Inauguration of the Cray XT6m "Lindgren"

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KTH
VETENSKAP
OCH KONST
PDC Center
for High
Performance
Computing

”*Advances in computing and connectivity make it possible to develop computational models and capture and analyze unprecedented amounts of experimental and observational data to address problems previously deemed intractable or beyond imagination”*

CRAY
THE SUPERCOMPUTER COMPANY

20th Anniversary of PDC

31 August 2010

KTH
VETENSKAP
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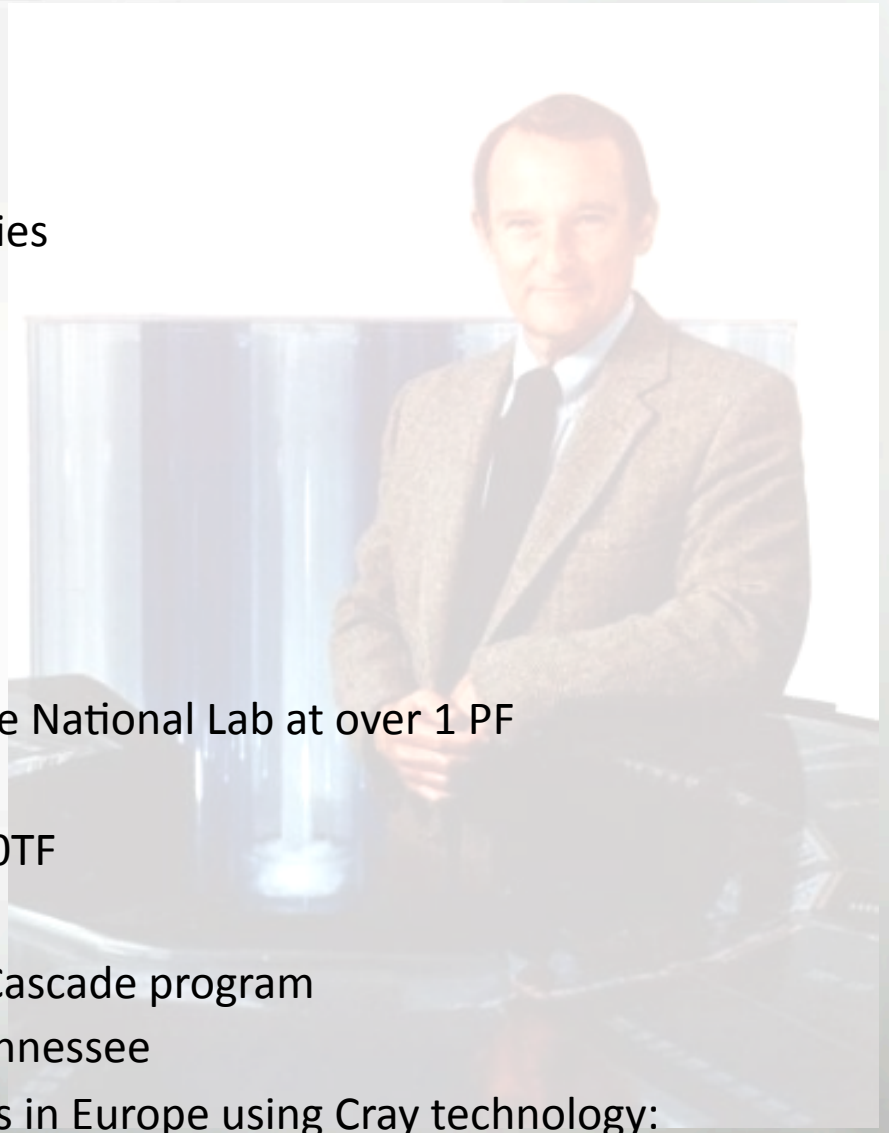
Dr. Ulla Thiel
VP Cray Europe

Cray Today

- **Nasdaq: CRAY**
  - Formed on April 1, 2000 as Cray Inc.
  - Headquartered in Seattle, WA
  - Roughly 850 employees across 30 countries
- **Four Major Development Sites:**
  - Austin, TX
  - Chippewa Falls, WI
  - Mendota Heights, MN
  - Seattle, WA
- **Significant Progress**
  - DOE Leadership Class system at Oak Ridge National Lab at over 1 PF
  - NERSC system over 350TF
  - Sandia Red Storm went from 40 TF to 280TF
  - CSCS and HECToR systems over 200TF
  - $250M DARPA HPCS Phase III award for Cascade program
  - NSF funded PF system at University of Tennessee
  - Four production weather forecasting sites in Europe using Cray technology: CSCS for Meteo Swiss, DMI (Denmark), FMI (Finland) and AEMet (Spain)

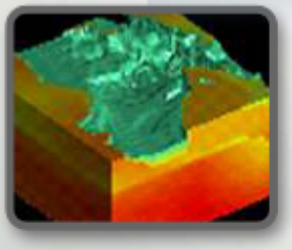


Cray = Supercomputing

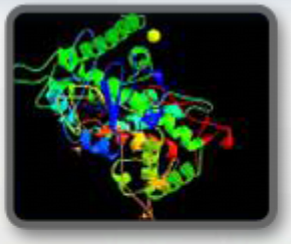
We build the world's largest and fastest supercomputers for the highest end of the HPC market

For government agencies, research institutions and large enterprises

We help solve the "Grand Challenges" in science and engineering that require supercomputing



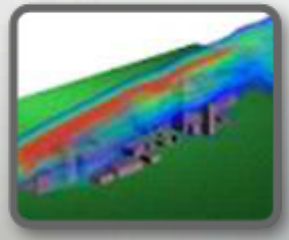
Earth Sciences



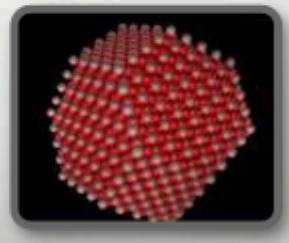
Life Sciences

Aerospace Research

Automotive Engineering



National Security and Defense



Scientific Research

CRAY XT5
DMI
CSCS
CRAY XT5
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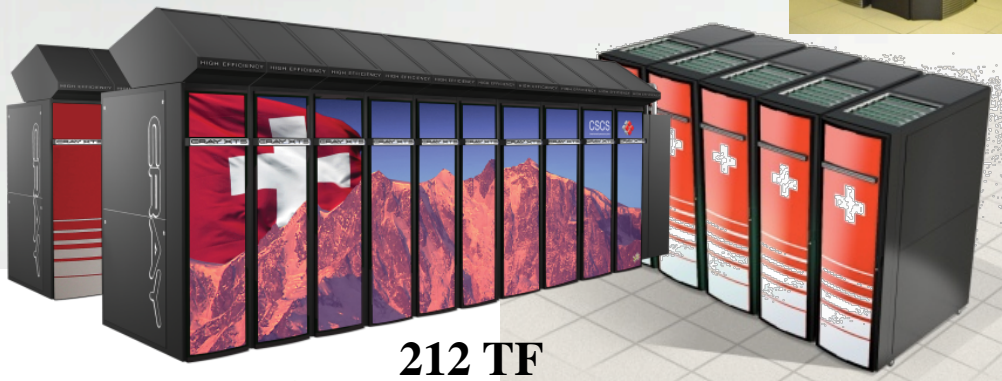
Cray Customers in Europe

CRAY THE SUPERCOMPUTER COMPANY

CSCS Swiss National Supercomputing Centre

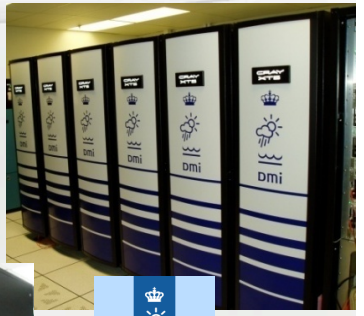


212 TF

DUISBURG ESSEN

31 TF

AEMet Agencia Estatal de Meteorología



EADS

35 TF

HLRS

CSC

KTH VETENSKAP OCH KONST

93 TF → 303 TF

HECToR

374 TF

100 TF

50 TF

Cray XE6 orders at announcement

PDC-KTH

- Five Cabinet Cray XT6m
- Peak Performance of 93 TFLOPS
- AMD 12-Core Magny Cours Processors
- 11K processor cores
- *This system represents the first Cray in Sweden in 15 years!*

What Makes a Great Supercomputer?

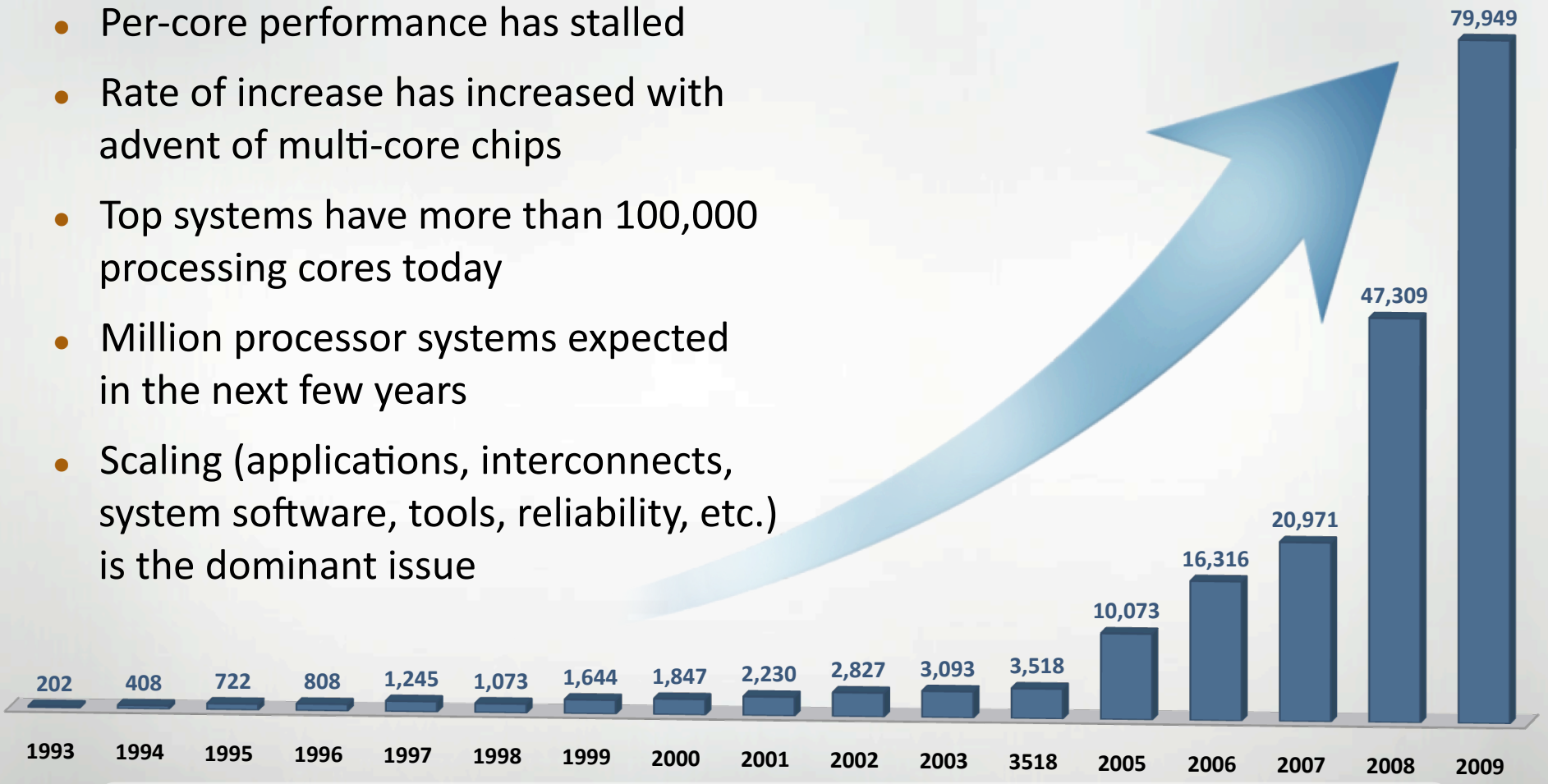
- **Powerful Processors**
  - AMD best-in-class processors
  - Future AMD and Intel best-in-class processors
- **Scalable Interconnect**
  - Cray Custom Interconnects SeaStar and Gemini
  - Integrated NIC and SWITCH design
  - Unique Innovative Features
- **Flexible and Efficient Infrastructure**
  - Liquid and Air Cooled
  - Fits a wide range of data center conditions
- **Scalable Software**
  - Cray Linux Environment
  - Cray Programming Environment

Main areas of Research & Development in Cray

System Interconnect	Custom interconnect and communications network
Systems Management & Performance	Software to productively manage and extract performance out of thousands of processors as a single system
Packaging & Power Efficiency	Very high density, upgradeability, liquid and air-cooling

Increasing Importance of Scaling

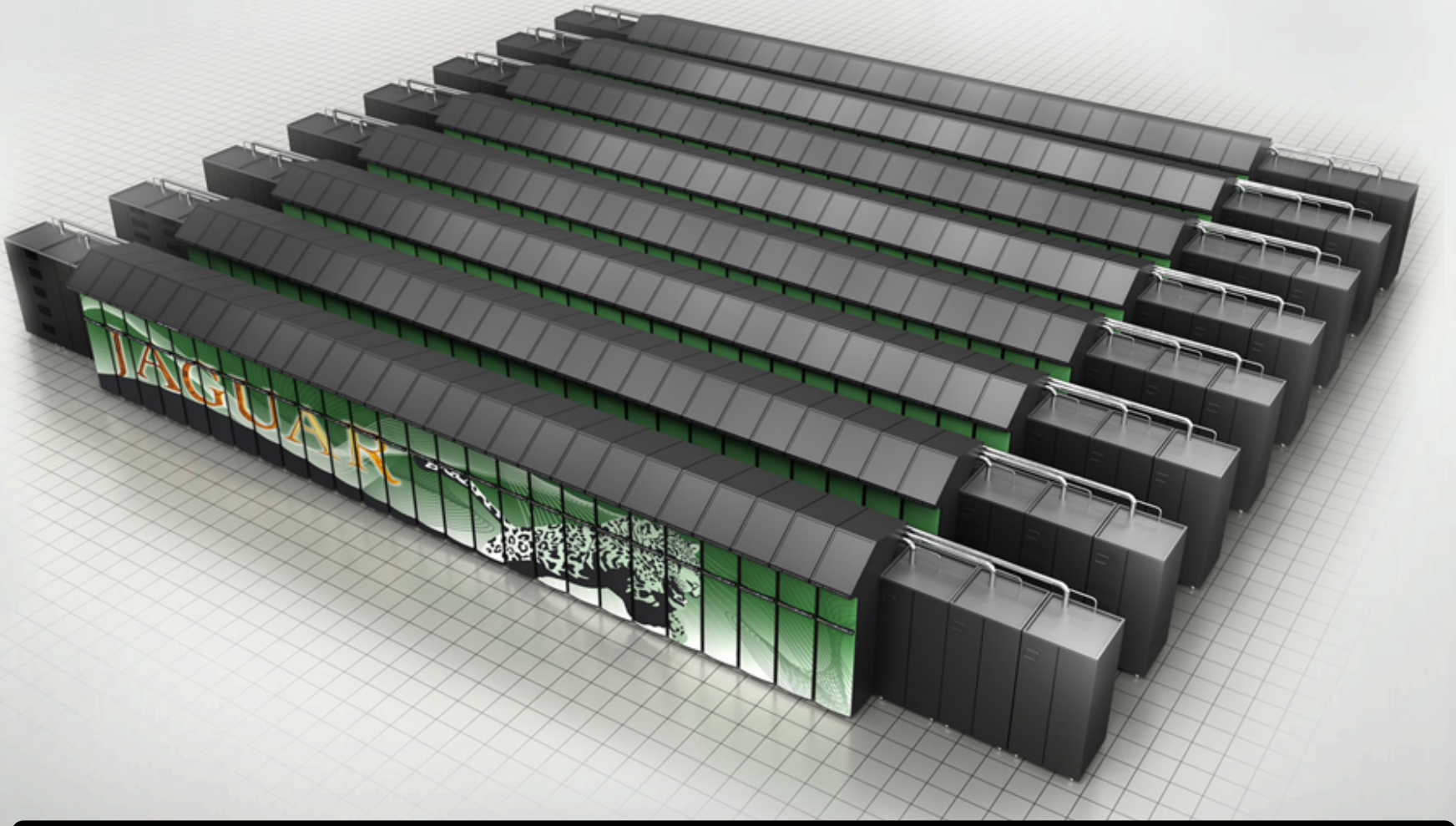
- Per-core performance has stalled
- Rate of increase has increased with advent of multi-core chips
- Top systems have more than 100,000 processing cores today
- Million processor systems expected in the next few years
- Scaling (applications, interconnects, system software, tools, reliability, etc.) is the dominant issue



Average Number of Processor Cores per Supercomputer (Top 20 of Top500)

Source: www.top500.org

"Jaguar"
Oak Ridge National Labs XT5 Petaflops System



Example of Cray's strong customer partnership focus → from 3 TF to 1PF and beyond

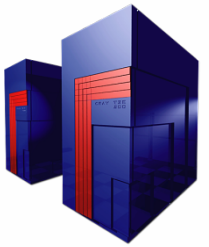
A History of Breaking Sustained Performance Barriers …Looking at the Gordon Bell Prize

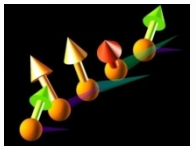
1 GF 1988; Cray Y-MP; 8 Processors

- Static finite element analysis

1 TF; 1998; Cray T3E; 1,024 Processors

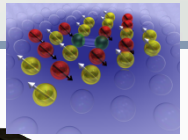
- Modelling of metallic magnet atoms

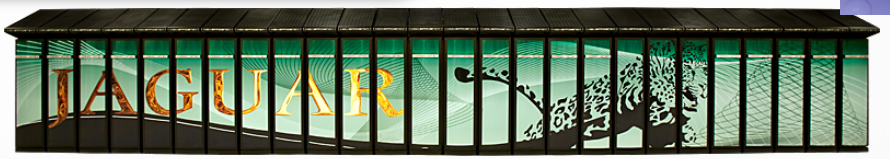




1 PF; 2008; Cray XT5; 150,000 Processors

- Superconductive materials





1 EF; ~2018; ? ; 10,000,000 Processors

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Tack!

Lindgren – Phase 1

- Cray XT6m
- 2 12core AMD Opteron CPUs 2.1 GHz, 32 GB RAM per node
- 460 compute nodes (11,040 cores),
- 93 TF TPP
- SeaStar-2 2D torus network

- Online since July 1st 2010
- Usage currently restricted to experienced users

Lindgren – Phase 2

- Cray XE6
- 2 12core AMD Opteron CPUs 2.1 GHz, 32 GB RAM per node
- 1516 compute nodes (36,384 cores)
- 305 TF TPP
- 3D torus Gemini network
- SNIC PRACE system

- Installation late 2010, production early 2011

Heat Reuse Project

PDC Center for
High Performance Computing

- Background: today around 800 kW used at PDC
- Project started 2009 to re-use this energy
- Goals:
  - -Save cooling water for PDC
  - -Save heating costs for KTH
  - -Save the environment
- Use district cooling pipes for heating when no cooling is required
- No heat pumps
- Starting with Cray
- First phase of Cray will heat the KTH Chemistry building

Other PDC Computing resources

Ekman - Dell PowerEdge Cluster
Climate and Flow research

10,144 cores (1268 nodes, 2 quad core AMD)
89 TF theoretical peak performance
20 TByte memory

Povel
Prace Prototype (energy efficiency)
4320 cores (180 4x6core AMD nodes)
36 TF theoretical peak performance
5.76 TByte memory

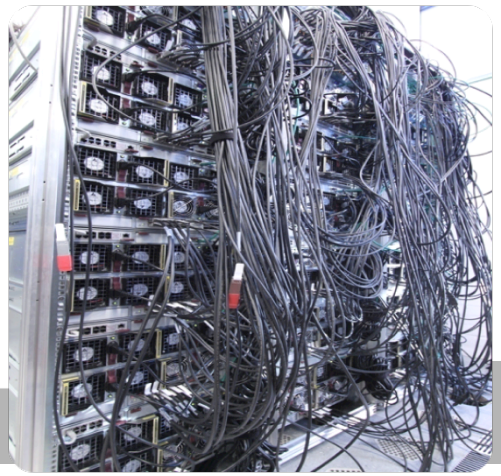
Hebb - IBM Blue Gene
Stockholm Brain Institute, Mechanics, and INCF

1024 nodes
6 TF theoretical peak performance

Key - HP SMP
32 Cores, 256 GB memory

Ferlin and SweGrid - Dell Cluster
SNIC Foundation Level Service
32 nodes with Infiniband

6120 cores (765 nodes, 2 quad core Intel)
7 TByte memory



Summary

PDC Center for
High Performance Computing

System	Cores	TPP
Lindgren	11,040	93 TF
(Lindgren final)	(36,384)	(305 TF)
Ekman	10,144	89 TF
Ferlin	5,360	58 TF
SweGrid	744	8 TF
Hebb	2,048	6 TF
Povel	4,320	36 TF
Total	**33,656 (59,000)**	**290 TF (502 TF)**

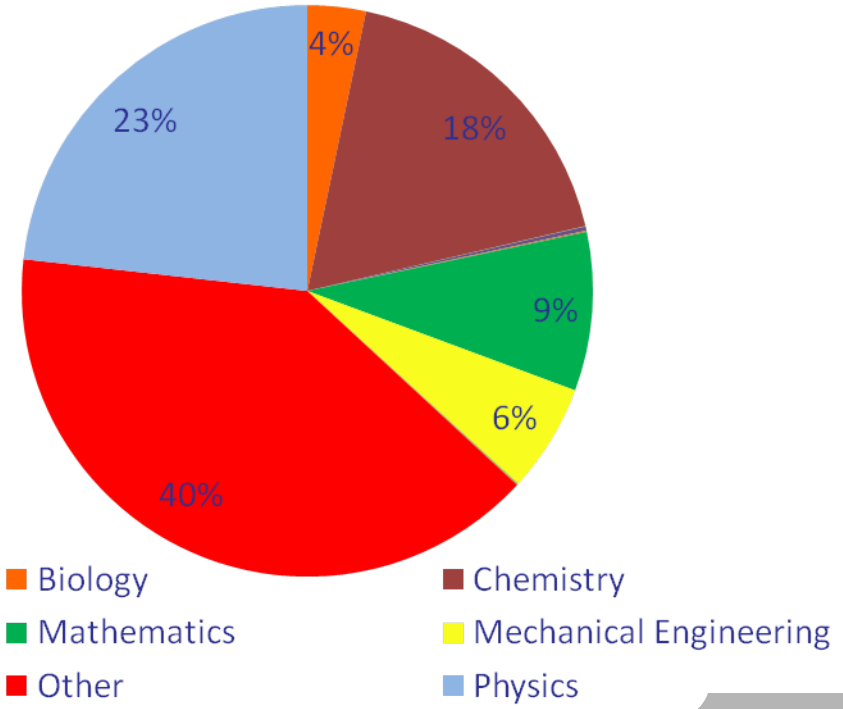
PDC Applications

Systems at PDC are used for a wide variety of scientific applications.

PDC Center for
High Performance Computing

Examples of these research areas include:

- Quantum Chemistry
- Climate Modeling
- Neuroinformatics
- Life Sciences
- Physics
- Computational Fluid Dynamics



Cray Programming Environment Workshop

PDC Center for
High Performance Computing

- October 18-20 at PDC
- Learn how to efficiently use the Cray
- Lectures and hands-on sessions
  - **Bring your own code!**
- Registration will start soon!

Other Activities

- Prace - Partnership for Advanced Computing in Europe
  Design of future European supercomputing landscape
  - Prototype
    - Focus on energy efficiency and high density packing
  - Tier-1 system
    - Cray
- Integration in DEISA - Distributed European Infrastructure for Supercomputing Applications
- Windows HPC prototype
- Cloud computing
  - Nordic cloud study (NEON)
  - Cloud infrastructure project (Venus-C)
- EGI/SweGrid
- Advanced software support
  - SeRC
  - Scalable Software Services for Life Sciences (ScalaLife)

PDC Center for
High Performance Computing

Looking forward to many scientific breakthroughs on the Cray!!

PDC Center for
High Performance Computing

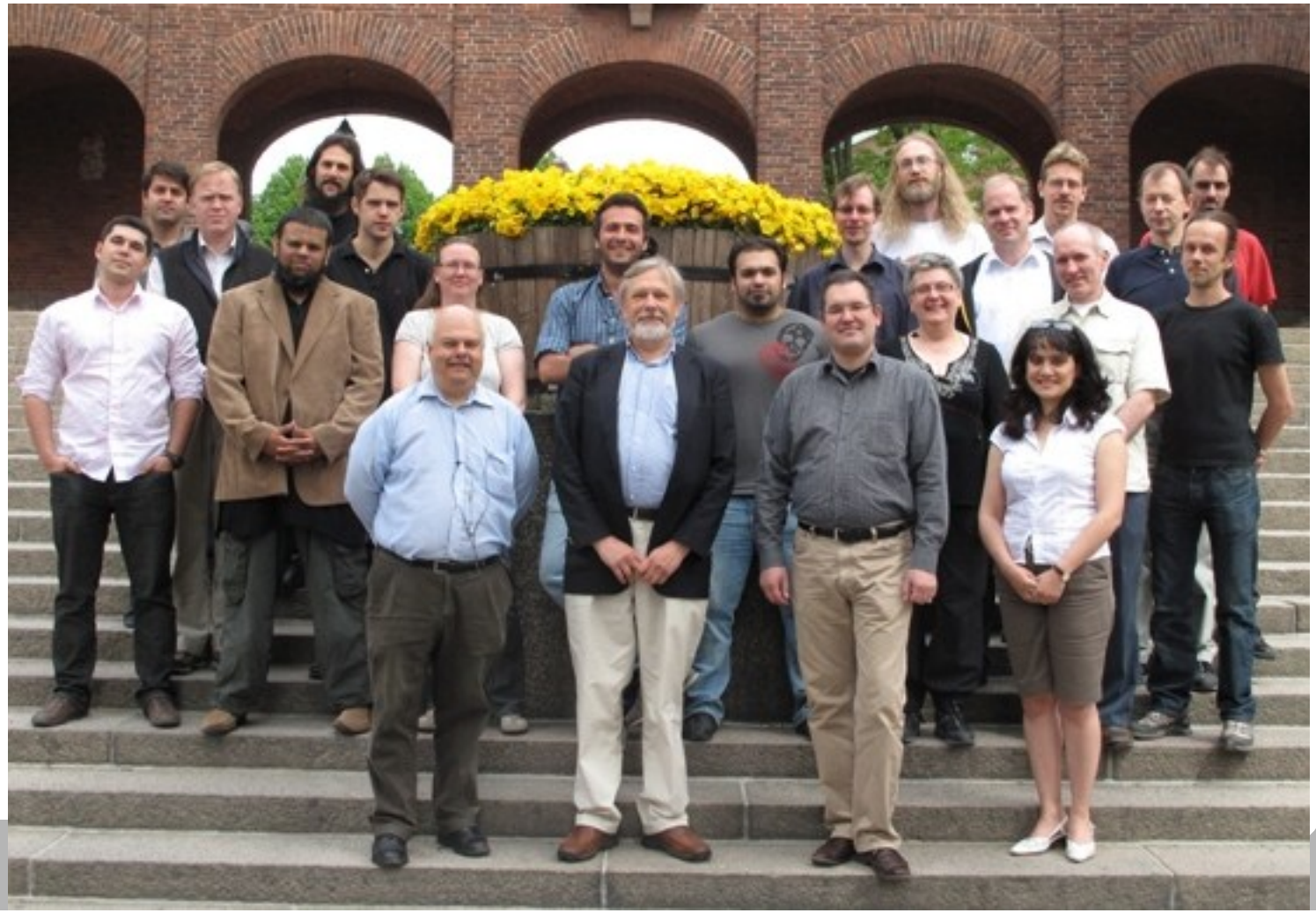
Thanks to

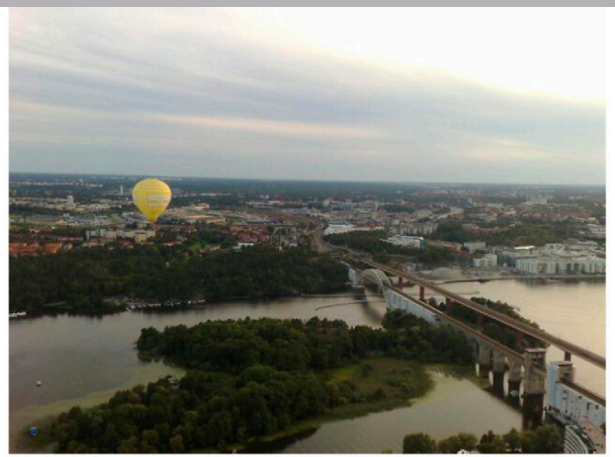
SNIC

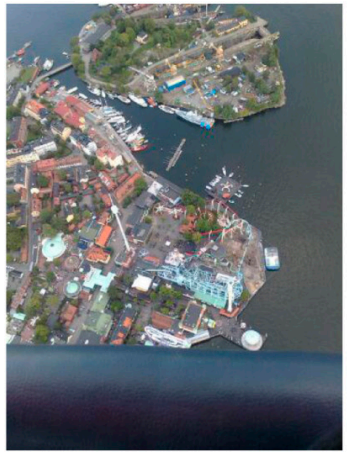
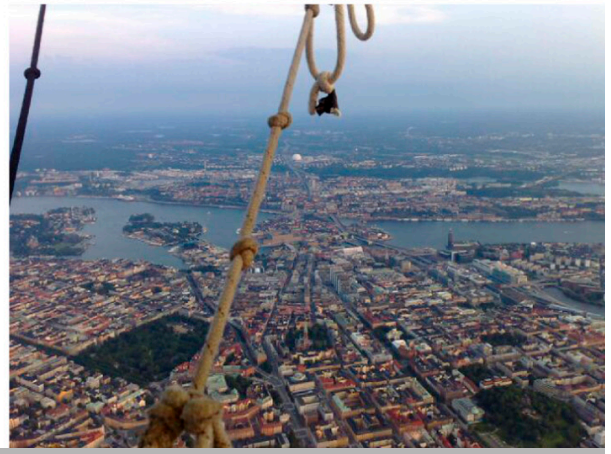
SOUTH POLE

CRAY
THE SUPERCOMPUTER COMPANY

Thanks to all the PDC personnel who made it work!







PDC – the sky is the limit!