# Serbian Participation in Grid Computing Projects

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# Overview

- eScience - A Scientific Renaissance
- Technology push
- The Grid vision
- Grid projects relevant for Serbia
  - EGEE programme
  - SEE-GRID programme
  - AEGIS programme
- Serbian Grid resources – AEGIS eInfrastructure
- Serbian Grid Applications – AEGIS Applications
- Conclusions

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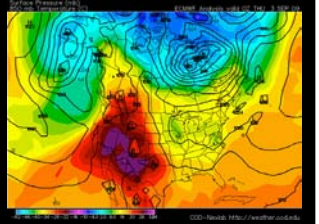

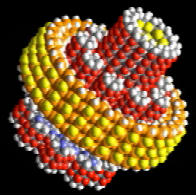

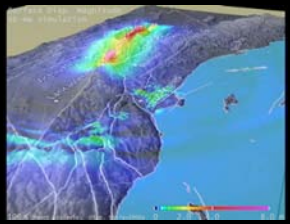

# eScience

- Science is becoming increasingly digital, needs to deal with increasing amounts of data and computational needs
- Simulations get ever more detailed
  - Nanotechnology – design of new materials from the molecular scale
  - Modeling and predicting complex systems (weather forecasting, river floods, earthquake)
  - Decoding the human genome
- Experimental Science uses ever more sophisticated sensors to make precise measurements
  - Need high statistics
  - Huge amounts of data
  - Serves user communities around the world
- Different groups collaborate

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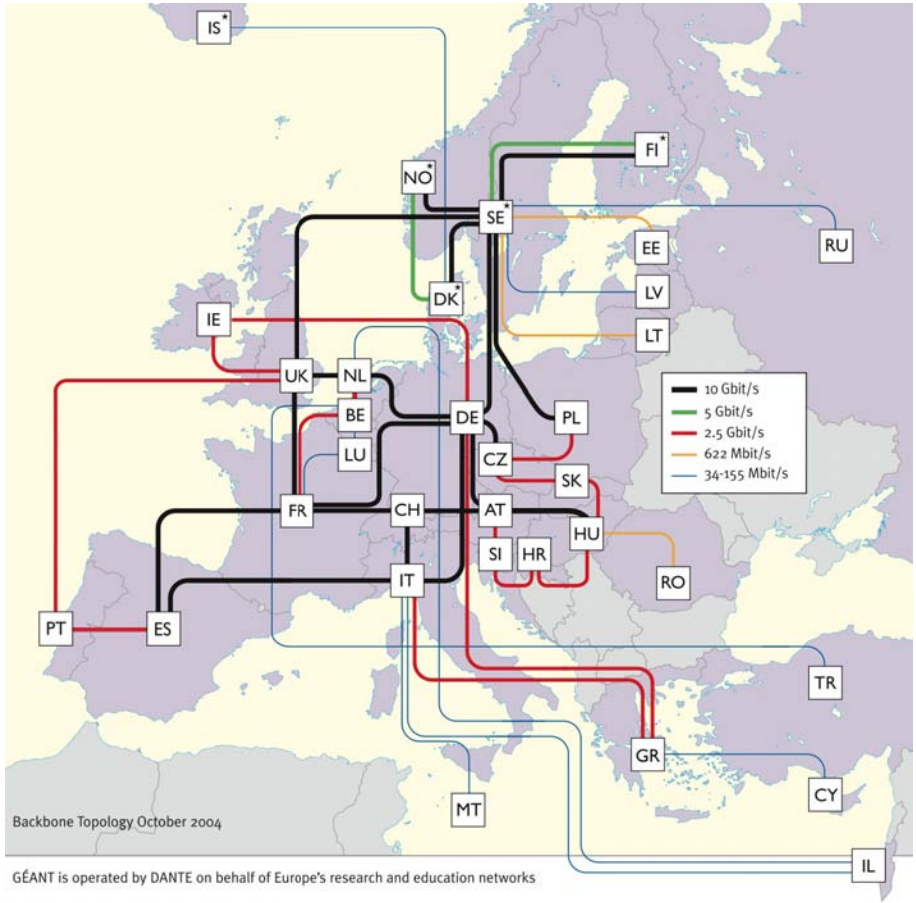
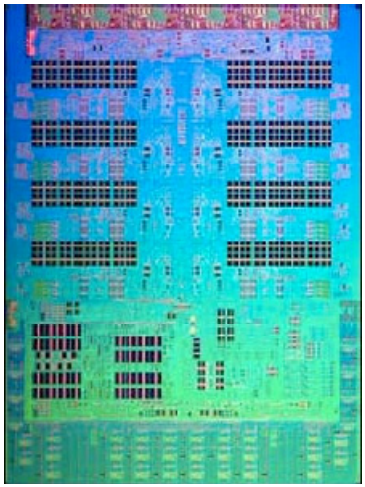
# Technology push (1/2)

- High performance networks



# Technology push (2/2)

- Higher performance at reduced cost
  - Multi Core architectures
- Petaflops machines
  - USA: RoadRunner, Jaguar (1PF 2008);
  - Europe: JUGENE (1 PF 2009)
    PRACE (3-5 1PF machines 2010)
  - Japan: Keisoku (10PF 2011/12)



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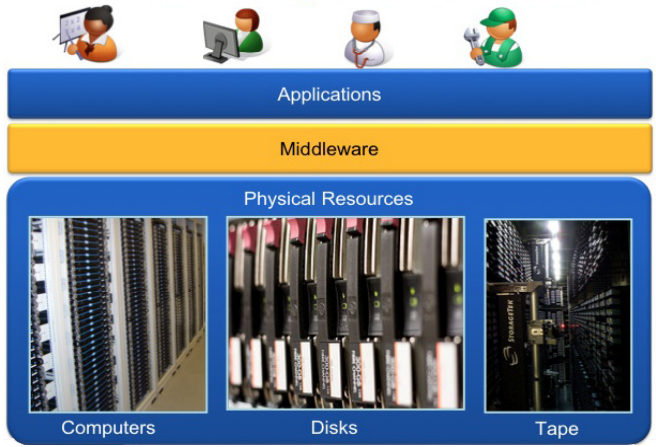
# The Grid vision

- Researchers perform their activities regardless geographical location, interact with colleagues, share and access data
- The Grid: networked data processing centres and middleware software as the "glue" of resources
- Scientific instruments and experiments provide huge amount of data

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# What is the Grid?

- The World Wide Web provides seamless access to information that is stored in many millions of different geographical locations
- In contrast, the Grid is a new computing infrastructure which provides seamless access to computing power and data distributed over the globe
- The name Grid is chosen by analogy with the electric power grid: plug-in to computing power without worrying where it comes from, like a toaster

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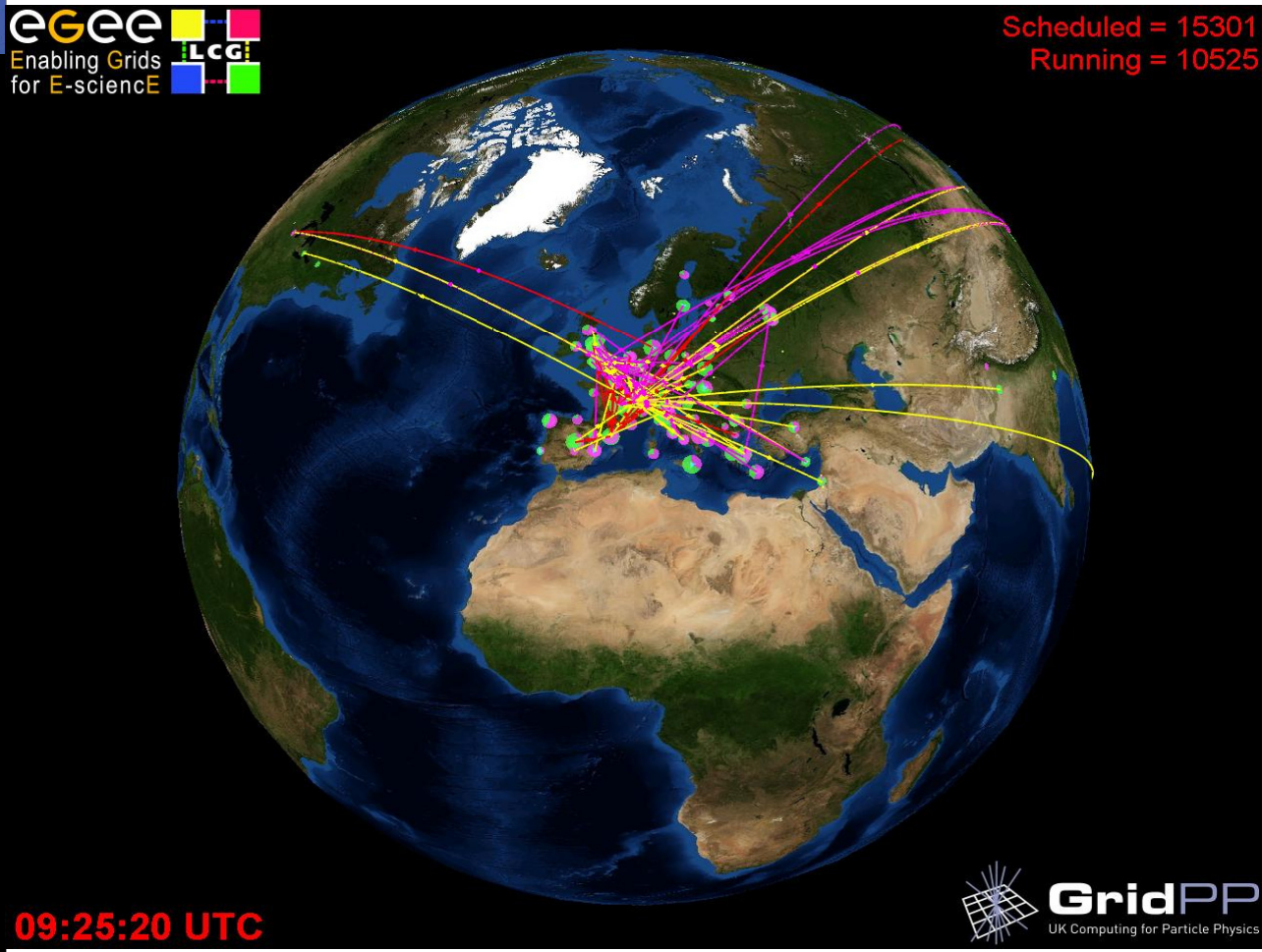
# Grid projects relevant for Serbia – EGEE [1/3]

- Europe's leading grid computing project, providing a computing support infrastructure for over 10 000 researchers world-wide, from fields as diverse as high energy physics, earth and life sciences
- EGEE objectives
  - Brings together experts from more than 50 countries with the common aim of building on recent advances in Grid technology and developing a service Grid infrastructure
  - The main focus to prepare the migration of the existing production European Grid from a project-based model to a sustainable federated infrastructure based on National Grid Initiatives

# Grid projects relevant for Serbia – EGEE [2/3]

- EGEE results
  - About 290 sites across 55 countries
  - More than 144 000 CPU available
  - More than 60 petabytes of storage
  - Regular workloads of 330K jobs/day
  - Massive data transfers ~1.5 GB/s
  - Real time monitoring
  - User Support: single access point for support, knowledgeable experts, responsive support
  - More than 15 application domains

# Grid projects relevant for Serbia – EGEE [3/3]

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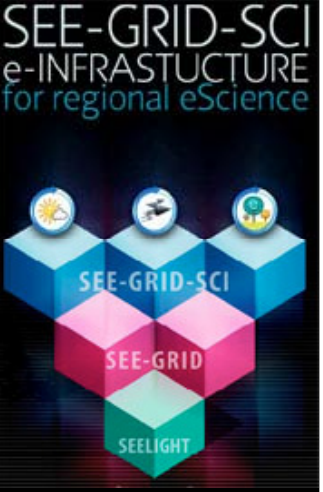


# Grid projects relevant for Serbia – SEE-GRID [1/2]

- SEE-GRID
  - The SEE-GRID through its two phases has established a strong regional human network in the area of scientific computing, has set up a powerful regional Grid infrastructure, and attracted a number of applications from diverse fields from countries throughout the South-East Europe
  - Current phase of SEE-GRID programme, SEE-GRID-SCI involves three strategic international scientific communities:
    - Seismology
    - Meteorology
    - Environmental protection)

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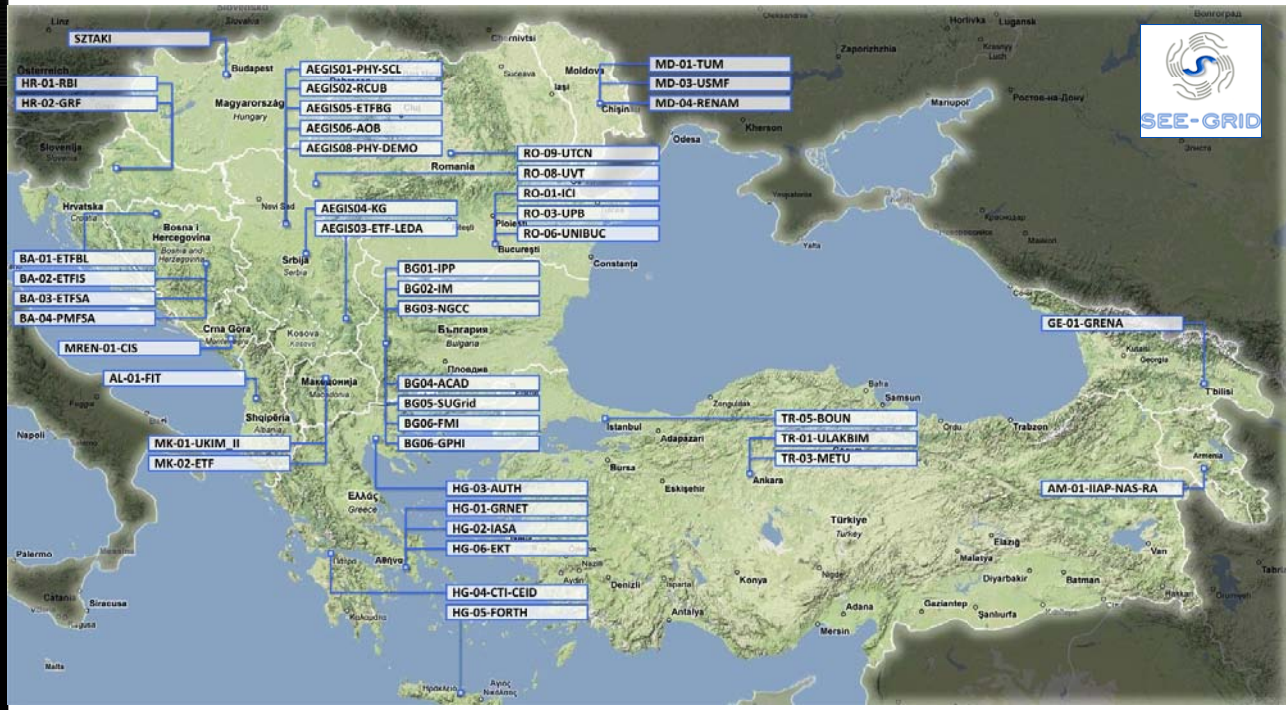
SEE-GRID-SCI
e-INFRASTUCTURE
for regional eScience

# Grid projects relevant for Serbia – SEE-GRID [2/2]

- SEE-GRID infrastructure
  - About 35 sites across 15 countries
  - More than 2 000 CPU available
  - More than 400 terabytes of storage

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# Grid projects relevant for Serbia – AEGIS [1/2]

- Academic and Educational Grid Initiative of Serbia was established in 2005 to coordinate efforts on developing academic and educational high performance computing facilities in Serbia
- One of the major AEGIS tasks
  - dissemination and training activities organization
  - help to Serbian research communities in developing and production use of applications

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# Grid projects relevant for Serbia – AEGIS [2/2]

- AEGIS eInfrastructure
  - 9 sites
  - More than 1 000 CPUs
  - More than 30 terabytes
  - National software and middleware repositories
  - National Grid core services
  - National VO
  - National monitoring
  - National user portal
  - National helpdesk


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AEGIS

# Serbian Grid Applications [1/5]

- The user activities drive the evolution of Grid technology through specific, challenging applications, and demonstrate that these infrastructures provide viable computing services for many scientific communities
- AEGIS applications require, in particular, that the Grid middleware performance and core Grid services scale with the growth of the infrastructure, and have additional requirements for high-level services

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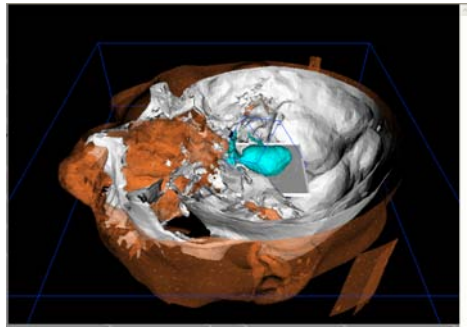
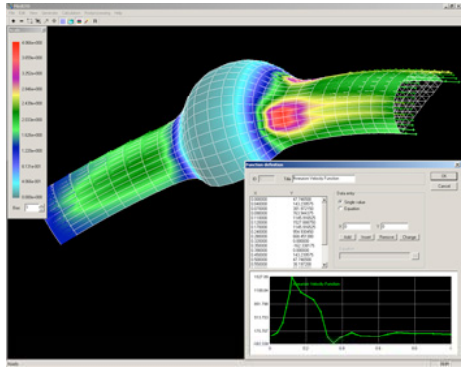
# Serbian Grid Applications [2/5]

- Volumetric Image Visualization Environment - VIVE
  - interactive analysis tool for 3D medical images, facilitating diagnosis, surgical planning, therapy evaluation, and remote 3D examination



- Parallel Blood Flow Simulation - PBFS
  - improves diagnosis and treatment of health problems such as aneurysms and wounds to artery vessel walls



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# Serbian Grid Applications [3/5]

- Path Integral Monte Carlo code - SPEEDUP
  - efficient and reliable tool for calculating basic properties of matter, such as free energy, energy spectra, probability amplitudes, low and high temperature properties etc
- Simulation of planetary system formation - SOLAR
  - effective model of planetary accretion
- Compaction of granular materials – COMPACTION
  - Event driven method is modification of molecular dynamics approach since the simulation increments from collision event to collision event rather than incrementing at a specified time

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# Serbian Grid Applications [4/5]

- Parallel Analog and Logic Electronic Simulation System - PALESS
  - Simulation of modern electronic circuits and systems which are very complex, and can be applied in complex surroundings including sensors, actuators and other devices not directly connected to electronics
- Asteroid Proper Elements Calculation - PROPEL
  - Powerful tool to study the problems of the stability of motion, resonant and chaotic phenomena

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# Serbian Grid Applications [5/5]

- Visual interactive general purpose discreet event simulator – SLEEP
  - Simulates digital circuits made in VLSI technique for educational purposes and verification of business process integration

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# Conclusions [1/2]

- Serbia has long-standing strong participation in European Grid projects and has established a reliable and extensive national Grid eInfrastructure
- Serbian Grid eInfrastructure provides more than 1000 CPUs and 30 TB of data storage to all user communities through a distributed set of Grid sites hosted by major research institutes and universities
- Serbian Grid eInfrastructure is fully utilized by a number of scientific high-performance applications, developed Serbian researchers and adapted for optimal use on the Grid

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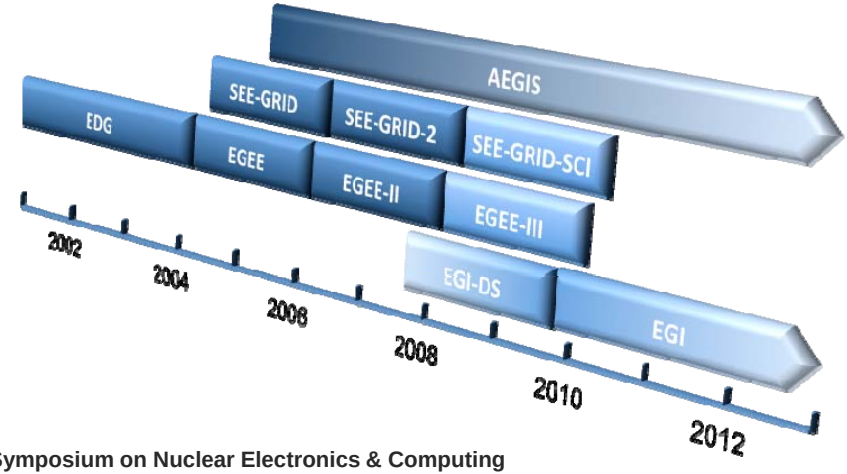
# Conclusions [2/2]

- Serbian Grid eInfrastructure also stimulated further collaboration of Serbian and European researchers, and helped in bringing the issue of providing support for research infrastructure to the agenda of Serbian policy makers
- Serbian NGI actively participates and works with other NGIs on establishing a sustainable European Grid Initiative

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