RAMIRI

Operating an infrastructure: case CSC

Kimmo Koski
CSC

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CSC – Tieteen tietotekniikan keskus Oy
CSC – IT Center for Science Ltd.

Target

- Show a case example about running an existing ICT infrastructure
  - Actually running multiple infrastructures, depending on definition…
- Pointing out challenging areas, aiming to stimulate discussion

CSC at a glance

- Founded in 1971 as a technical support unit for Univac 1108
- Reorganized as a company, CSC - Scientific Computing Ltd. in 1993
- All shares to the Ministry of Education of Finland in 1997
- Operates on a non-profit principle
- Facilities in Espoo, close to Otaniemi community (of 15,000 students and 16,000 technology professionals)
- Staff 230 and growing
- Budget 2011 close to 30 MEUR (excluding investments)

CSC

CSC services

Universities

Polytechnics

Ministries

Public sector

Research centers

Companies

FUNET NETWORK SERVICES

COMPUTING SERVICES

APPLICATION SERVICES

INFORMATION MANAGEMENT SERVICES

DATA SERVICES

CSC

OUR MISSION:

CSC, as part of the Finnish national research structure,
develops and offers
high quality information technology services

OUR VISION 2015

CSC – pioneer in the sustainable development of ICT services

What do you need to consider when running a center?

- Sustainability
  - Project funding vs. ‘sustainable’ funding
  - Customer base and services
  - Ability for long-term planning
- Organization and steering structures
- Strategy and implementation
- Communication (external and internal)

Make sure this works

- Financing
- HR
- Customer relations
- Stakeholder management
- Services and their development
- Decision making process
- Target setting for individual employees, groups, the whole company
- Internal communications
- Strategic planning

Typical challenges to solve

- Key person leaves, it takes time to recruit new
  - Needs fast reaction time, pre-scanning of risks in personnel, efficient HR, take care of the customer
- Budget cuts
  - Fast priority settings with real implications, impacts for short term/long term, actions for savings AND increasing funding
- Personnel is overloaded
  - Restructuring workload, priority settings, check the ‘booking’ of the most wanted person resources

Other challenges

- Steering bodies try to make decisions for operational matters
  - Get angry and show it!
- Atmosphere in the company is stressed and tight, people quarrel
  - Organize a party!
- The credit of your achievements is pretty much taken in public by people above you
  - If you are CEO, be happy (the decision makers like you)
  - If you are an employee, shout loud!
- The government states that there is a need for a major reorganization of the national ICT support structure
  - PANIC! ☺

Important

- Be aware what your customers need and want
  - If you do not know, ask them
  - Customer driven services usually better approach than technology driven
  - Infrastructures have been closed down due to forgetting the customer
- Be proactive towards the bodies that govern and fund you
  - Get to know their targets and current interests

Milestones and case examples

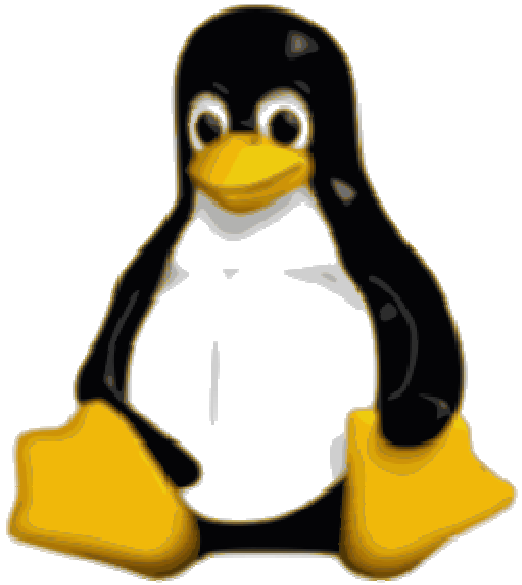
Successful application of scientific information technology in Finland

CSC – Tieteen tietotekniikan keskus Oy
CSC – IT Center for Science Ltd.

CSC connected Finland to the Internet

- CSC started to build the Funet data communications network for universities and researchers in 1983. Two years later in 1985 the data communications connections between universities were established. Funet was also first in Finland to connect to the World Wide Web in 1988.

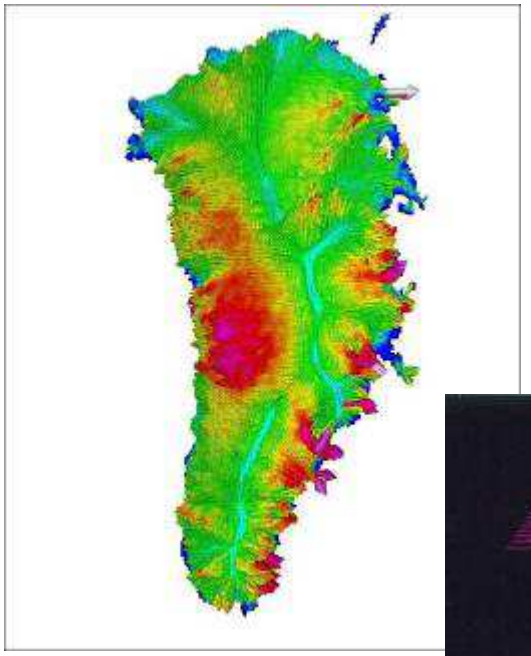
Linux was introduced to the world from CSC servers

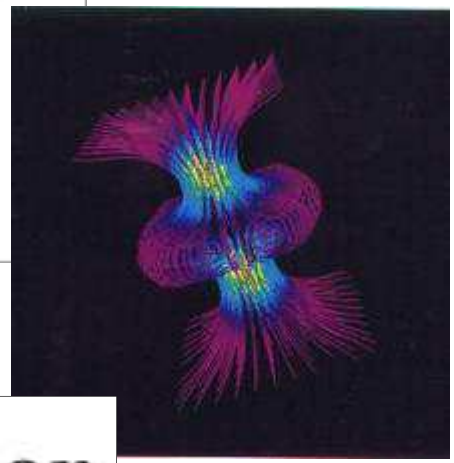


- CSC's file server nic.funet.fi was at one point the world's most popular file server.
- Linus Torvalds's Linux operating system was distributed through the server.

The world's most versatile modelling software

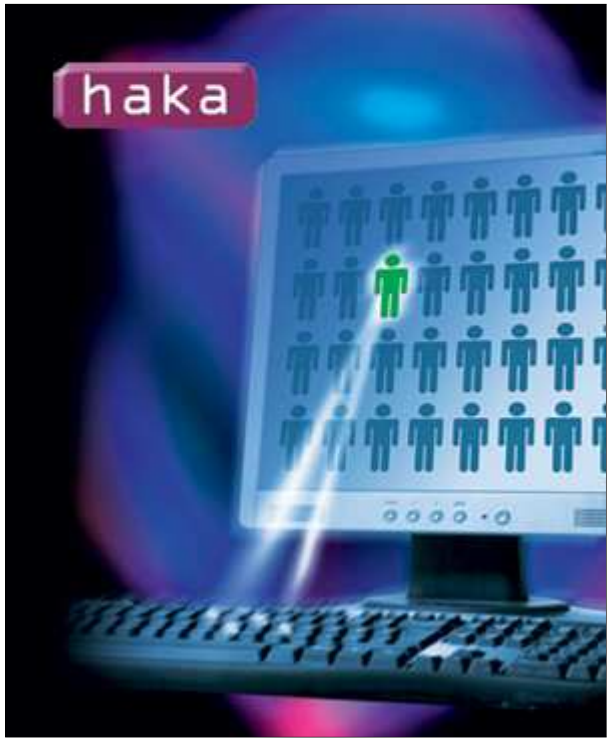
- Elmer is one of the world's most versatile open source multi-physics modelling software developed by CSC.
- Elmer is well suited for flow, structure, mechanical, electromagnetic, acoustics, micro flows and micro electro-mechanical systems modelling.
- The Elmer software kit has been successfully used in, for example, continental glaciers and silicon modelling.
- International user community.





Elmer

Haka-user identification combines the electronic services of universities into the same system



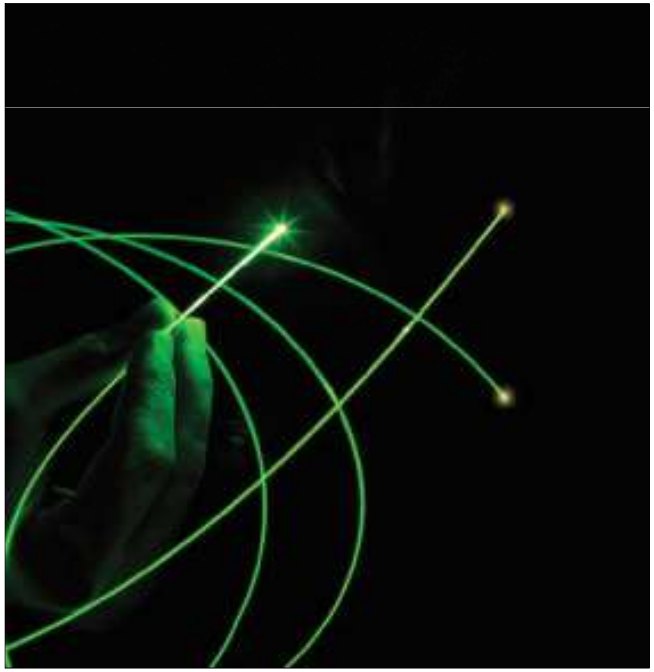
- The Haka infrastructure, coordinated by CSC, is used by Finland's universities and research institutes as a common user identification system.
- Makes it possible to use network services across various universities with their own user identifications.
- At the moment over 96% of university and around 37% of polytechnic end users are using the Haka identification system.

The world’s first common university library system

- In autumn of the year 2000, researchers and students began to use Finland’s university library services through a common system. With the Linnea 2-project, being the first in the world, all the nation’s university library databases were combined to a common server system.

- CSC has been responsible for the system maintenance, network connections and system monitoring.

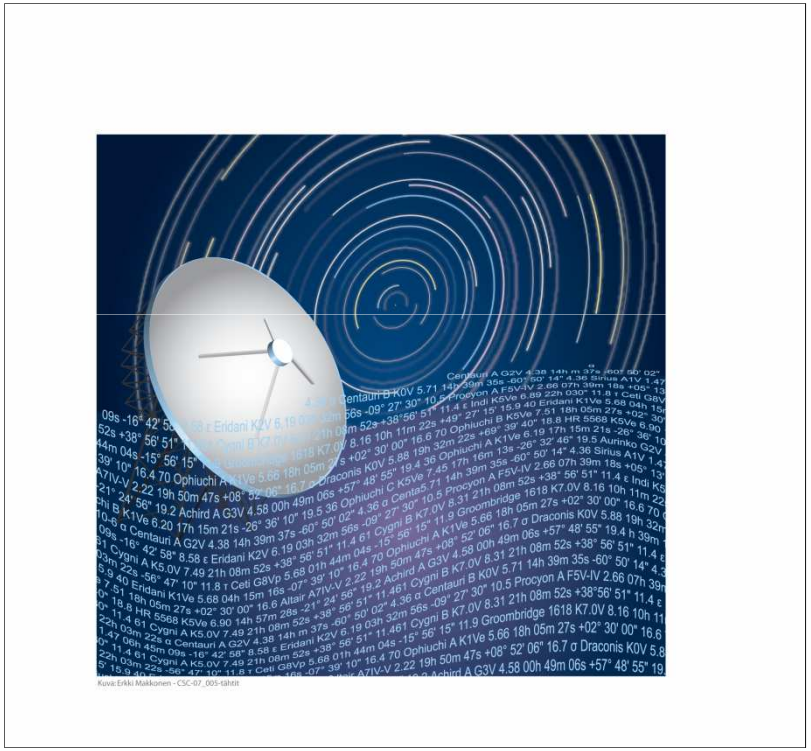
The most reliable, fastest and most secure data network



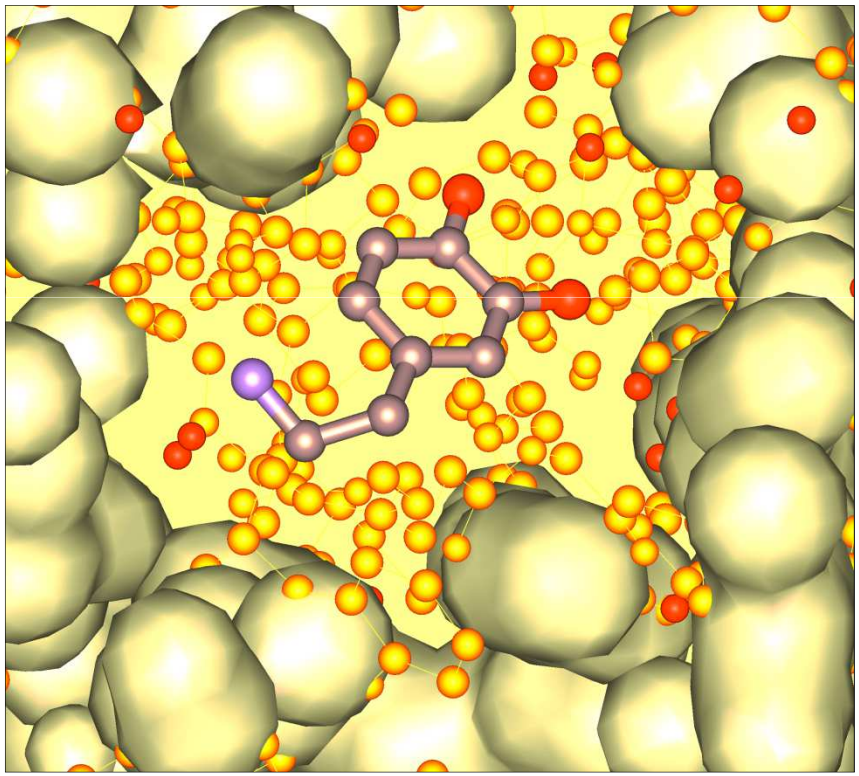
- The Funet network has been one of the most secure backbone networks in the world for over 10 years.
- CSC was the first in Finland to begin concentrating on secure data communication networks (CERT).
- The same data security models were adopted in other world's organisations.
- CSC develops data security solutions in cooperation with the Communications Regulatory Authority.

Funet made the intercontinental data transfer speed record

- Metsähovi radio research station of HUT and NICT from Japan carried out a test in which Metsähovi's radio telescope signal was used to determine the rotational speed difference of the earth (UT1) and UTC time variance (dUT1). This is one of the parameters that are used to describe the variance in earth rotation.
- The data processing was less than 30 minutes. Before this could have taken weeks. The intercontinental data transfer speed was at best 256 Megabits per second – world record in UT1 measurements.
- The 10 Gbit/s internet connection used in the test was provided by CSC/Funet.



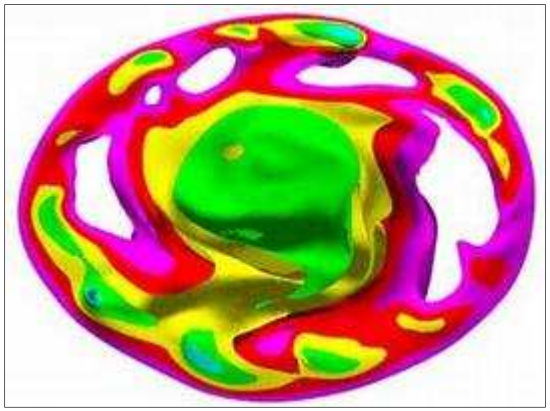
New methods to medicine planning



- With computer modelling, it is possible to efficiently perceive the complex mechanism by which our biological machinery operates.
- The medicine planning is done with computer mapping and combining results from computer simulations and laboratory tests. The combined data amount is, however, immense and requires an expert and a functional molecule modelling environment.
- CSC has been involved in several medicine planning projects with Suomen Akatemia, Tekes and Åbo Akademi. With the project, new methods for medicine planning were developed.

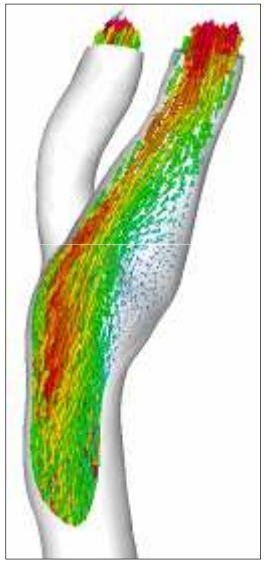
Silicone carbide and silicone crystal growth simulation: higher quality products for the sensor and semiconductor industry

- Okmetic is the world's leading silicon wafer manufacturer for MEMS sensors.
- CSC has been working together with Okmetic Oy in semiconductor modelling. The modelling has supported Okmetic's product development and improved their competitiveness by being able to manufacture higher quality products with smaller manufacturing costs.



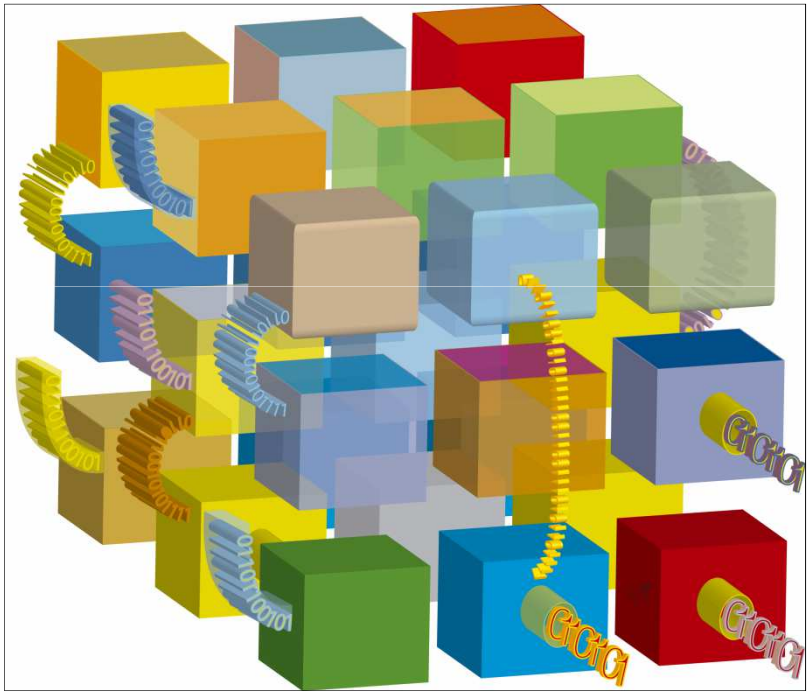
Dynamo: efficient accessories for research on circulation diseases

- In the joint DynAMo (Dynamic Adaptive Modelling of the Human Body) project funded by Suomen Akatemia, the Technical University of Tampere, Technical University and CSC, a more accurate and reliable modelling system of the human physiological body was done.
- The mathematical modelling of the human body can offer doctors efficient tools for circulation disease research and operative planning.
- CSC developed a computation method that is able to describe a pulse type flow in elastic veins.

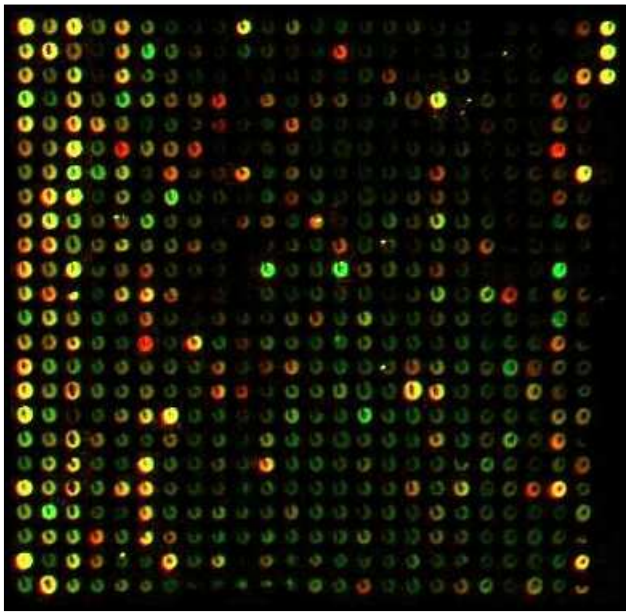


Centralised scientific databases bring savings to everyone

- The scientific database programme by CSC has made functioning of several scientific areas in Finland easier and more efficient.
- In many scientific areas the information in the databases has been a significant tool for research. The databases are usually of high cost, which means that by centralising the procurement and maintenance, the financial savings achieved have been significant.



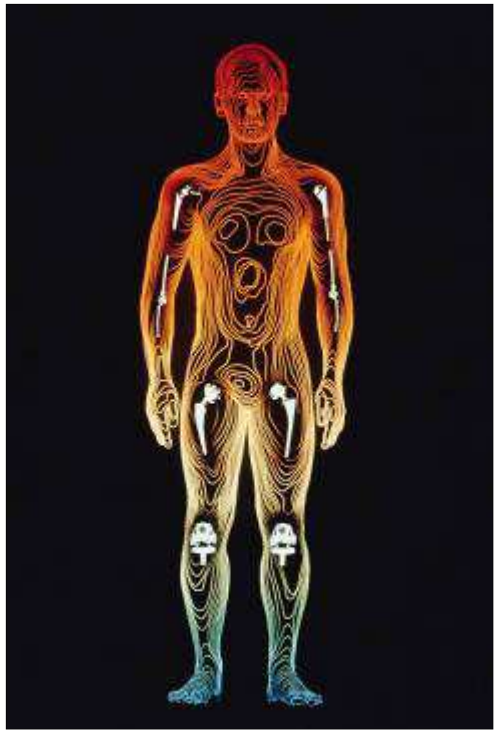
Chipster – an user friendly and comprehensive software for DNA fragment analysis



- Chipster is a userfriendly software for DNA fragment analysis developed by CSC. Chipster brings for the researchers a comprehensive selection of the newest analysis methods in a user friendly form.
- With the DNA fragments it is possible to investigate the functions of thousands of genes simultaneously, and they are used in many research fields from plant refinement to medicine.

400 years or two days? By optimising the code, the research results are achieved faster and more accurately

- In the FINHPC project, partly funded by Tekes (2005-2008), functionality of more than 30 scientific program codes were improved in cooperation with Åbo Akademi.
- In a CSC, HIIT and Helsinki University project, a disease mutation was compared in three different ethnic groups (thousand billion comparisons).
- Markers or so called SNIPs are one of the alkali changes in DNA. Because of this we are all different. Snip is inherited together with the mutation properties. With this connection unbalance, it is possible to locate the disease mutation.
- With one processor the computation time would have been 400 years, but with the optimisation of the information structure and algorithms, moving to Fortran 90 language and parallelism, the code was over 40,000 times faster, and computation with 16 processors took 16 days.



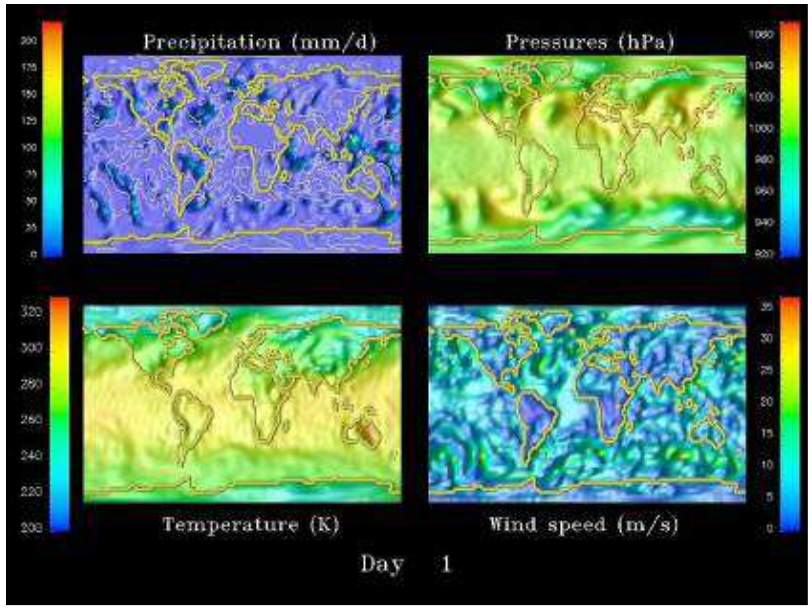
Finding genes with parallel computation

- Human growth and adult age are properties that are affected by genetic and environmental factors.
- Leena Palotie's team did a research on over 6,600 European twins' genes (over 10,000 twins and their siblings).
- The statistical connections were determined by simulations. In the connection analysis, each artificial material and chromosome was calculated with its own parallel processor.
- The computation time was significantly reduced with parallel calculations. The chromosomes can be analysed separately and the results can be combined after the analysis.

Connected models in forecasting weather changes

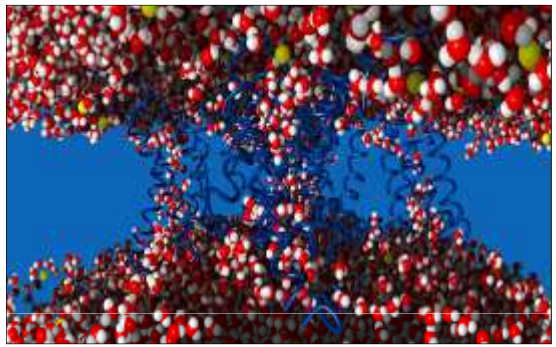
- Finnish Meteorological Institute, Finnish Institute of Marine Research and University of Helsinki were involved in the CoMS research project funded by CSC and Tekes.
- The scientific estimates about the climate development are based on information about the earth's historical climate data and calculated models.
- Global climate models are structured from reciprocated partial models for the earth's atmosphere, oceans, glaciers, vegetation, carbon recycling etc.
- The development of the global climate models is being done in an international research community, where the Finns are actively involved.
- In climate research, a significant part is played by the required software know-how and large computation and saving resource needs of heavy computation models.

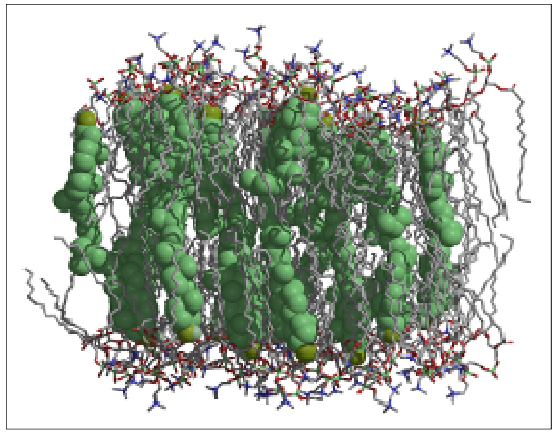
Importance of vegetation in climate change. CoMS Project of CSC and University of Helsinki



- The effect of vegetation is modelled with atmosphere-sea-models connected to the late Miocene climate conditions for the first time in the world.
- Modelling: CSC's guest researcher Arne Micheels cooperating with Mikael Fortelius, Professor of University of Helsinki, and researcher Jussi Eronen.
- A research of CoMS project used the CSC MPI-M (Max Planck Institute for Meteorology) equipment environment for Cosmos climate modelling and CSC computation resources.

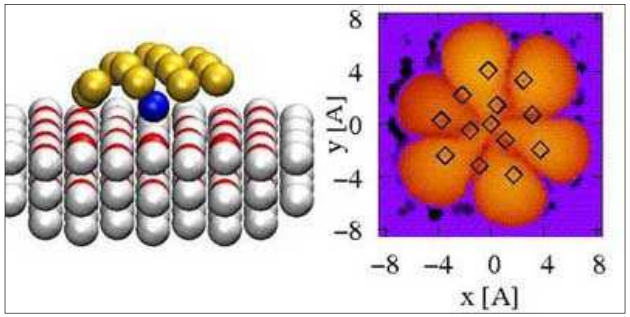
Scientific breakthrough – Record simulation of the long ion channel system with Gromacs software





- Ion channels affect e.g. nerve systems, energy storing, muscle coordination and heart functions.
- Ilpo Vattulainen and Erik Lindahl successfully simulated about 120,000 atom sized ion channel system functions over one micro second.
- The significantly improved scalability and optimisation made scientific breakthrough in cell membrane research possible.
- The research brought out significant new information about molecular biology.

The electronic structure of gold particles discovered with CSC supercomputers



- The nanometre class physical and chemical structure phenomenon are modelled with super calculation resources. The nanometre sized gold particles can be used, for example, as bio markers and catalysts.
- Hannu Häkkinen's (University of Jyväskylä) research clarified the interpretation of the gold particle pictures taken with the tunnel microscope.
- To be able to interpret the gold particle atomic structure pictures correctly, computational support methods are always required.

300 gigabytes of memory is needed for a breakthrough in nanotechnology

- Mikael Johansson's research team (University of Århus) witnesses how the structure of material changes according to the atomic quantity. To achieve more accurate electron structure calculations, almost 300 Gigabytes of memory and two Terabytes of disc space were required at CSC's super cluster Murska. Murska enabled the required quantum mechanics calculations, one of the largest in the world.

- Very small negatively charged gold clusters' largest possible size was determined: when they reach eighteen atoms of size, the gold cluster changes from a plane structure to a three dimensional structure.

- A unique property of gold is its tendency to stay in plane level out of reach of other metals. This feature has important consequences for example in nanocatalysis, in which two dimensions affect performance. With the catalysis, chemical reactions can be accelerated, such as converting vehicle exhaust gases to become less harmful by adding a catalyst to the reaction. Traditionally, the catalyst efficiency is directly proportional to its surface area.