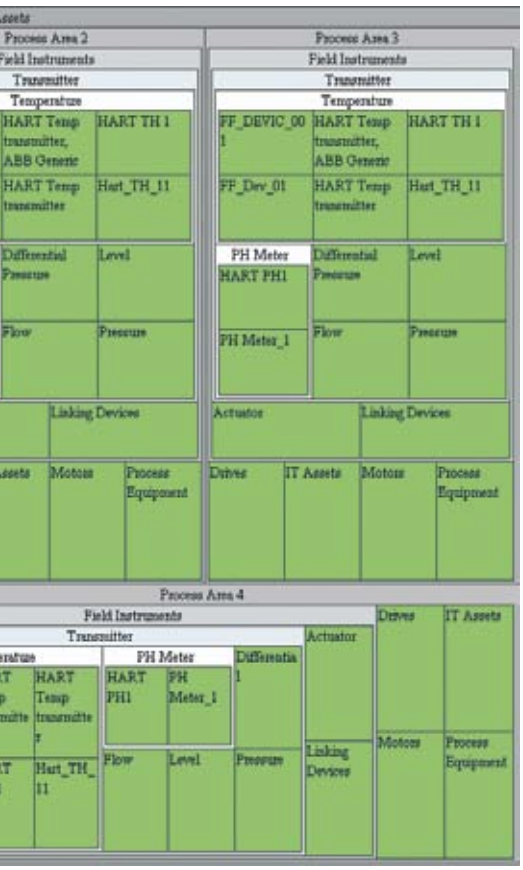
The simulation approach for validation makes it possible to quickly test a large number of system and fault events as the simulator is not limited to real-time as is testing of a physical prototype. Using the simulator, several years of use, measured in the number of fault events, can be simulated during a week-end. The simulator also makes it possible to skew the probability for the occurrence of events to exercise event sequences which are unlikely, but possible, to occur in the deployed system. During simulation at least two event sequences not handled by the protocol has been identified and the protocol corrected.



When an error is discovered the simulator stops and you can find out what went wrong with the help of a graphical tool.

INTERACTIVE VISUAL ANALYSIS OF NETWORKED SYSTEMS

A Treemap of a small ABB 800xA configuration.



SICS, ABB, and Ericsson are together exploring information visualization methods to make complex networked systems easier to understand, and thereby less costly to develop, manage and maintain. ABB targets system supervision for the 800xA industrial automation platform. Ericsson targets future business support for telecom services. The project goals are software demonstrators showing the benefits of visualization in these industrial domains.

Large sets of data are difficult to comprehend, and to analyze them and draw the correct conclusions is even harder. Today, when large data sets are generated in a vast number of domains, this has quickly become a severe problem, not only in the area of networked systems.

Information visualisation is a solution to this problem. Instead of overloading our ability to understand textual information, the same information is presented graphically. Thus our visual abilities are used to see what entities, properties and relations may be present in order to identify behaviour and trends hidden in the data set. Still, structure always helps, and finding proper ways to represent data visually and interact with that representation, is a major part of what we have to develop in the information visualisation area in general as well as in visual analysis of networked systems in particular.

One well known visualisation technique is the use of so called treemaps which are spacefilling diagrams for visualization of tree hierarchies. In the figure, we show a Treemap of a small ABB 800xA configuration, from the cooperation with ABB Research and Marius-Petru Stanica at ABB AS Norway. The Treemap illustrates the hierarchical structure of the 800xA configuration and the state of its parts, where shades of red indicate that the part is currently not functioning as expected. In this case, the relative importance of a part can also be shown in terms of the size of the area that the part occupies within the Treemap. In general, the colours and sizes can reflect arbitrary attributes.

This project is funded by the Knowledge Foundations (KK-stiftelsen), VINNOVA, the Swedish Foundation for Strategic Research (SSF), Invest in Sweden Agency (ISA), and the Vårdal Foundation. The work continues in 2008, and includes combinations with statistical methods, as part of the work at SICS Center for Networked Systems.

STATISTICAL PHYSICS GIVES A NEW PERSPECTIVE ON P2P NETWORKS

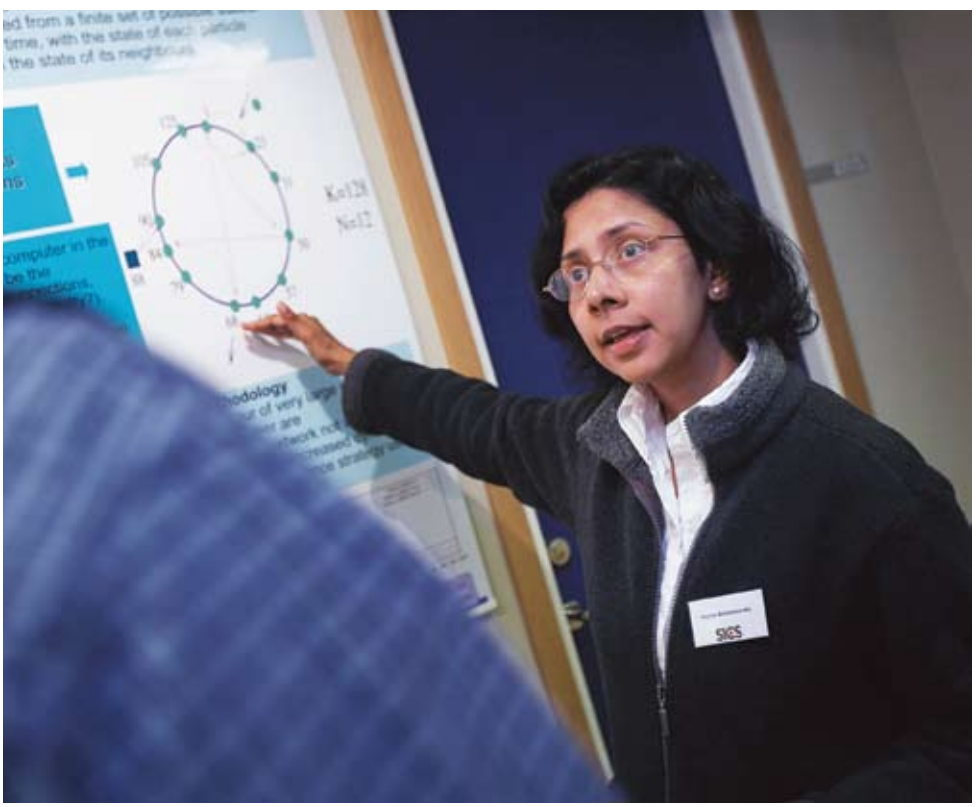
P2P networking, in which the network uses the cumulative resources of all the participants, is a potentially very important paradigm shift for the future Internet. However, if a network is to be composed entirely of "end-users", who can come and go as they please, can it still survive and serve a function irrespective of this dynamism? Currently extensive and time consuming simulations are the only tool to answer this question precisely. In our research, we have looked at this problem with a new perspective: Since physics routinely deals with problems in which the constituent entities are dynamic we have have used the mathematical framework provided by statistical physics, to make very precise predictions about the functioning of P2P networks.

Peer-to-Peer (P2P) Networking is being promoted as the future of Internet networking. P2P systems like Kazaa already account for most of the traffic on the Internet nowadays. Even apart from file-sharing, P2P networking solutions have been proposed for several applications such as VOIP, streaming media, instant messaging and publication and distribution. P2P computer networks use the cumulative resources of all the participants in the network rather than the more conventional centralized resources, where a relatively low number of servers provide the core value to a service or application. P2P networking is hence a potentially very important paradigm shift in the area of networking.

However if a network is to be composed entirely of "end-users" who can log in and log off as they wish, can it still survive and serve a function irrespective of this 'dynamism'? How does its performance compare with the more traditional client-server architectures? What are its strengths and weaknesses? How can we predict how the network will fare under different conditions?

It is to answer some of these questions that we have looked at the problem using a different perspective. Though traditionally it is only the computer science community that has looked at this problem, the problem is well suited to being analysed using physics-based techniques, since physics routinely deals with problems in which the constituent entities are dynamic. Hence, in our work, we have analysed P2P systems using theoretical tools from Statistical Physics. We have already applied this methodology to a P2P architecture in which we can predict the performance of the network to about 1% accuracy, for different ways of building the network, different ways of maintaining the network, for varying levels of dynamism and varying number of network participants. In recent work, over and above all these, we have also taken delays caused by the underlying network into account. Many of our results have been verified by extensive simulations.

The usefulness of this perspective will lie perhaps not only in being able to predict the performance of the network of interest in many useful applications, but also in laying the foundation for a new theoretical framework for understanding P2P networks.



Supriya Krishnamurthy

Simon Schütz, NEC Laboratories Europe, demonstrates Ambient Network Results at the WWI Innovation Day, Brussels, in November 2007.

FUTURE INTERNET

Ambient Networks, a great success

2007 was the final year for the four year long EU-project Ambient Networks. It was highly successful and produced scientific papers of high quality, an integrated prototype, and valuable input to standardisation bodies. Ambient Networks had more than 40 partners, was lead by Ericsson Research, and had an EU grant of about 25 Million Euros. All major players in the European mobile systems industry participated in the project, including Alcatel-Lucent, Ericsson, Nokia and Siemens as well as several phone network operators, and SICS.

A vision of cooperation

The research scope of the project was mobile systems beyond the 3G system with a clear flavour of Internet technology. The research was guided by a vision of cooperation between communication networks of different types, ranging from small home and personal networks to large operator networks. In a mobile and dynamic environment the process of establishing cooperation between networks has to be performed automatically. This concept of automatic negotiation of agreements to cooperate is called *network composition*. The majority of the research conducted in the project contributed to this vision in one form or the other.

Dynamic Internetwork Architecture

One major result from the Ambient Networks project, which SICS' researchers contributed substantially to, is the *Node Identity Internetwork Architecture*. It is a key component for realising dynamic network composition.

The goal of this architecture is to provide a new Internetwork function with intrinsic support for node and network mobility, basic security and bridging over multiple networking technologies, for example IP version 4 and IP version 6. In order to achieve these goals, routing is divided in two levels. The lower level is the same as today's IP routing. The upper level is realised using cryptographic node identities, which are independent of the current location of the particular node.

A prototype of the architecture was implemented and demonstrated in one of the project-wide demonstrators. The architecture was also submitted (as an Internet Draft) to the Internet Engineering Task Force (IETF).

A radical approach for the Future Internet

Researchers at SICS played a major role in defining the research agenda for the 4WARD project, a new large EU-project starting 2008. Again Ericsson Research coordinates the project and about 35 partners participate with 23 Million Euros in total budget for two years. 4WARD takes a more radical, and longer term, approach compared to the just concluded Ambient Networks project. Compatibility with existing network technologies is less important while innovation and bright new ideas are more important this time around. This approach is necessary to create a network for the future which can overcome the obstacles of current technologies.

A NEW CENTRE FOR WIRELESS SENSOR NETWORKS

The impact of wireless sensor networks on society, industry and everyday life is forecasted to be of the same scope as that of Internet. Multidisciplinary efforts are needed to take the lead in the development of these networks. SICS is one of the founders of WISENET, a new research centre, where this magic will happen.

The vision of a wireless sensor network is a network of hundreds, even thousands, of tiny interconnected monitoring devices that can be launched anywhere and almost instantly since there is no need for wiring. When this vision is fulfilled an almost unimaginable number of new applications can be developed. For example: easy monitoring inside machinery, precision environment monitoring at land and sea, and monitoring of health care patients in daily life.

WISENET is a new research centre on wireless sensor networks located at Uppsala University. The goals of the centre are to become one of the leading multidisciplinary centres on wireless sensor networks in the world, to provide prototypes and other top level research results for further commercialization by industrial and other partners, and to create new study programs on wireless sensor networks for undergraduate as well as graduate students.

To reach these goals, a multidisciplinary research approach is necessary, combining expertise in networking, operating systems, sensor devices, micro-systems and wireless communication. The centre will combine the expertise of several groups from Uppsala University and SICS, along with a wide range of government and industry partners. Altogether about 200 researchers are expected to be involved in WISENET.

Fredrik Österlind

Wireless sensor networks combine sensing, data processing and wireless communication into a coherent ensemble of tiny embedded devices. Peer-to-peer protocols then combine the individual devices into an interconnected system.

Our research is focused on how to:

- integrate sensing, data processing and communication into one sensor unit
- manage and generate energy
- make sensor networks self-configuring, robust and maintenance-free for up to 10 years
- attach sensors to Internet in a secure way, with the objective to reach an integration size of 5x5x5mm and a manufacturing cost down to 1€ for a regular unit.

WISENET is funded by Uppsala university, SICS, VINNOVA and industrial partners for the years 2007–2017.

SENSOR NETWORKS TO MONITOR MARINE ENVIRONMENT AND CLIMATE CHANGES

This multi-disciplinary project is concerned with two issues that have been discussed frequently in media during the last year, namely our planet's climate and the unfavourable condition of the Baltic Sea. The project's goal is to design and produce innovative technology that measures the impact of global warming on the Baltic Sea.

While through the history of our planet the climate has continuously changed, we have more and more indications that the climate change is accelerating. Therefore, we need to understand how it will affect us. It is assumed that northern Europe gets more precipitation and more extreme weather conditions, and this will affect the marine environment, especially in the coastal areas.

In order to reduce effects of a climate change, we must get reliable environmental information. Marine environmental monitoring is expensive, with a cost of operation at sea of at least 100.000-150.000 SEK *daily* when using a large research vessel. There is a limited number of buoys for environmental monitoring in the Baltic Sea. These buoys represent an investment of several million SEK, and usually also require expensive ship-time for deployment, retrieval and service since the buoys must be visited on a regular bases.

In this project we try a new approach. The idea is to instead use a larger number of small inexpensive buoy units using sensor networking technology. We have designed units that are small enough to be deployed by two people and that can work unattended throughout the entire ice-free time period in Sweden. Each buoy is equipped with sensors and a GPRS module which allows it to communicate with the Internet. The buoys are inexpensive and powered by wave energy.

Partners besides SICS, who coordinates this VINNOVA-funded project, are Uppsala University, Umeå Marine Sciences Centre and SMHI.

The design of our buoy system is depicted in the figure below. Our design features a so-called diving unit that allows us to use one set of sensors and nevertheless take measurements at different heights. Further, the diving unit enables us to make continuous profiles in shallow as well as deep habitats, and changing sensors only requires one operation. For a long-living marine sensor network there is a severe danger of changes in sensor function due to fouling, the deposition of living organisms and certain non-living material on hard surfaces. To solve this problem, we have designed a "garage" for the diving unit. The buoy communicates onshore using GPRS. We are also developing an energy harvesting unit that utilizes wave motions to produce sufficient energy to power the buoy. We expect to have a first prototype in the sea before summer 2008.

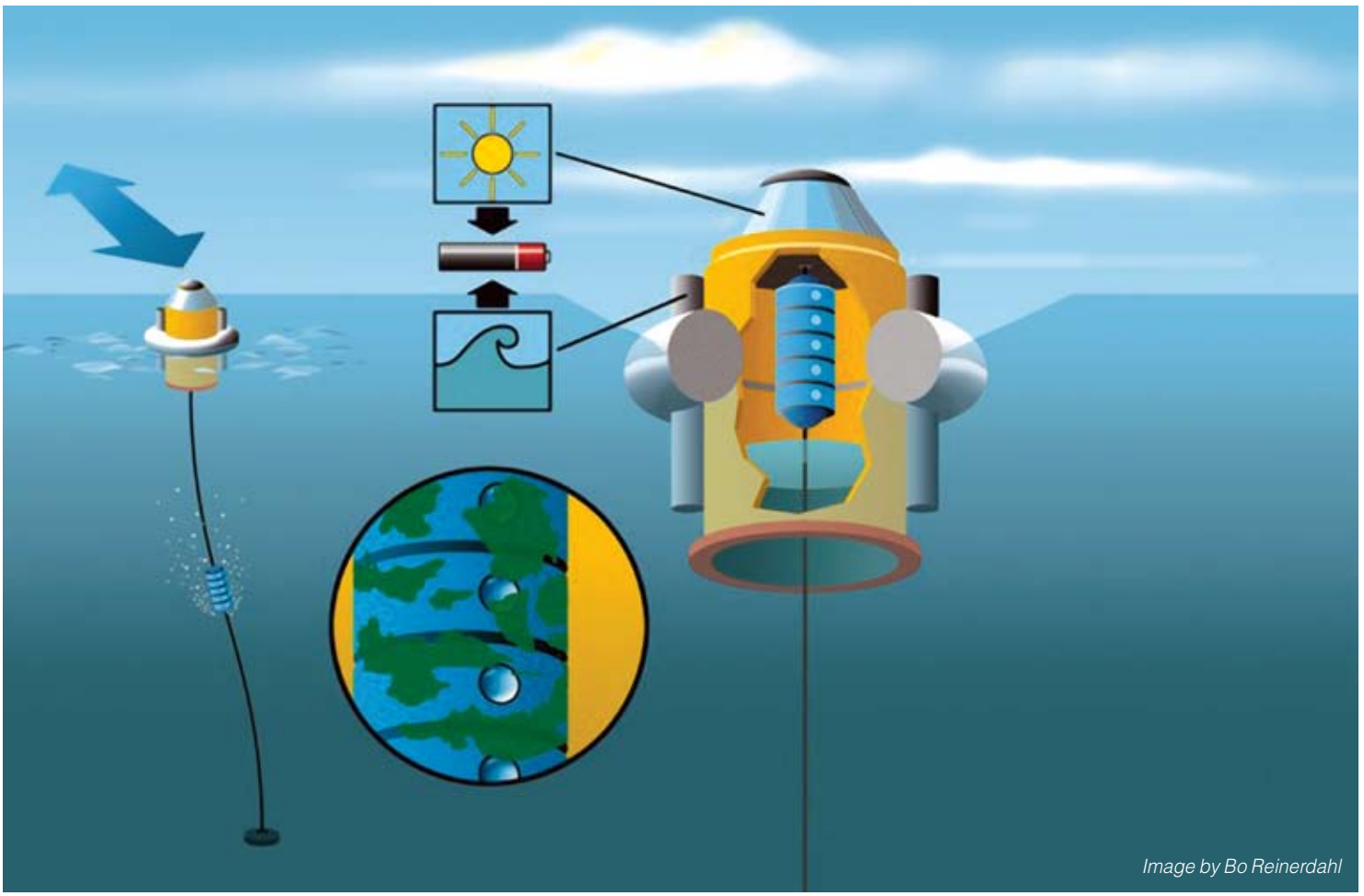


Image by Bo Reinerdahl

OPENING DOORS WITH YOUR MOBILE PHONE

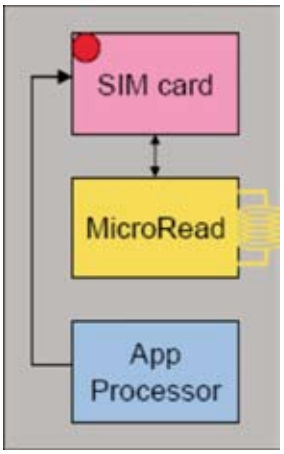
People have to lock and unlock doors each day, and keys can be forgotten, lost and stolen. The MobileKey project at SPOT laboratory is aimed at developing a user-friendly mobile phone based solution to this problem.

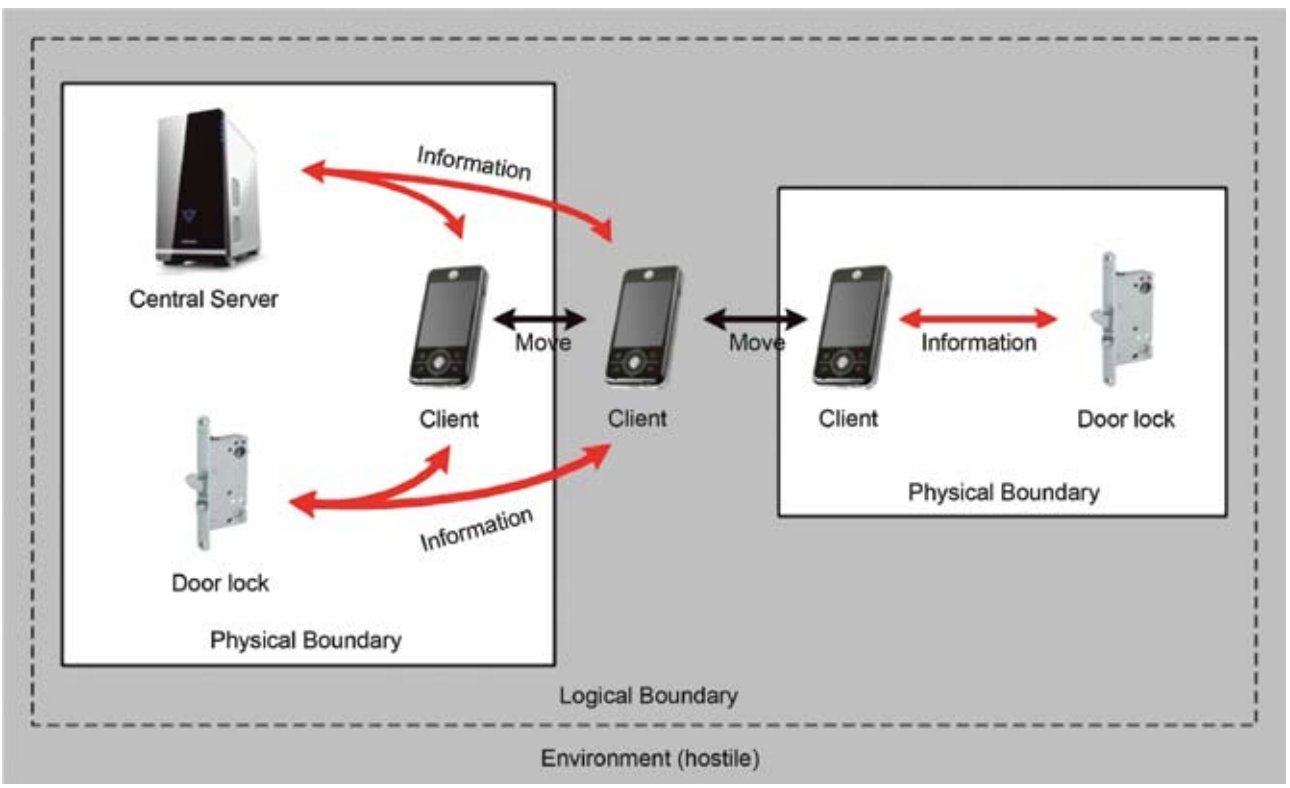
Organisations often have to restrict access to resources that are geographically extremely widely distributed and disconnected from the central organisational communications infrastructure. In such scenarios the management – creation, distribution and revocation – of user access credentials (keys) can be done efficiently in only one way: via roaming clients which have on-demand connectivity with the central network.

To this end we are developing a key management infrastructure centred on a central server which translates organisational management policies (XACML) into user access credentials which are sent via GSM network to mobile phones. Each phone is tied to the identity of its user, and access credentials are not falsifiable or re-usable by attackers since they are used in conjunction with authentication protocols. Any mobile device which supports one of several combinations of communication protocols and secure hardware, e.g. Near Field Communication (NFC) and JavaCard, can be used. Stored keys can be managed remotely without user interaction.

At the resource side, our stand-alone access control platform restricts access to a physical zone by controlling an electronic door lock. This platform or Black Box incorporates a power supply, CPU, crypto-processor, and secure data storage and supports the short-range high-frequency wireless communication protocol NFC. Using NFC, the user's mobile device submits a request containing access credentials to the Black Box which evaluates them, decides on an action – such as opening the lock and logging the event – and enforces it. Event logs or software update requests are sent over a delayed reverse channel via the mobile phone to the central server.

Our solution has three main advantages: firstly, it allows easy integration with organisational infrastructure and improves management strategies; secondly, it facilitates user credential management and eliminates the risk, cost and inconvenience associated with reliance on physical keys and cards; thirdly, the emerging NFC and JavaCard technologies are becoming standardised and growing in popularity (e.g. in contactless payment schemes) which guarantees their presence and decreasing cost into the foreseeable future.





RESOURCE USAGE PRIVILEGES IN CRISIS MANAGEMENT

It is vital for crisis management not only that the right resources can be acquired at the right time in the right place, but also that there is personnel with the right competencies and the right mandate to use those resources. Modern Swedish crisis management requires collaboration between governmental agencies and private corporations for resolving crises and it relies on the sharing of required and limited resources. SICS is funded by Swedish Emergency Management Agency (KBM) for developing a framework for the management of usage rights to shared limited resources in coalitions.

While collaboration between agencies and private corporations allows individual specialisation and cost efficient resource management, there are factors that can impede efficient resource usage during a crisis. Among those factors are conflicts when the same resource must be used by several emergency management units; shortage when the availability of a resource is too scarce; and inactivation due to insufficiency in mandate or sharing agreements between collaborating parties.

The project is developing a policy-framework, called TRAVIS, where resource sharing agreements between collaborating agencies and corporations can be expressed in terms of usage privileges. A usage privilege is a precise rule (policy) expressing when, by whom, and how much of a resource may be used. Usage privileges are organised in contracts, which in turn are to be used for managing the sharing agreements in a crisis management coalition. The project will deliver a prototype of the usage privilege calculus. The prototype will demonstrate how the usage privilege calculus can be used for overcoming impeding factors in efficient sharing of resources in coalitions.

An example where TRAVIS could be used for managing shortage of a resource, is in the case of major accident in Stockholm where the number of intensive care beds in the county of Stockholm is not large enough. TRAVIS can then be used both for enforcing contracts with neighbouring counties for the usage of intensive care beds, and for suggesting the best solution in terms of from which neighbouring county to acquire intensive care beds. TRAVIS can further be used for suggesting which resource usage sharing agreement to implement in advance of a crisis, by simulation of resource requirements obtained crises scenarios.

Photo by Kari Kohvakka, KBM

OLDER TECHNOLOGY USERS

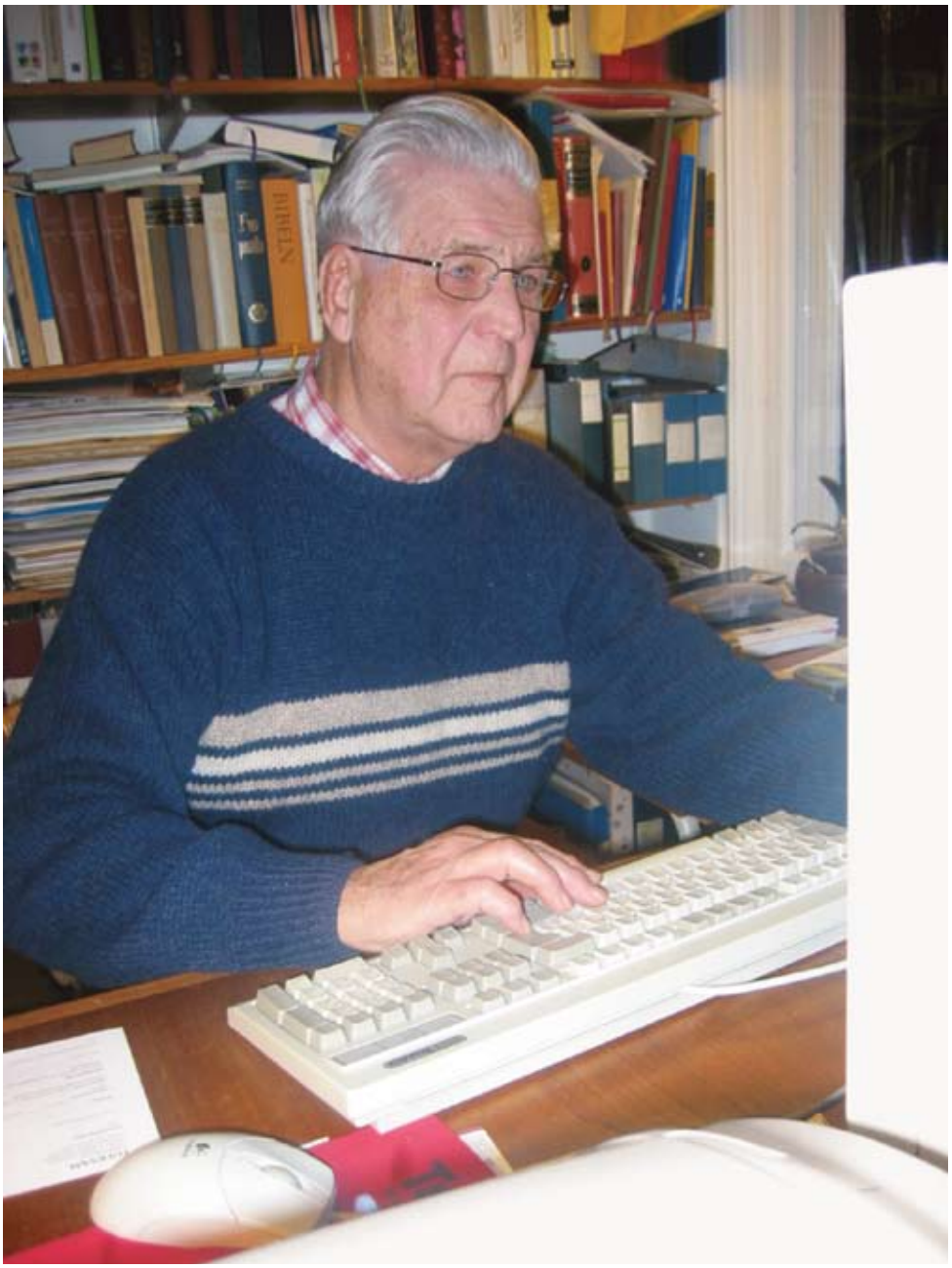
The older part of the population is a growing and important target group for new technology within many areas. At SICS work is conducted in a variety of perspectives, including user needs, design of interfaces and technology platforms.

The older part of the population is increasing, and so is life expectancy. There is a growing reliance on technical devices, and many everyday tasks require the use of computers and the Internet. If an older user group should have equal access to technology, the design of interfaces and devices must take this group's preferences and abilities into account as well.

At SICS work related to the age-related cognitive decline and use of technical devices and interfaces has been done for many years. In many of the projects at SICS, that involve design of services and interfaces, the older users are taken into consideration, as researchers from technology areas and behavioural sciences work close together. Furthermore SICS hosts the Swedish office of the World Wide Web Consortium (W3C), which is an international organisation developing protocols and guidelines for the Web, where accessibility is an important goal.

One crucial aspect of older users and technology is user needs and requirements. It is especially important to investigate user needs among this group since motivational factors are likely to affect usage. After retirement, there is no longer the same demand on people to keep up with new technology. To make new services attractive and used by older people they have to be very well targeted towards their actual needs. Older people's needs and requirements on technology have been investigated in several projects at SICS. For example in the EU funded project COMPANION, where these issues have been studied among participants from the organisation SeniorNet Sweden.

There is also an increasing need for technology to take a larger part in the care of older people. New technologies are developed to enhance independency of older people and to provide support so they can remain living in their own homes longer. Research is conducted regarding monitoring systems and the use of sensor-technology. In a report published in 2008, "Ageing and technology – recent research", new findings within the area of older technology users is presented and discussed. One section describes new findings within the area of assisted living for older adults. Another report, "Technology for the Elderly – Scenarios, Technologies and Guidelines", is about technology platforms and future scenarios for this assistive technology and was published in cooperation with the Swedish Institute of Assistive Technology.

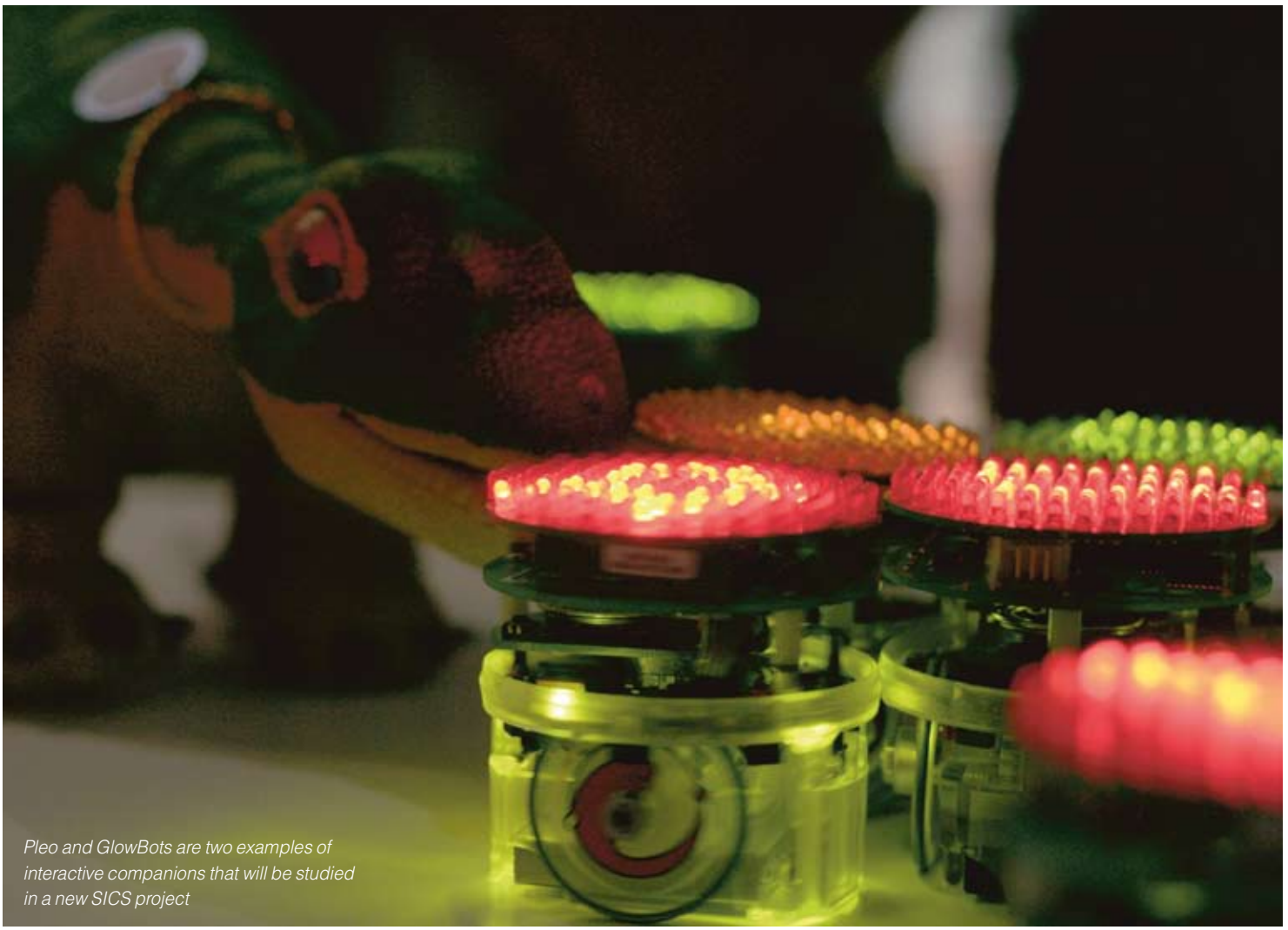


Older people's needs and requirements on technology have been investigated in several projects at SICS.

LIVING WITH ROBOTS

How will the intelligent machines of the future look, and what roles can they play in everyday life? How can researchers develop new forms of robots that provide long-term interesting relationships with humans? These are some of the questions of a new European project just starting at SICS.

When hearing the word "robot", most people think of images that appear in science fiction. We imagine intelligent machines that look almost like humans, and help us with chores like cleaning or cooking. In reality, you will not find a robot that can help you do the dishes anytime soon, and most robots today perform very limited tasks at assembly lines and factories. In the new European project LIREC, Living with Robots and Interactive Companions, researchers at SICS will explore new forms of relationships between robots and humans. Together with nine other European partners, coordinated by the University of London, the project will develop and study a variety of robots and other autonomous – but not necessarily "intelligent"! – interactive companions. At SICS, we are particularly interested in how people develop long-term relationship with artificial creatures in everyday settings. Entertainment robots or "artificial lifeforms" could represent a large future market, and there are already several companies in this area. For instance, the Pleo toy dinosaur, developed by Ugobe in USA, has just been released as a commercial product. We will use Pleo in early stages of the project to study peoples' perceptions of robots. An example of an interactive companion that has not yet become a product is the GlowBot, which was developed in an earlier EU project by the Viktoria Institute. GlowBots are small wheeled robots that communicate with each other and users through colourful patterns of light. We will be continuing the study and development of GlowBots in this new project, as well as creating entirely new examples of interactive companions. Perhaps, even though the robots of the future might not help you do the dishes, they can keep you company and entertain you and your friends!



Pleo and GlowBots are two examples of interactive companions that will be studied in a new SICS project

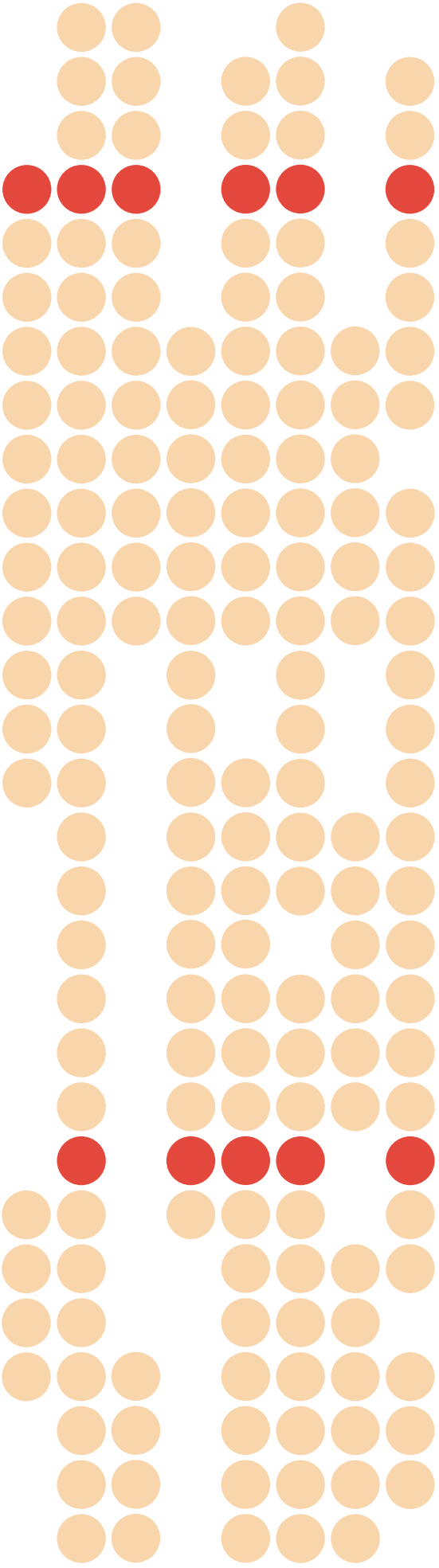
FINANCIAL REPORT

SICS,
STATEMENT OF PROFIT AND LOSS, KSEK

	Year 2007	Year 2006
Income		
Net Sales	90 178	83 605
Other operating income	543	2 899
TOTAL INCOME	**90 721**	**86 504**
Operating expenses		
Other external costs	-27 281	-21 947
Personel	-64 064	-64 372
Depreciation and write-downs of tangible assets	-157	-161
Operating profit/loss	**-781**	**24**
Resutl from financial investments	1 599	364
Profit/loss after financial items	**818**	**388**
Other taxes	-272	-152
NET PROFIT FOR THE YEAR	**546**	**236**

SICS,
BALANCE SHEET 2007, KSEK

ASSETS		Dec 31, 2007	Dec 31, 2006
Fixed Assests			
	Tangible assets (Machinery)	1 219	340
	Financial Assets	318	294
Total fixed assets		1 537	634
Current assets			
	Ongoing projects	10 573	6 197
	Current receivables	6 997	9 948
	Investments	4 527	3 609
	Short-term investments	11 053	16 000
	Cash and bank deposits	28 918	25 702
Total Current assets		62 068	61 456
TOTAL ASSETS		63 605	62 090
EQUITY AND LIABILITIES			
Equity			
	Share capital	100	100
	Statutory reserve	21 908	21 908
	Profit brought forward	728	492
	Profit for the year	546	236
Total Equity		23 282	22 736
Current Liabilities		40 323	39 354
TOTAL EQUITY AND LIABILITIES		63 605	62 090



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