GRID Activities In Singapore

Jie Wei

Institute of High Performance Computing, Singapore

Outline

Institute of High Performance Computing
A*STAR

- **Singapore's National Grid**
- **Overview of Grid Activities**
- **Grid Activities at IHPC**

Institute of High Performance Computing
A*STAR

Singapore's National Grid

National Grid
NG
SINGAPORE

National Grid

The NG is a national effort to:

- **Develop a** Cyberinfrastructure **for *science and engineering research and education;* and**
- **Promote the use of** Grid Computing **for research, academia, *commerce and industry***

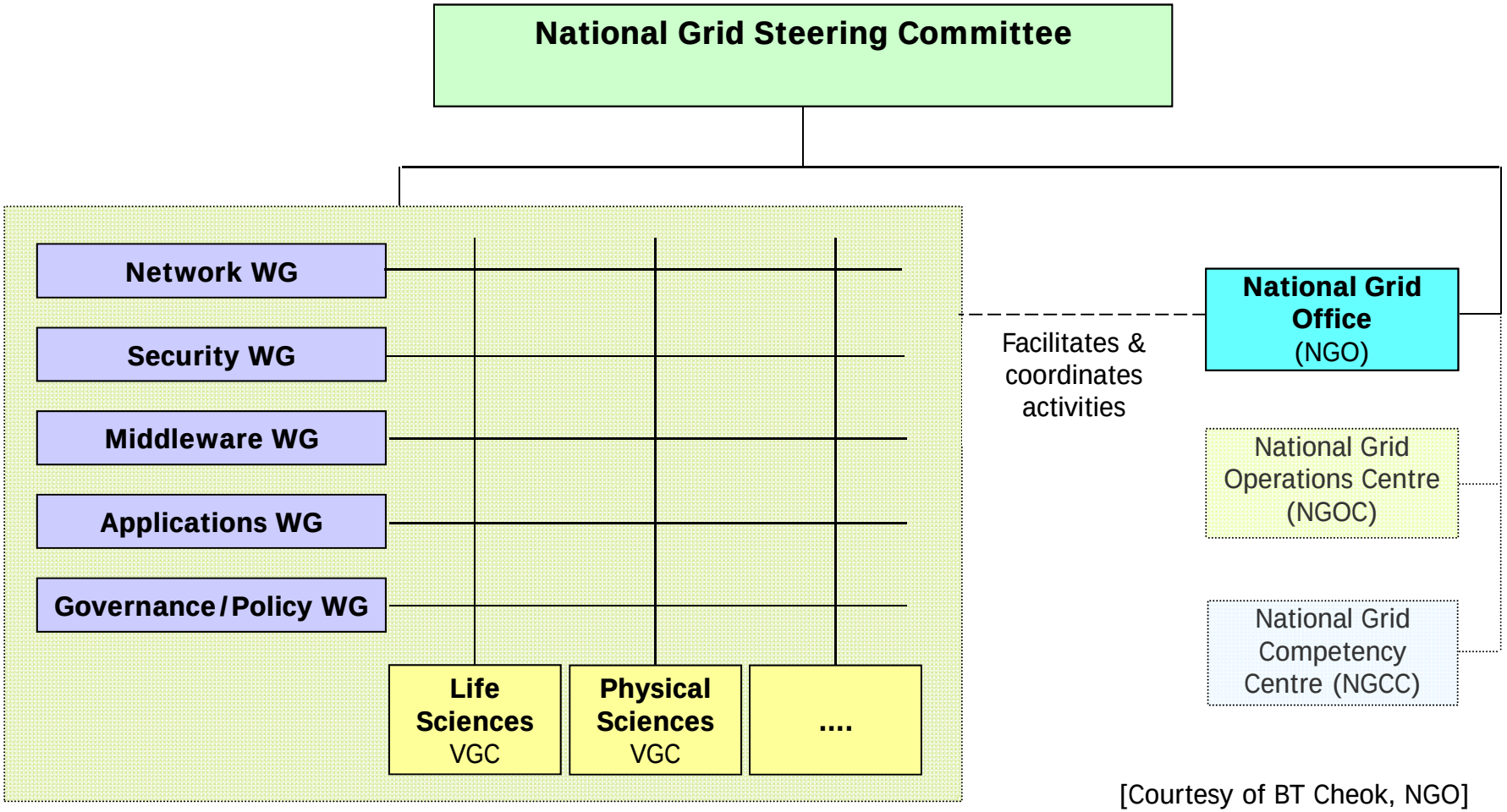
Approach – multi-agency co-funding & ownership

[Courtesy of BT Cheok, NGO]

NG Organisation Chart

Institute of High Performance Computing
A*STAR

MTI	MINDEF	MITA	MOH	MOE	IHLs
(A*STAR, EDB, JTC, RICs))	(DSTA, DSO, defence contractors)	(IDA, MDA)	(Hospitals)	(Schools)	NUS, NTU & Polys



[Courtesy of BT Cheok, NGO]

NG Pilot Platform

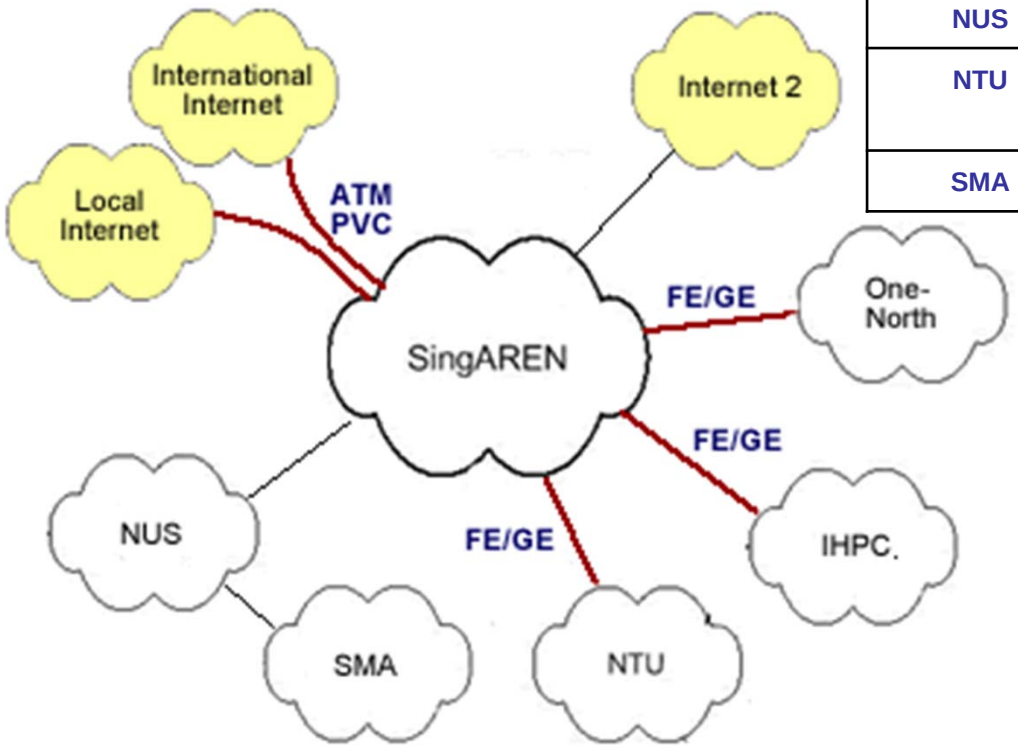
Institute of High Performance Computing
A*STAR

- **A pilot project to demonstrate feasibility of aggregating compute resources among IHLs & RICs.**
- **Reducing upfront investments by building upon existing facilities.**
- **Co-funding & ownership by 8 stakeholders.**
- **Tracking performance indicators at regular reviews by NGSC.**
- **Synergizing activities to ensure that there will be applications adequately running on NGPP.**

NG Pilot Platform

Institute of High Performance Computing
A*STAR

Entity	OS	Platform
IHPC	**AIX**	**IBM Regatta**
One-North (BII & GIS)	**Linux Solaris**	**Compaq Alpha Cluster Sun**
NUS	**Linux**	**Intel Xeon Cluster**
NTU	**Solaris Linux**	**Sun Fire Intel Pentium 4**
SMA	**Linux**	**Itanium 2**



- 1 Gbps high-speed network
- 750 Giga FLOPS

Official Launch of NG Pilot Platform

Institute of High Performance Computing
A*STAR

- System for geo-rectification of satellite images for environmental monitoring
- Distributed computer-assisted cel animation system
- Distributed dissipative particles dynamics simulation
- Distributed simulated flow over dimpled surfaces
- GridBLAST for similarity matching of genomic sequences

More info at http://www.ngp.org.sg

Grid Promotion Activities

National Grid NG SINGAPORE

Seminar Series

Grid Technology as Competitive Weapon, by Dr. Andrew Grimshaw (Avaki Corp.)

Gridbus Toolkit for Grid & Utility Computing, by Dr. Rajkumar Buyya (University of Melbourne)

The Microgrid : Enabling Scientific Study of Dynamic Grid Behavior, by Dr. Andrew Chien, UCSD, USA.

Challenges in High Performance Computing using Clusters & Grid, by Dr. Dave Scott (Intel Corp.)

PBS Pro as a Grid Enabler, by Michael M. Humphrey, VP, Enterprise Computing Business Unit, Altair Engineering, Inc. USA

Grid Computing at IBM, by Dr. Jean-Pierre Prost, the IBM Grid Design Center in EMEA ATS - Products & Solutions Support Center, Montpellier, France

UK e-Science Programme, by Dr. Anne Trefethen, Deputy Director, UK e-Science Core Programme

Grid - The Real Thing, by Dr. Dejan Milojicic, HP Labs, Palo Alto, USA

Grid Computing & e-Science - from Design to in-Service Support - An Industrial View of the Business Benefits, by Dr. Peter Cowley, Chief Scientist, Rolls-Royce plc, UK

Grid Promotion Activities

Institute of High Performance Computing
A*STAR

- **Physical Sciences Virtual Grid Community symposium 2003**

  Bring local grid researchers together

- **Grid Innovations & Applications Competition**

  Target to students at Institutes of Higher Learning

- **Thematic Strategic Research Program on GRID Computing**

  A*STAR mechanism to select a few emerging areas for funding grid research

Institute of High Performance Computing
A*STAR

Overview of Grid Activities

Nanyang Technological University

NUS National University of Singapore

Bioinformatics Institute
A*STAR

Genome Institute of Singapore
A*STAR

Nanyang Technological University

Institute of High Performance Computing
A*STAR

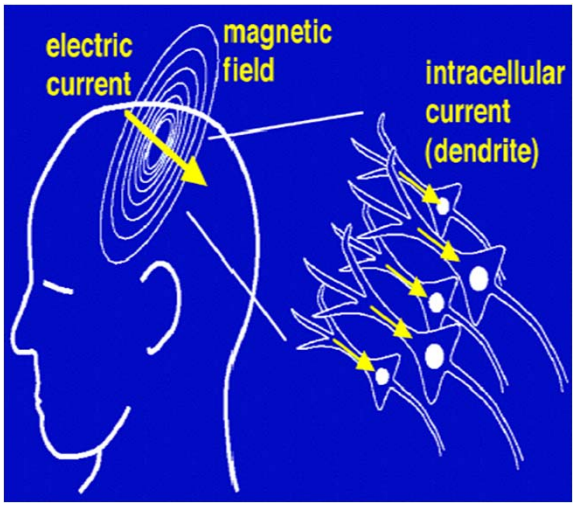
- **Research Focus**
  - Middleware development (with IHPC)
  - Application development
- **Projects**
  - MEG Data Visualisation (CyberMedia Center, Osaka Univ.)
  - Integration of SIBBS into Globus
  - Meta-scheduling, inter-operability, ...
- **Collaborators**
  - IHPC, BioMedGrid, ApGrid
- **HPC Resources**
  - PC Cluster with Cluster software
  - 0.5 teraflops HP (Compaq) Cluster
  - AP Science & Technology Centre (with Sun Microsystems)

[Courtesy of A/P Francis Lee, NTU]

Nanyang Technological University

Institute of High Performance Computing
A*STAR

MEG Data Analysis



- MEG : Non-intrusive method for capturing the electrical activity in the brain.
- Can help the practitioner to diagnose certain brain illness
- Data transfer, analysis & diagnosis are applied in the computing grid
- Collaboration: CyberMedia Center @ Osaka University (Japan)

[Courtesy of A/P Francis Lee, NTU]

National University of Singapore

Institute of High Performance Computing
A*STAR

- **Research Focus**
  - Middleware & Grid Programming
- **Projects**
  - ALICE (a Java-based Lightweight Grid)
- **Collaborators**
  - Centre for Remote Imaging, Sensing & Processing (CRISP), BII, Nanyang Polytechnic (School of Life Sciences)
- **Start-up: Atsuma Technology (www.atsuma.com)**
- **HPC Resources:**
  - HP Alpha servers (GS320 and ES40), SGI server (Origin2000), Linux cluster, & SGI/HP/Sun workstations

[Courtesy of A/P Teo Yong Meng, NUS]

Bioinformatics Institute

Institute of High Performance Computing
A*STAR

- **Research Focus**
  - Bioinformatics, grid software
- **Projects**
  - High Throughput Blast with National Cancer Centre
  - Analysis Pipeline of Zebrafish Genome with GIS
  - Annotation of Fugu Genome with IMCB & Sanger Center (UK)
  - Analysis of Arrhythmia
  - High Throughput Mass Spec Analysis with GIS
  - Bacterial Comparative Genomics with DMRI
  - Grid version of Clustlw
  - Cellware
- **HPC Resources**
  - Itanium cluster, Alpha, 64-CPU Pentium 3

[Courtesy of Larry Ang]

Genome Institute of Singapore

Institute of High Performance Computing
A*STAR

- **SNPs**
  - Building an integrated SNPs database which takes information from several SNPs databases & then aligns the information to a common genome sequence. The resulting information helps to identify SNPs which overlap & could be more significant for using as markers & building of primers.

- **Protein-Protein Interactions Database (PPDB)**
  - Building a system to help predict protein-protein interactions by integrating many tools & data from several sources. We use information from domain fusion, text-mining, experimental databases, & phylogenetic profiling to construct putative protein-protein interaction networks.

[Courtesy of Heidi Dowst, GIS]

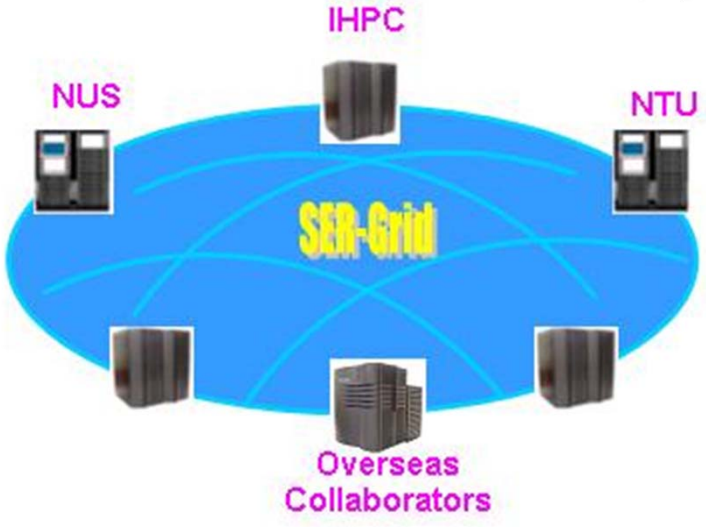
Grid Activities at IHPC

Grid Activities @ IHPC

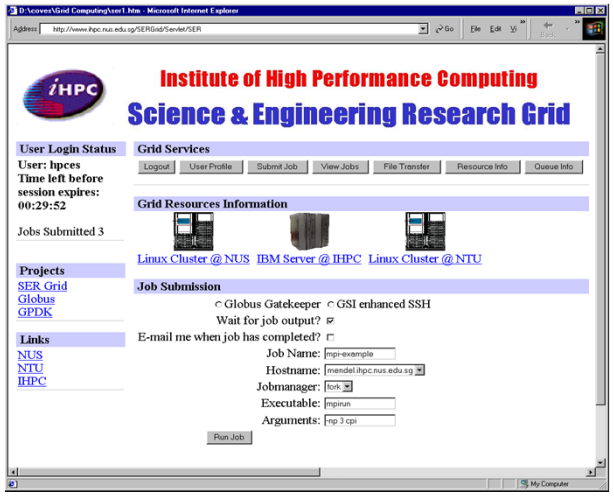
Institute of High Performance Computing

Research activities

- Grid infrastructure implementation
- Web-based problem solving environment for engineering modeling, simulation & visualization
- OGSA-based Grid services
- Remote Visualization
- Grid applications



Grid infrastructure partners

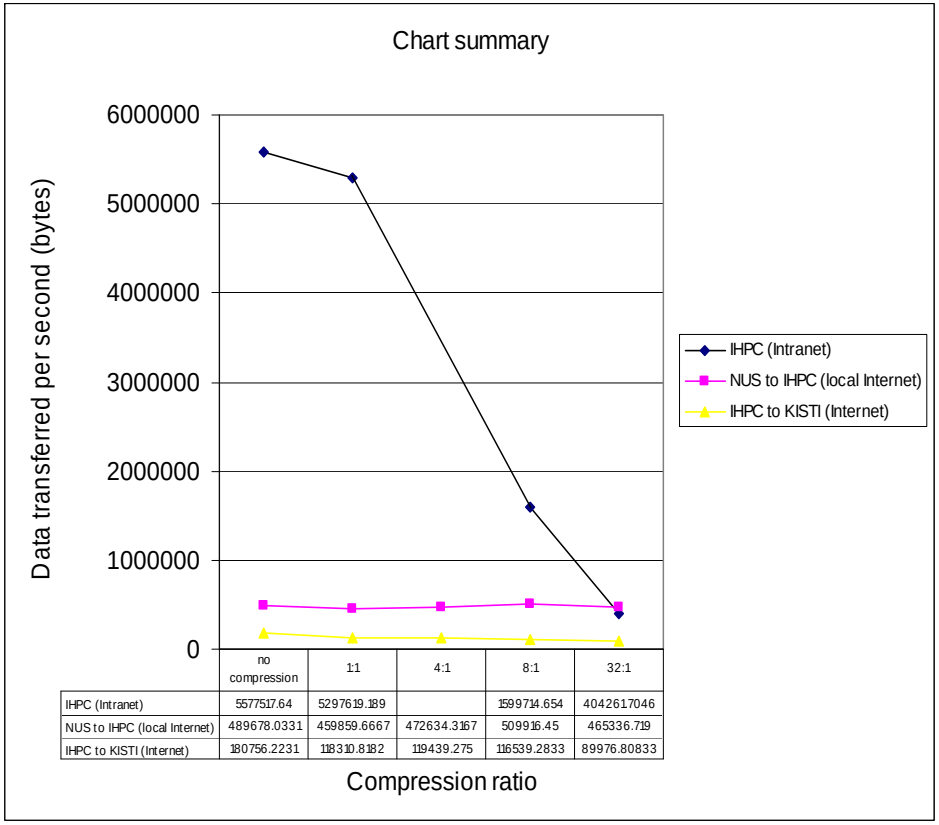


Web-based Grid Portal

Grid Infrastructure Implementation

Institute of High Performance Computing
A*STAR

- National Grid Pilot Platform (Singapore)
- KISTI (Korea)
  - Intergrid using Globus
  - Remote visualization using OpenGL Vizserver
- BAE, HP-UK, Swansea Univ., Cardiff Univ. (UK)



	no compression	1:1	4:1	8:1	32:1
IHPC (Intranet)	5577517.64	5297619.189		1599714.654	4042617.046
NUS to IHPC (local Internet)	489678.0331	459859.6667	472634.3167	509916.45	465336.719
IHPC to KISTI (Internet)	180756.2231	118310.8182	119439.275	116539.2833	89976.80833

OpenGL Vizserver Performance

Web-based PSE portal with workflow capability targeted at engineering simulation and multi-disciplinary optimization

Institute of High Performance Computing
A*STAR



✓ GOALS

✓ TASKS

✓ JOBS

PSE

Meta-scheduler

Globus

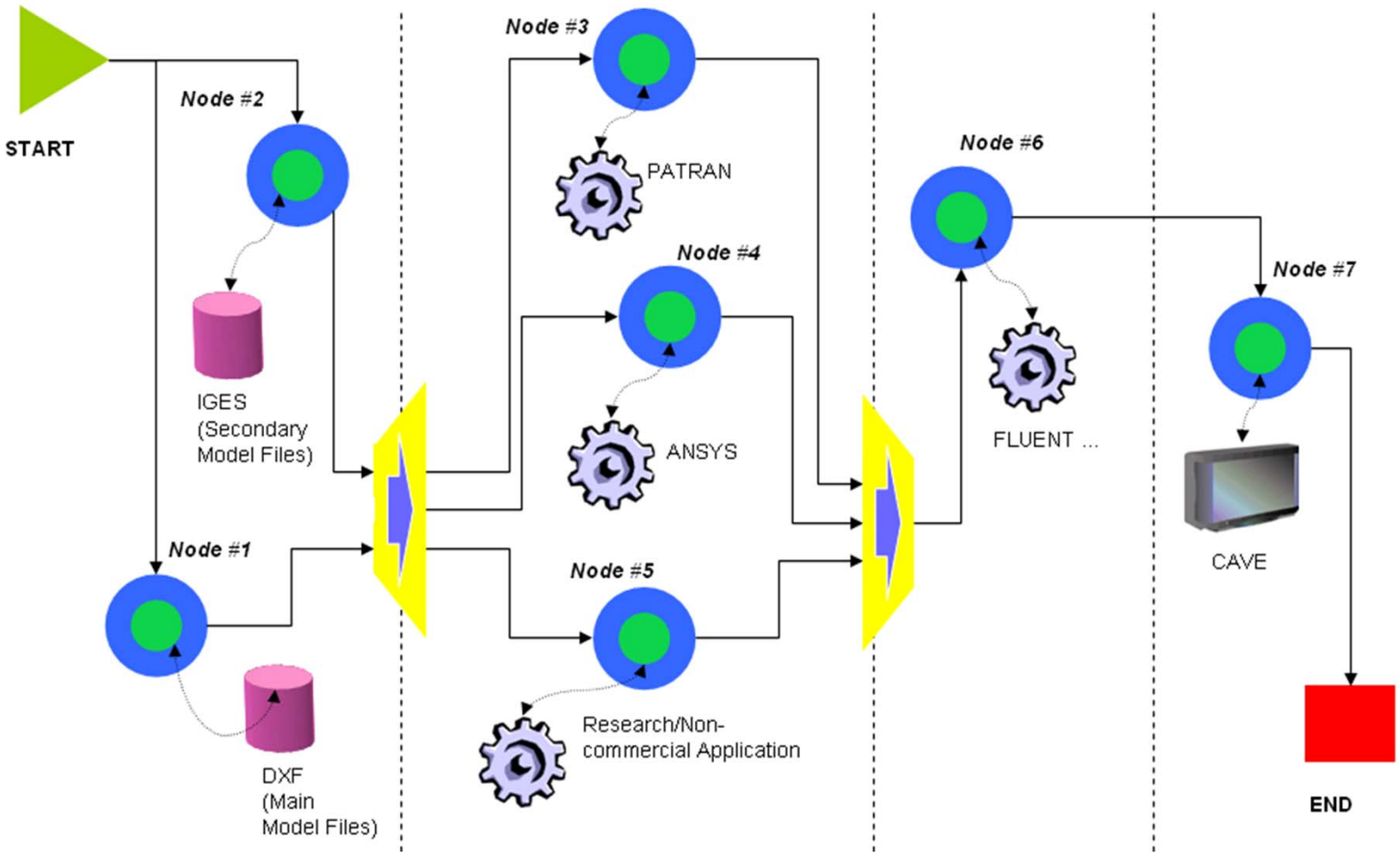
➢ CFD, FEM, …

➢ Modeling, Meshing, Analysis, …

➢ Fluent, ANSYS, …

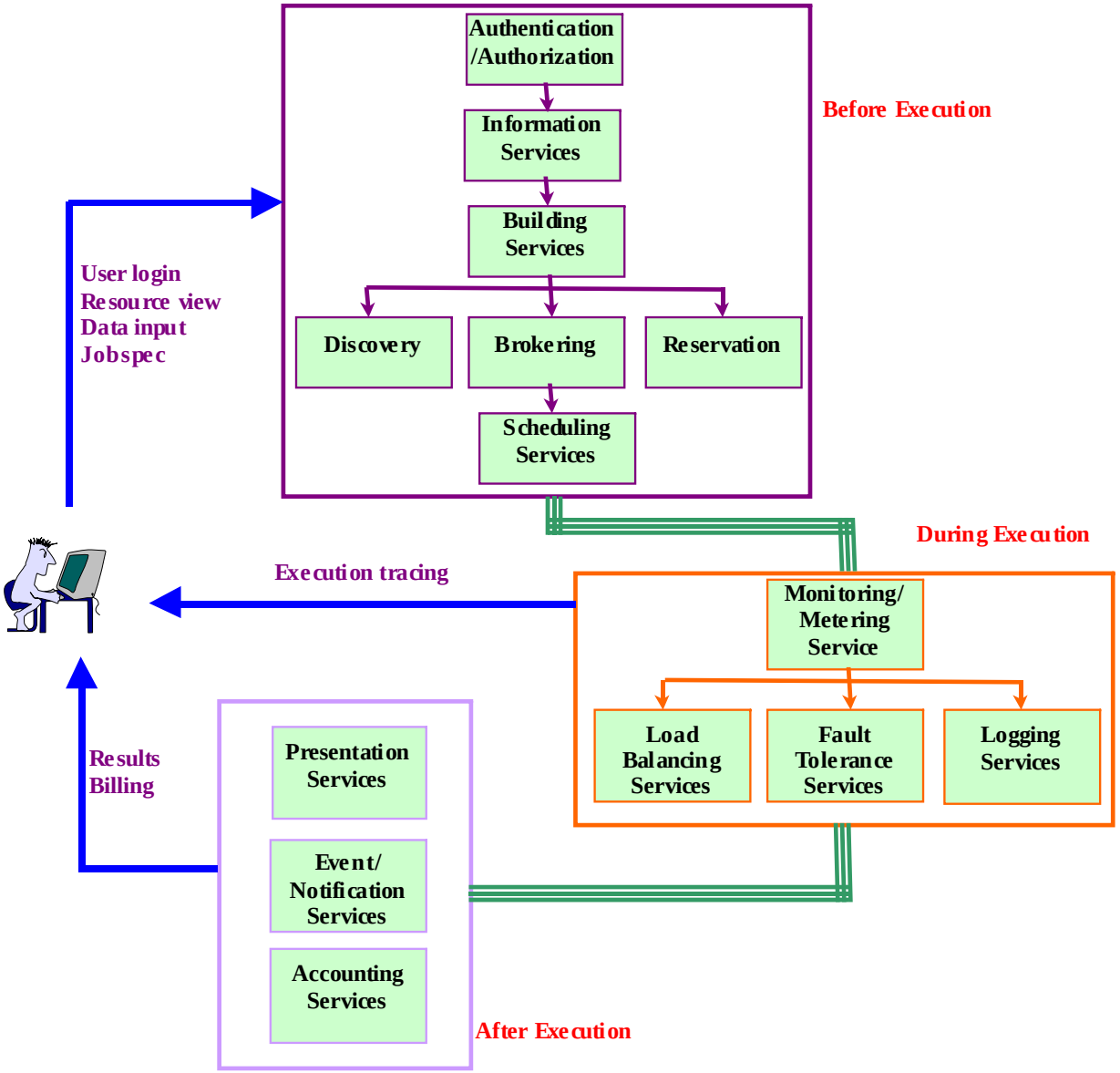
A possible high-level Grid Flow

Institute of High Performance Computing
A*STAR



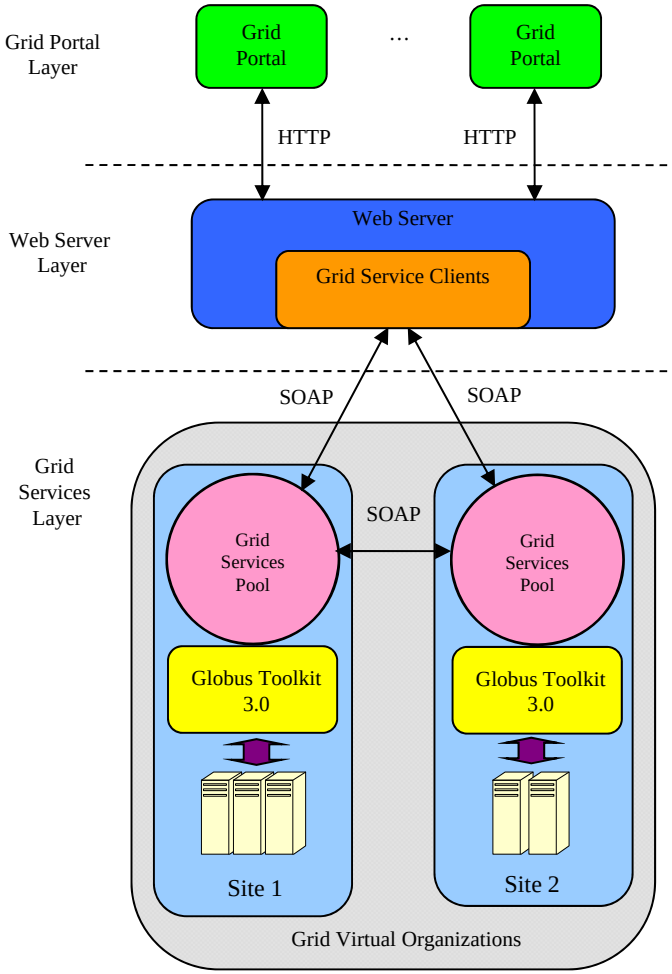
OGSA-based Grid Services

Institute of High Performance Computing
A*STAR



OGSA-based Grid Services Architecture

Institute of High Performance Computing
A*STAR

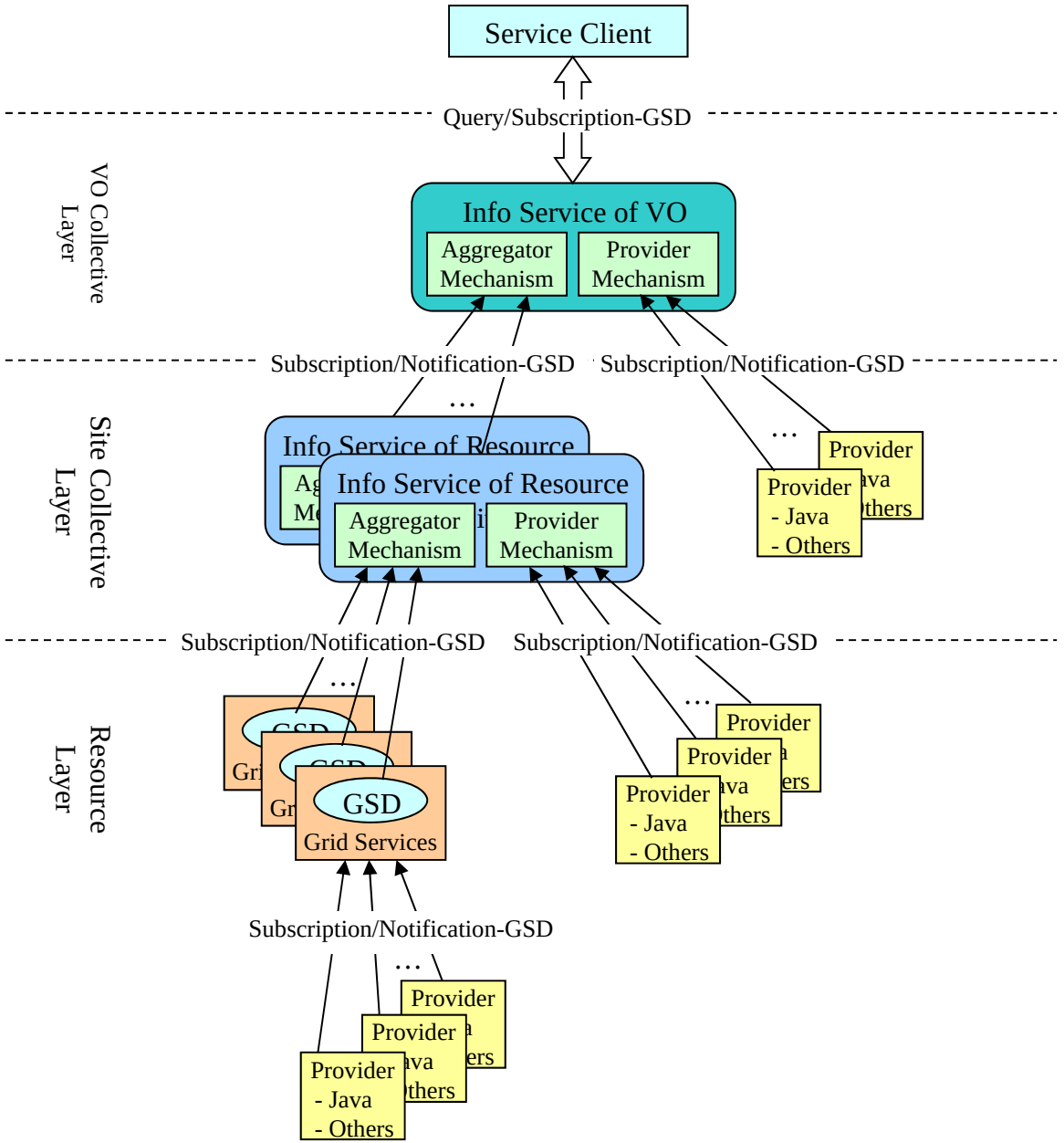


Focused Grid Services

Institute of High Performance Computing
A*STAR

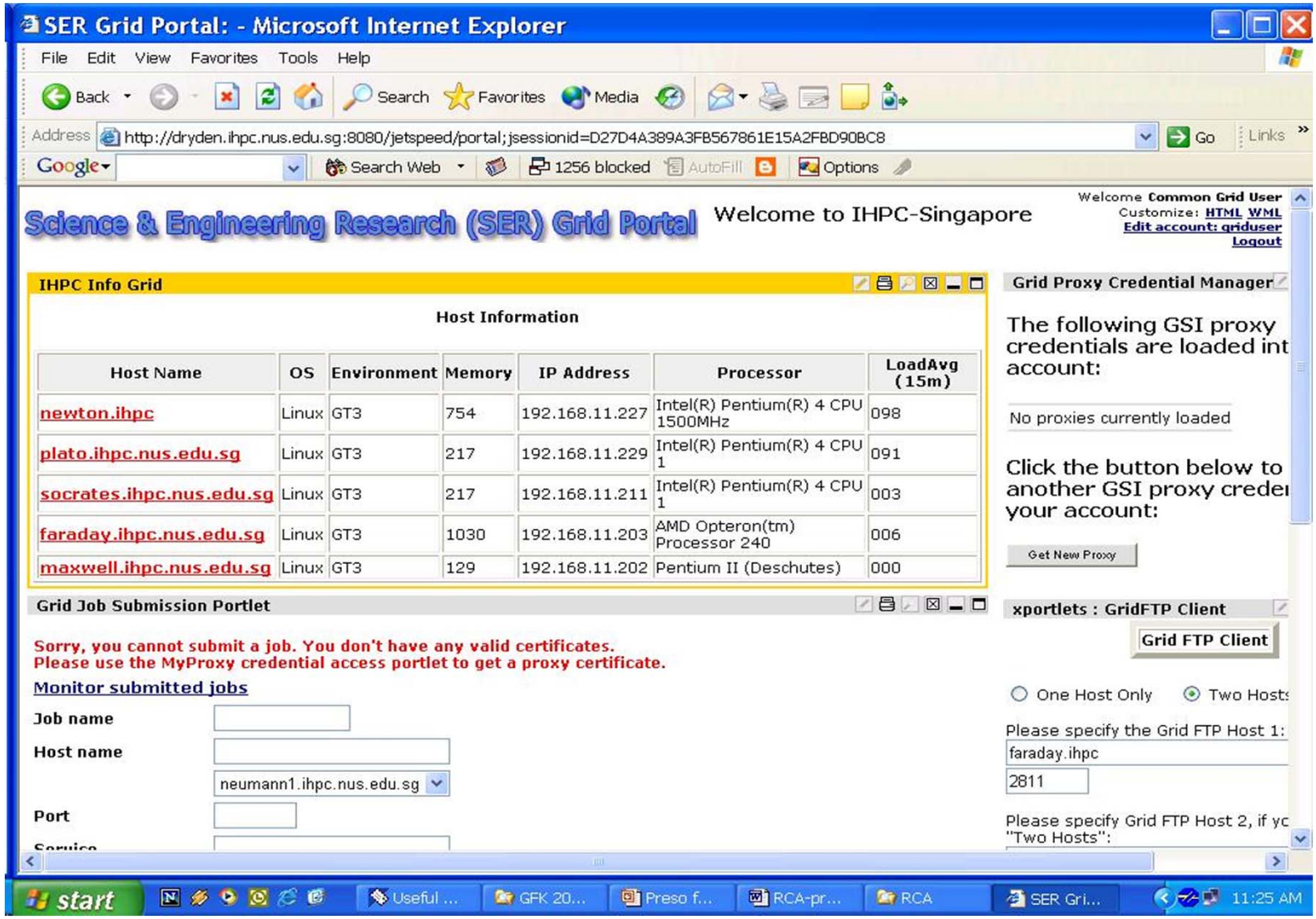
- Information Service
  - Resource info definition & description
  - Info collection, organization & update
  - Info access
  - Info presentation

Info Service Architecture



Info Service Prototype

Institute of High Performance Computing
A*STAR



Focused Grid Services

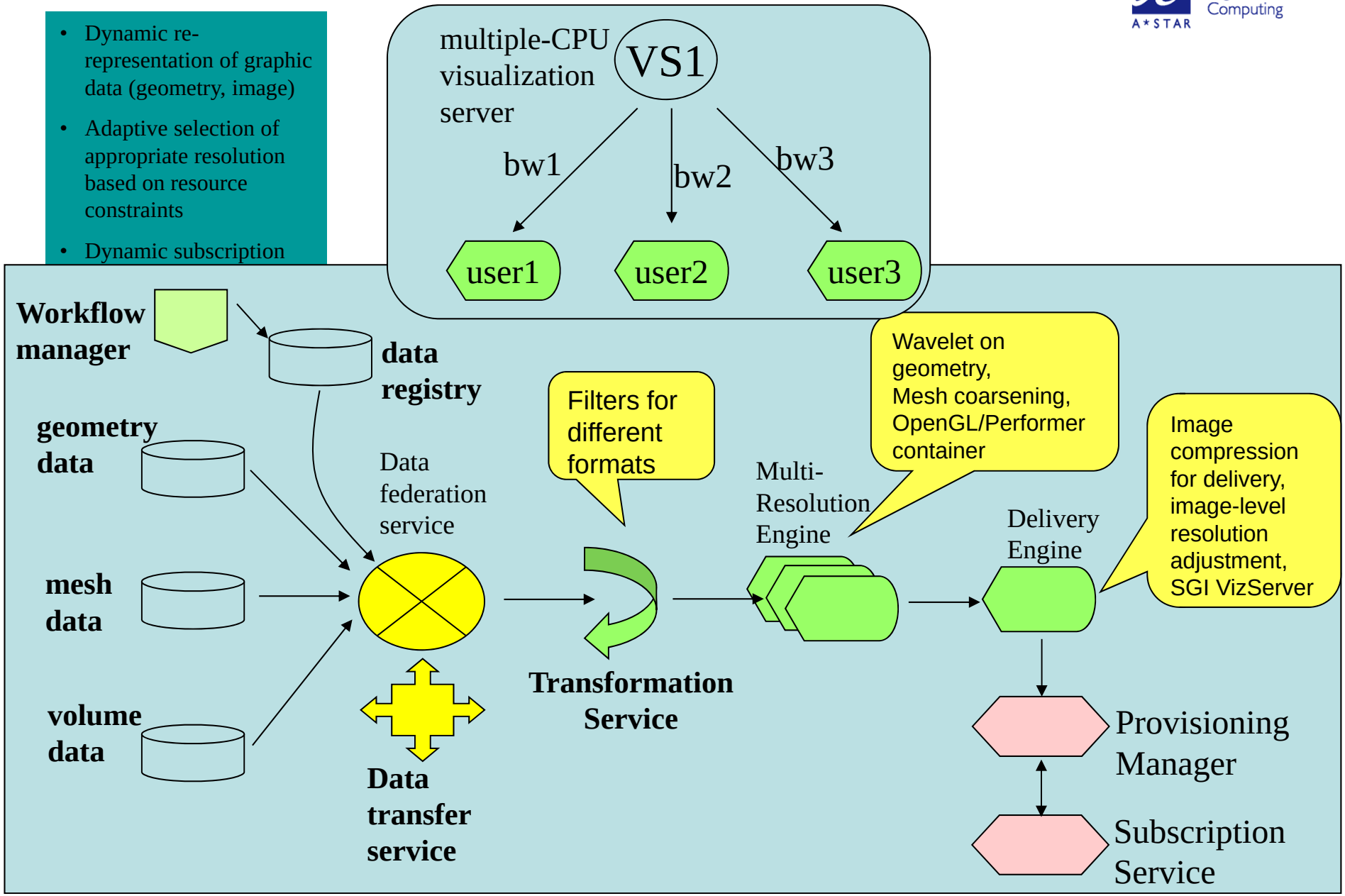
Institute of High Performance Computing
A*STAR

- Meta-scheduling & Resource Allocation Service
  - Resource info & monitoring
  - Resource Brokering and Discovery
  - Job Scheduling Strategies and Policies
  - Execution Monitoring

Grid Visualization Concept

Institute of High Performance Computing
A*STAR

- Dynamic re-representation of graphic data (geometry, image)
- Adaptive selection of appropriate resolution based on resource constraints
- Dynamic subscription



Grid Applications

Institute of High Performance Computing
A*STAR

GECEM (Grid Enabled Computational Electro Magnetics)

- **Aim**
  - Use & develop grid technology as an enabler of large-scale & globally distributed scientific & engineering research
- **Focus**
  - Collaborative numerical simulation & visualisation for Electromagnetic Application between UK & Singapore
- **Areas**
  - Grid Deployment & establishing a Virtual Organisation
  - Development of a Grid-enabled Problem Solving Environment
  - Grid Services for Mesh Generation & Manipulation
  - Secure Remote Execution
  - Grid based Collaborative Visualisation
  - Evaluation & Exploitation of Grid based Computing

Grid Applications

Institute of High Performance Computing
A*STAR

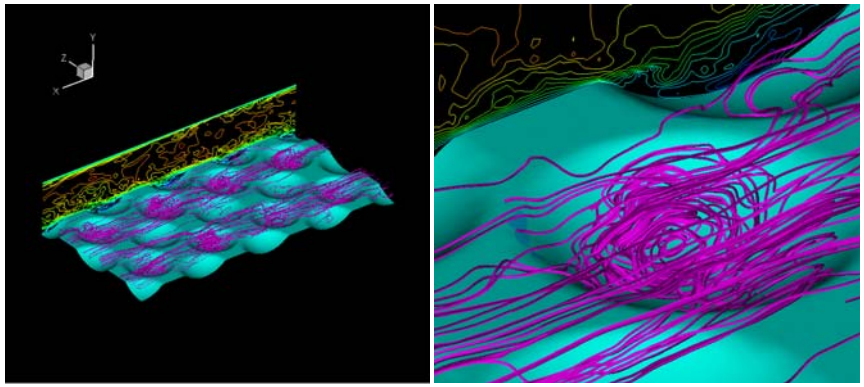
Collaborative Engineering Design & Simulation (with ST Kinetics)

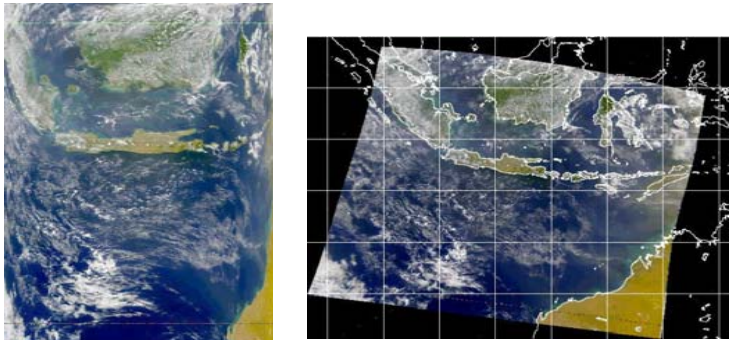
- **Aim**
  - develop a grid testbed for conducting collaborative design & simulation
- **Components**
  - Web-based PSE portal with workflow capability targeted at engineering simulation and multi-disciplinary optimization
  - Distributed data management & access
  - Visualization for engineering applications
  - 3rd-party software integration
- **Key Software Components**
  - Globus Toolkit 2.x, 3.x
  - Portal development using Jetspeed, Tomcat & IBM DB2
  - Avaki software for data grid to manage distributed data sets
  - Platform LSF for job scheduling & management
  - Engineering software from MSC (e.g. Patran, Nastran etc.)

Other Grid-enabled Applications

Institute of High Performance Computing
A*STAR

- MEMS – Dissipative Particle Dynamics (NUS, IHPC & SMA)
- Fluid Dynamics – complex flow over dimpled surfaces (NUS, IHPC & SMA)
- Support Vector Machine algorithm for distributed data mining





Our Collaborators

Rolls Royce

- Parallel gas turbine engine simulation, scientific visualisation

BAE, HP-UK, Swansea, Cardiff

- Grid-enabled computational electromagnetics

IBM

- Grid computing for engineering applications

SGI

- Remote visualisation

National University of Singapore

- Support vector machine, industrial mathematics

Nanyang Technological University

- Neural network algorithms, grid computing

KISTI, Korea

- Cross-border grid computing and visualisation

Institute of High Performance Computing
A*STAR

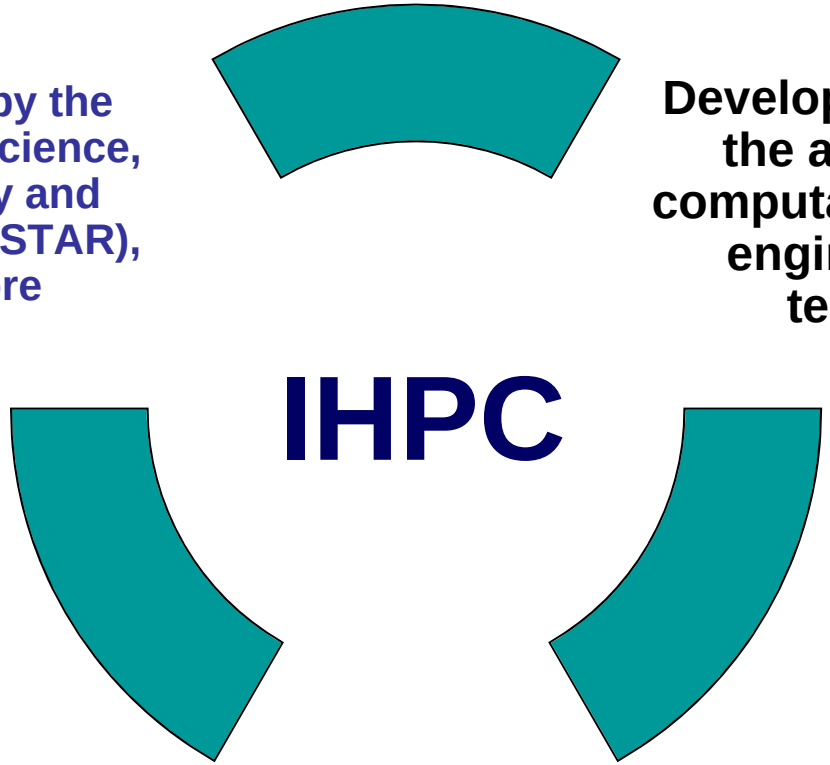
Introduction to IHPC

Institute of High Performance Computing (IHPC), Singapore

Institute of High Performance Computing
A*STAR

Supported by the Agency for Science, Technology and Research (A*STAR), Singapore

Develops and promotes the applications of computational science & engineering (CSE) technologies

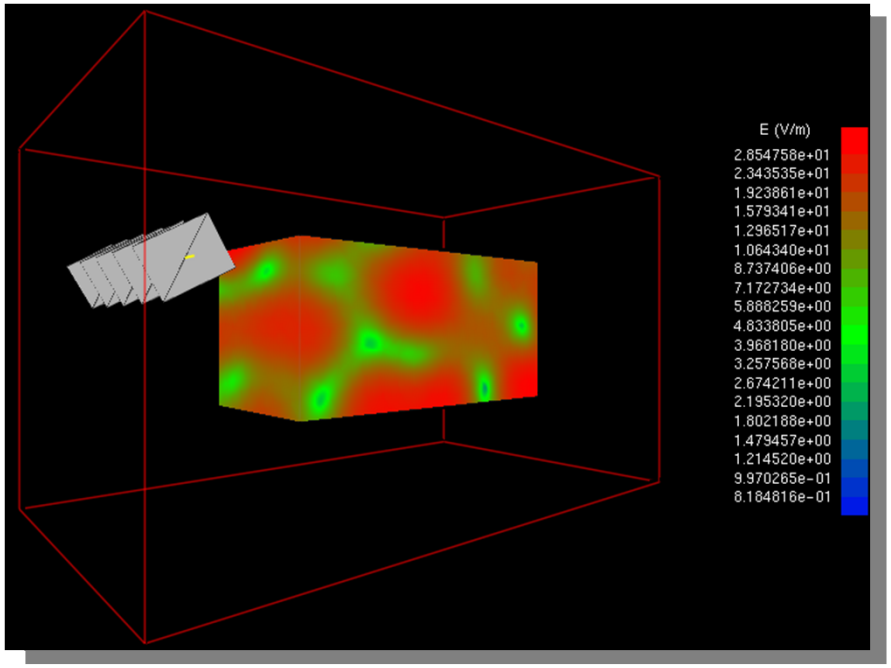


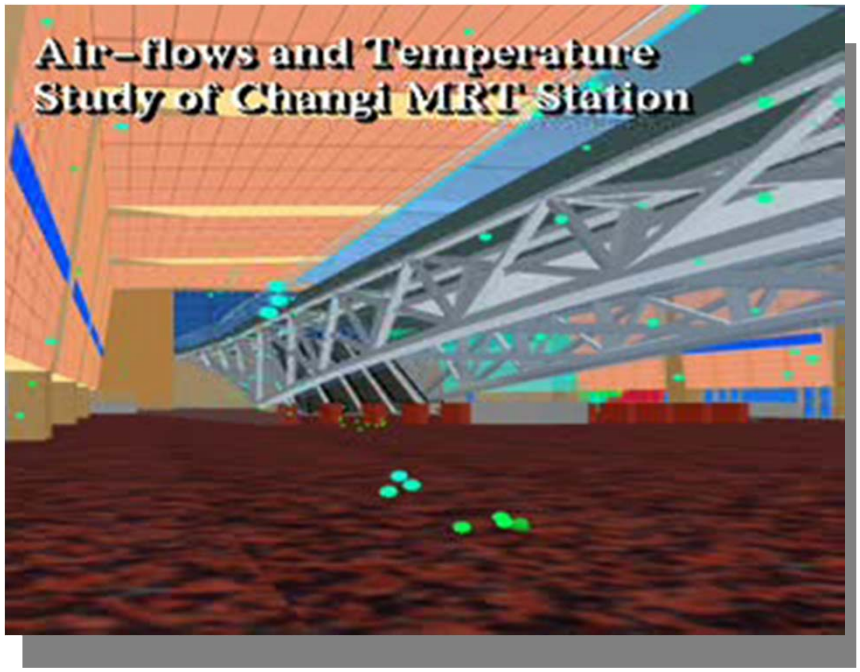
Adopts modelling, simulation and visualisation techniques for innovative research and engineering applications

CSE Applications

Institute of High Performance Computing
A*STAR

- **Reverberation Chamber:** electromagnetic compatibility testing



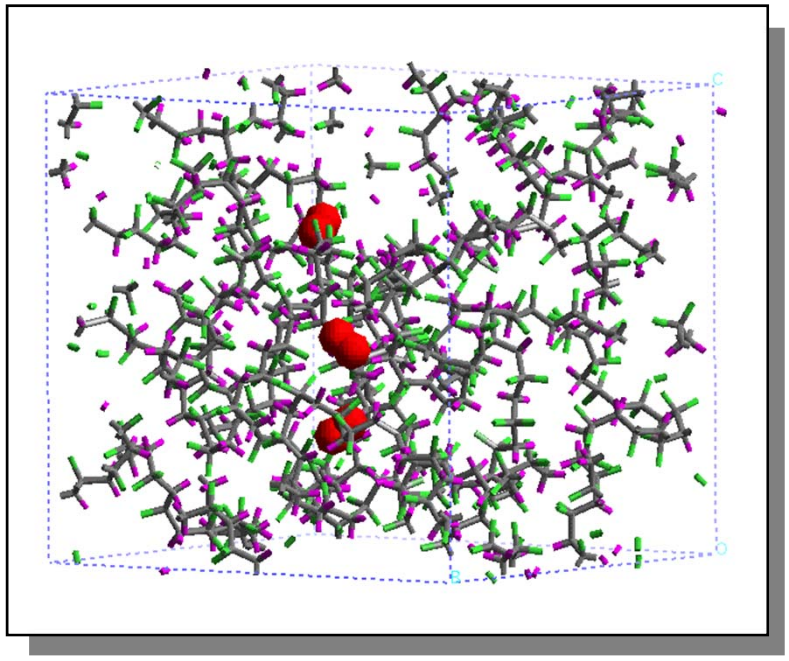


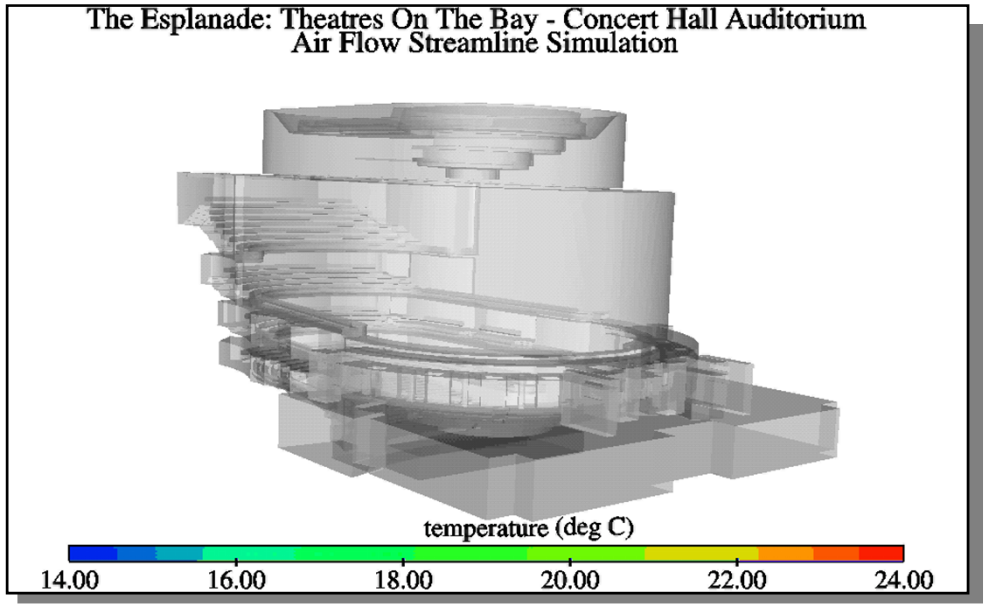
- **Changi MRT station:** ventilation system performance analysis

CSE Applications

Institute of High Performance Computing
A*STAR

- **Contact Lens:**
  study of oxygen dissipation





- **The Esplanade:**
  optimisation of air-conditioning design

IC-SEC 2004

2nd International Conference on Scientific and Engineering Computation

Institute of High Performance Computing
A*STAR

Call for papers is now on !
Check out IC-SEC website: http://www.ic-sec.org

- **Organised by IHPC and National University of Singapore**
- **30 June to 2 July 2004, Singapore**
- **A forum for interdisciplinary blending of computational efforts in diversified areas of sciences, materials and all branches of engineering**
- **Four topical symposia:**
  - **Grid Computing and Applications**
  - **Computational Nano-Science and Nano-Technology**
  - **Computational Fluid Dynamics**
  - **Scientific Computing and Optimisation**

Institute of
High Performance
Computing

Thank You