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International Telecommunication Union

What is a Grid?

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Computing as a Commodity

- From hand-built research computers…
- From individual computers…
- From specialist supercomputers…
- From proprietary formats…
- From individual servers…
- From applications…
- From ownership…
- From silos…

- to PC's, PDAs and mobile phones
- to the Internet and the WWW
- to clusters and cycle-scavenging
- to standards and ontologies
- to virtualised, dynamically provisioned server farms
- to services
- to computing-on-demand
- to Grids

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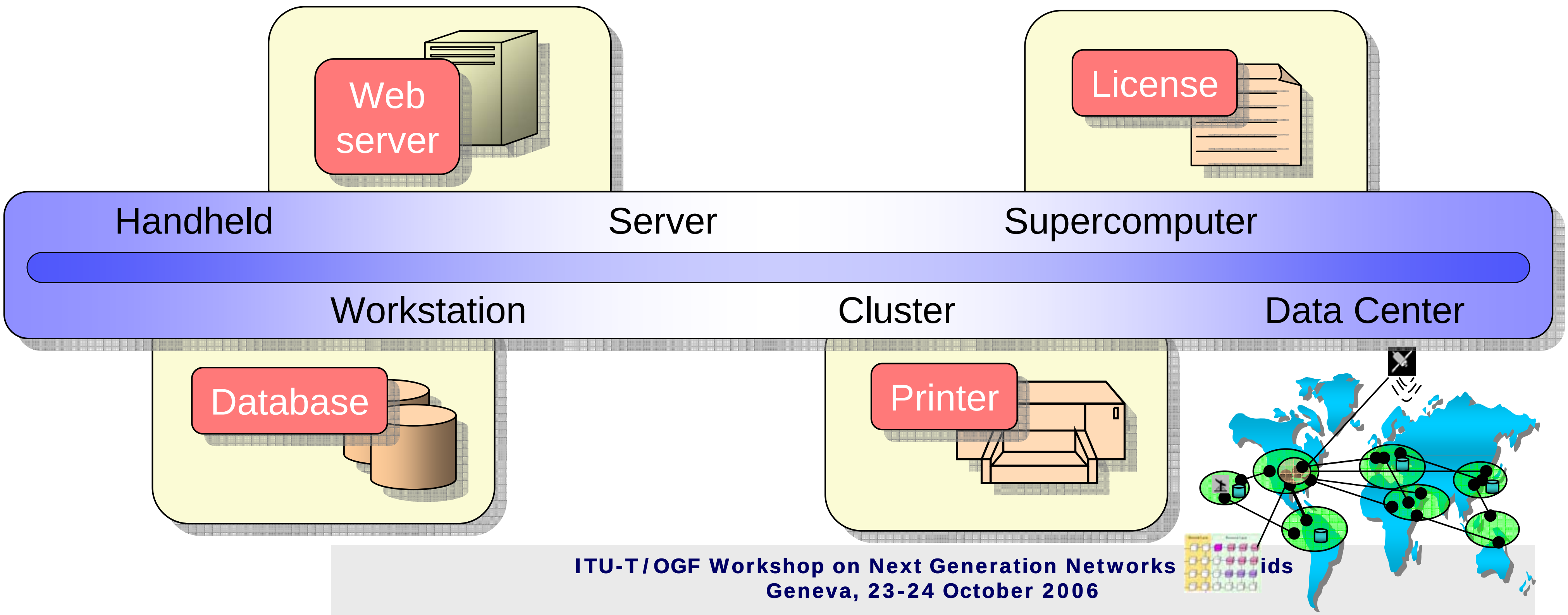
What is a Grid?

- A grid is a system consisting of
  - Distributed but connected resources and
  - Software and/or hardware that provides and manages logically seamless access to those resources to meet desired objectives



Grids vs. Distributed Computing

- Existing distributed applications:
  - Tend to be *specialised systems*
  - Intended for a single purpose or user group
- Grids go further and take into account:
  - Different kinds of *resources*
  - Different kinds of *interactions*
  - *Dynamic* nature

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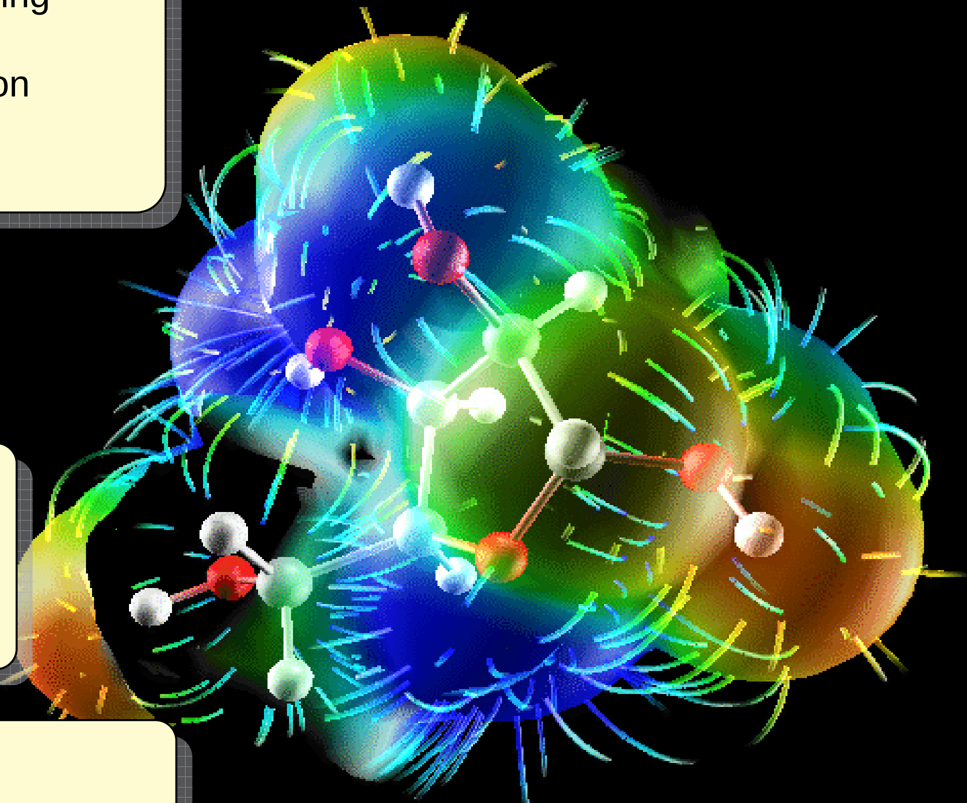
Ideas and Forms

- Key ideas
  - Virtualised resources
  - Secure access
  - Dynamic provisioning
- Many forms
  - Cycle stealing
  - Linked supercomputers
  - Distributed data management
  - Commercial data centres
  - Utility computing
  - Collaboration Grids

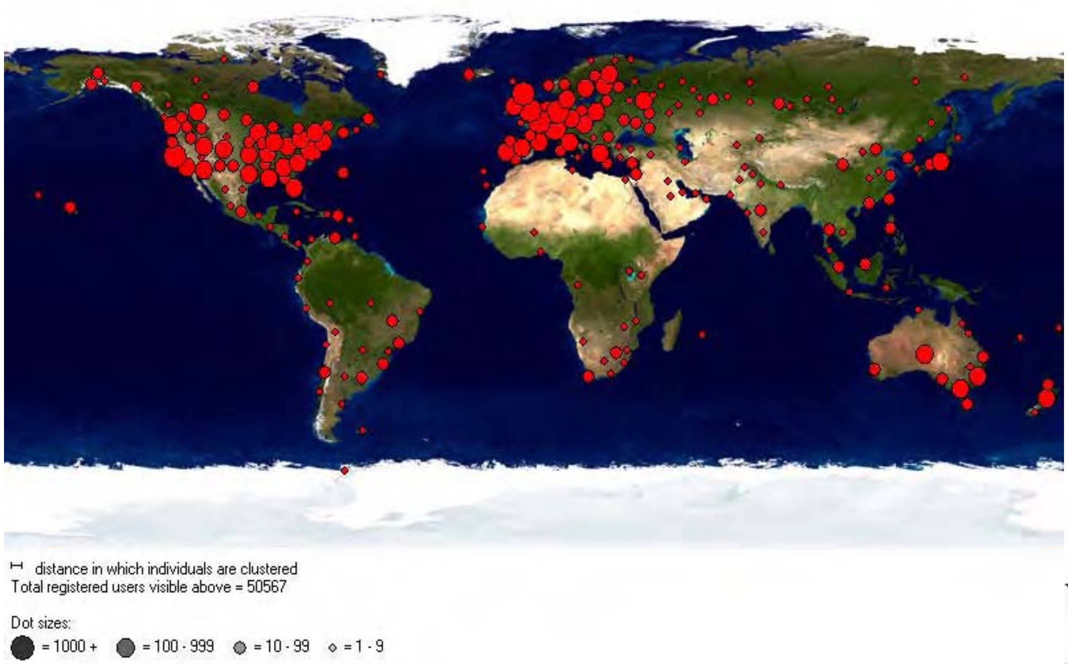
Grids In Use: E-Science Examples

- Data sharing and integration
  - Life sciences, sharing standard data-sets, combining collaborative data-sets
  - Medical informatics, integrating hospital information systems for better care and better science
  - Sciences, high-energy physics
- Simulation-based science and engineering
  - Earthquake simulation
- Capability computing
  - Life sciences, molecular modeling, tomography
  - Engineering, materials science
  - Sciences, astronomy, physics
- High-throughput, capacity computing for
  - Life sciences: BLAST, CHARMM, drug screening
  - Engineering: aircraft design, materials, biomedical
  - Sciences: high-energy physics, economic modeling

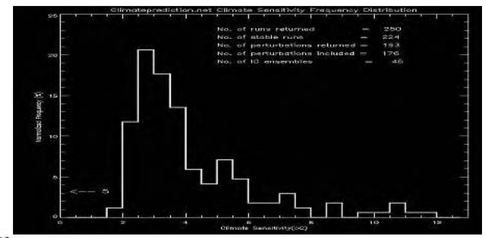


Slide from Hiro Kishimoto's GGF17 Keynote

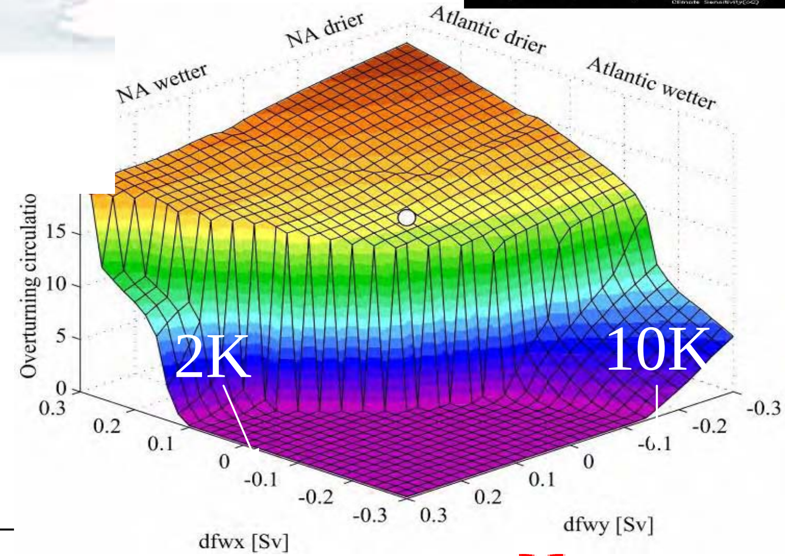
climate*prediction*.net and GENIE



- Largest climate model ensemble
- >45,000 users, >1,000,000 model years



Response of Atlantic circulation to freshwater forcing



NATURAL ENVIRONMENT RESEARCH COUNCIL

Large Hadron Collider

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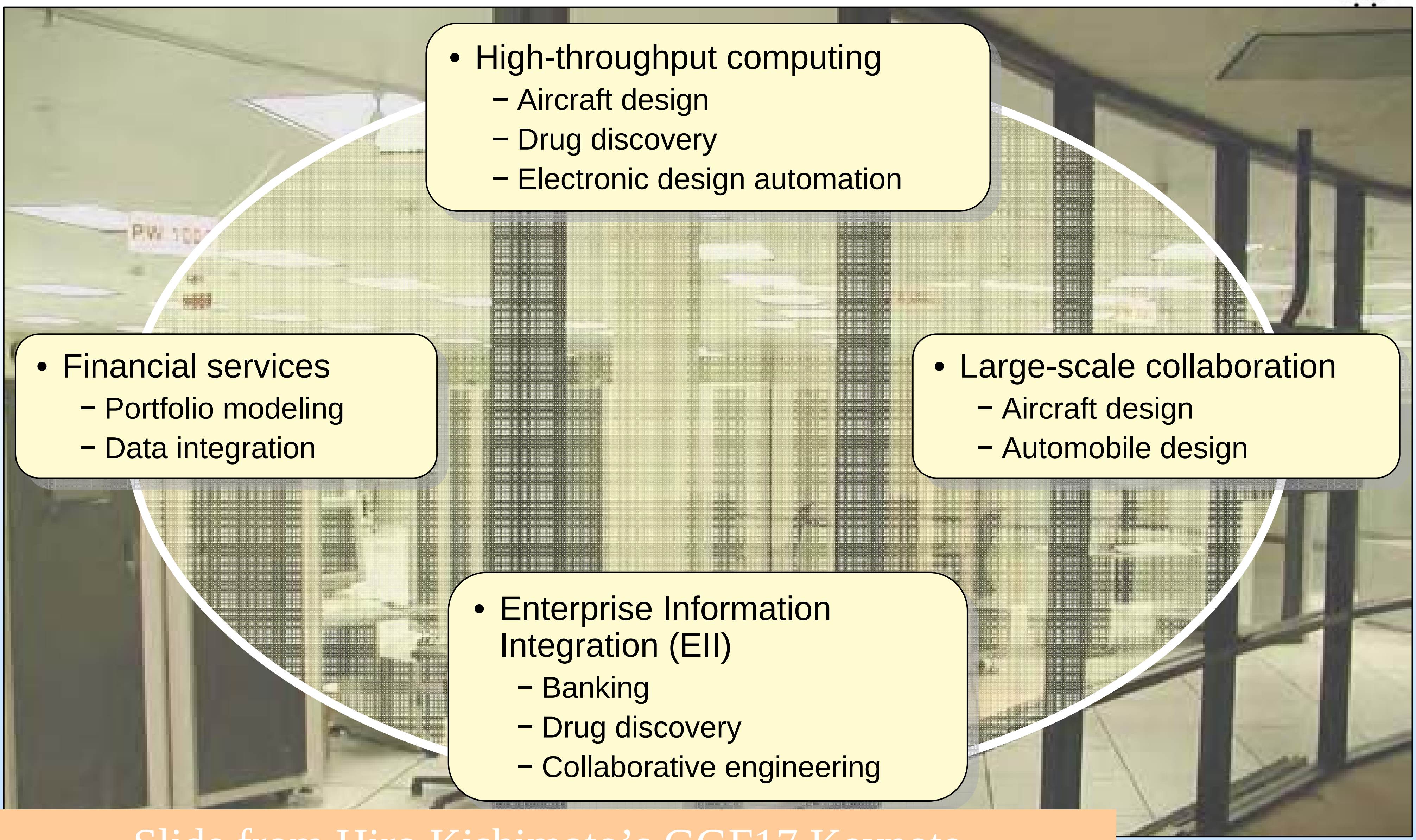
- The most powerful instrument ever built to investigate elementary particle physics
- 10 Petabytes/year of data
- Simulation, reconstruction, analysis:
  - Requires computing power equivalent to ~100,000 of today's fastest PC processors

Grids In Use: E-Business Examples



- High-throughput computing
  - Aircraft design
  - Drug discovery
  - Electronic design automation
- Financial services
  - Portfolio modeling
  - Data integration
- Large-scale collaboration
  - Aircraft design
  - Automobile design
- Enterprise Information Integration (EII)
  - Banking
  - Drug discovery
  - Collaborative engineering

Slide from Hiro Kishimoto's GGF17 Keynote

Leading Grid Application Domains

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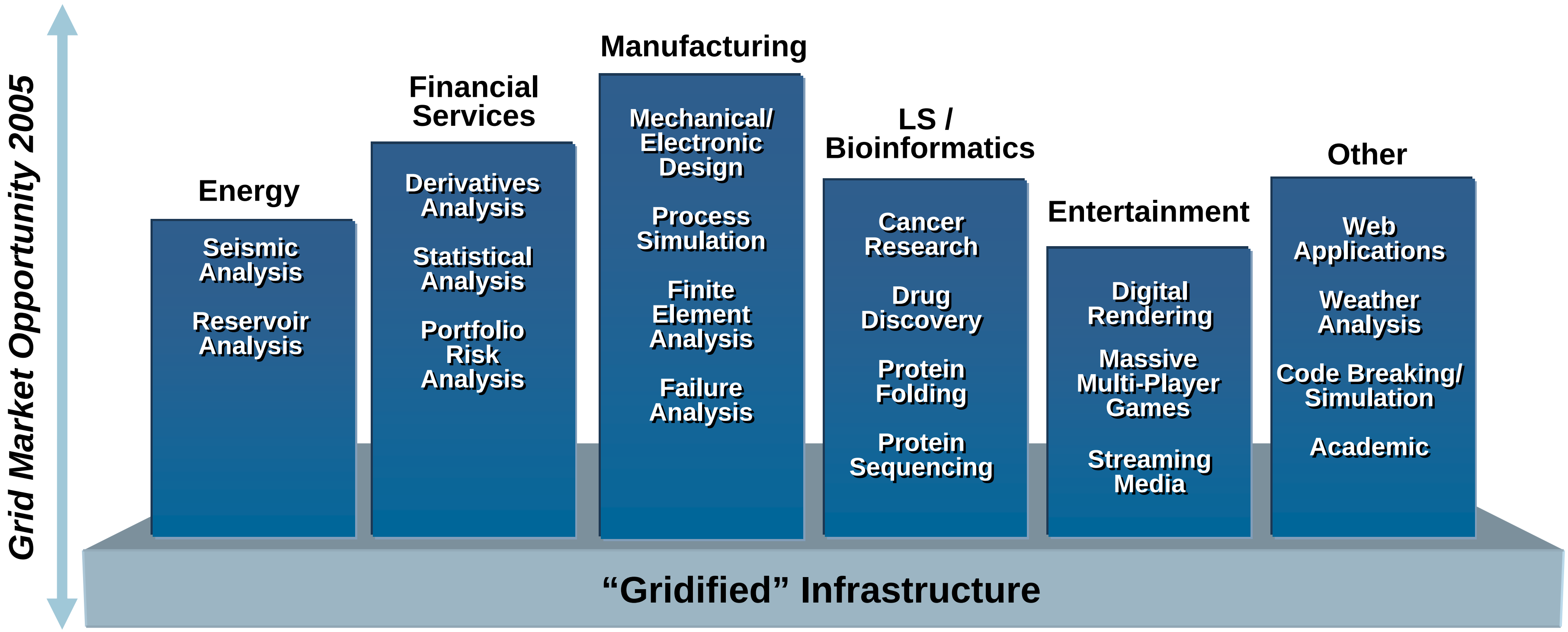

Sources: IDC

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Grids straddle disciplines

- A company working on the placement of a new factory needs financial forecasting combined with mining of proprietary historical data
- An industrial consortium work on the feasibility study for a new airliner
- A crisis management team reacts to a chemical spill using soil and weather models, demographic information, and productivity tools for emergency teams

Sources: Anatomy of the Grid, Foster et al.

Key Middleware Requirements

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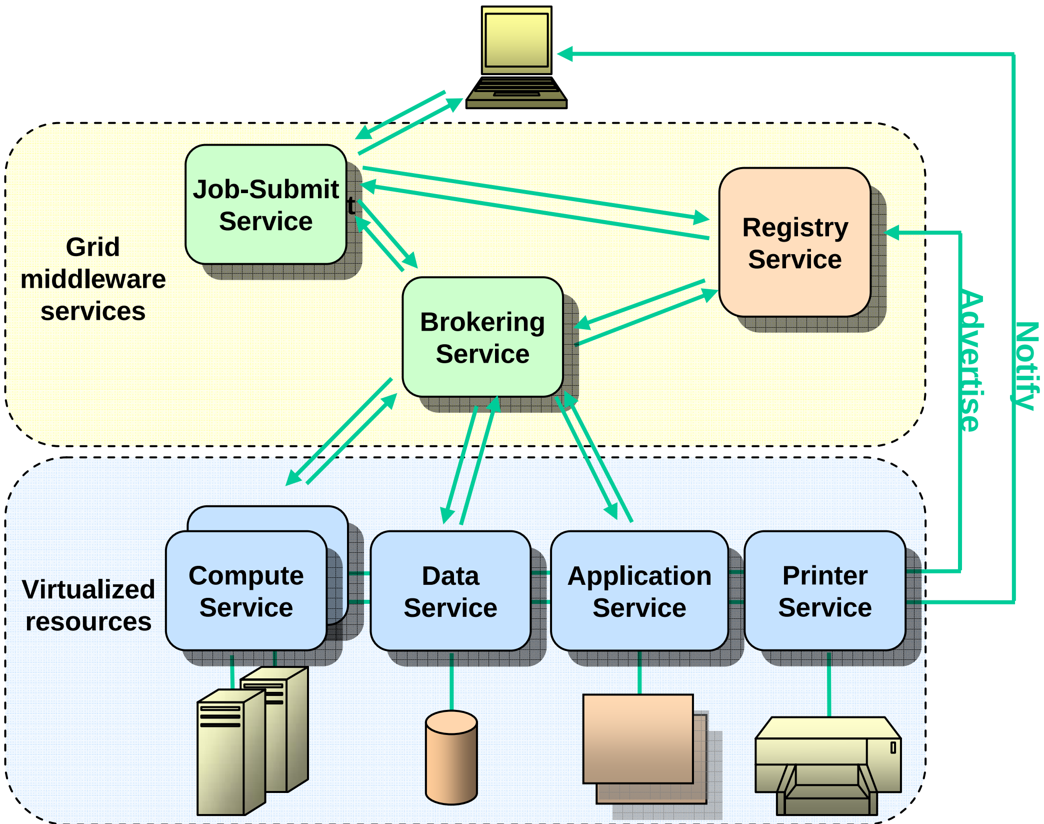
- **Secure** authorization, role and access privileges

- **Execute** and manage jobs/services

- **Data** access, transfer and management



- **Resource** discovery, monitoring & control

- **Information** about applications & resources

Collaboration Grids

- Key concept:
  - The ability to negotiate resource-sharing arrangements among a set of participating parties and then to use the resulting resource pool for some purpose. (Ian Foster)
- Virtual organisations:
  - Combining people and resources from different organisations to address a given problem
  - Enabled by Grid technology

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Defining a Collaboration Grid

Three aspects:

1. Coordinating on-demand, secure access to distributed and heterogeneous resources (cpu, storage, bandwidth …)
2. Using standard, open, general-purpose protocols and interfaces
3. To deliver non-trivial qualities of service

SOA & Web Services

SOA

- Flexible
  - Locate services on any server
  - Relocate as necessary
  - Prospective clients find services using registries
- Scalable
  - Add & remove services as demand varies
- Replaceable
  - Update implementations without disruption to users
- Fault-tolerant
  - On failure, clients query registry for alternate services

Web Services

- Interoperable
  - Growing number of industry standards
- Strong industry support
- Reduce time-to-value
  - Harness robust development tools for Web services
  - Decrease learning & implementation time
- Embrace and extend
  - Leverage effort in developing and driving consensus on standards
  - Focus limited resources on augmenting & adding standards as needed

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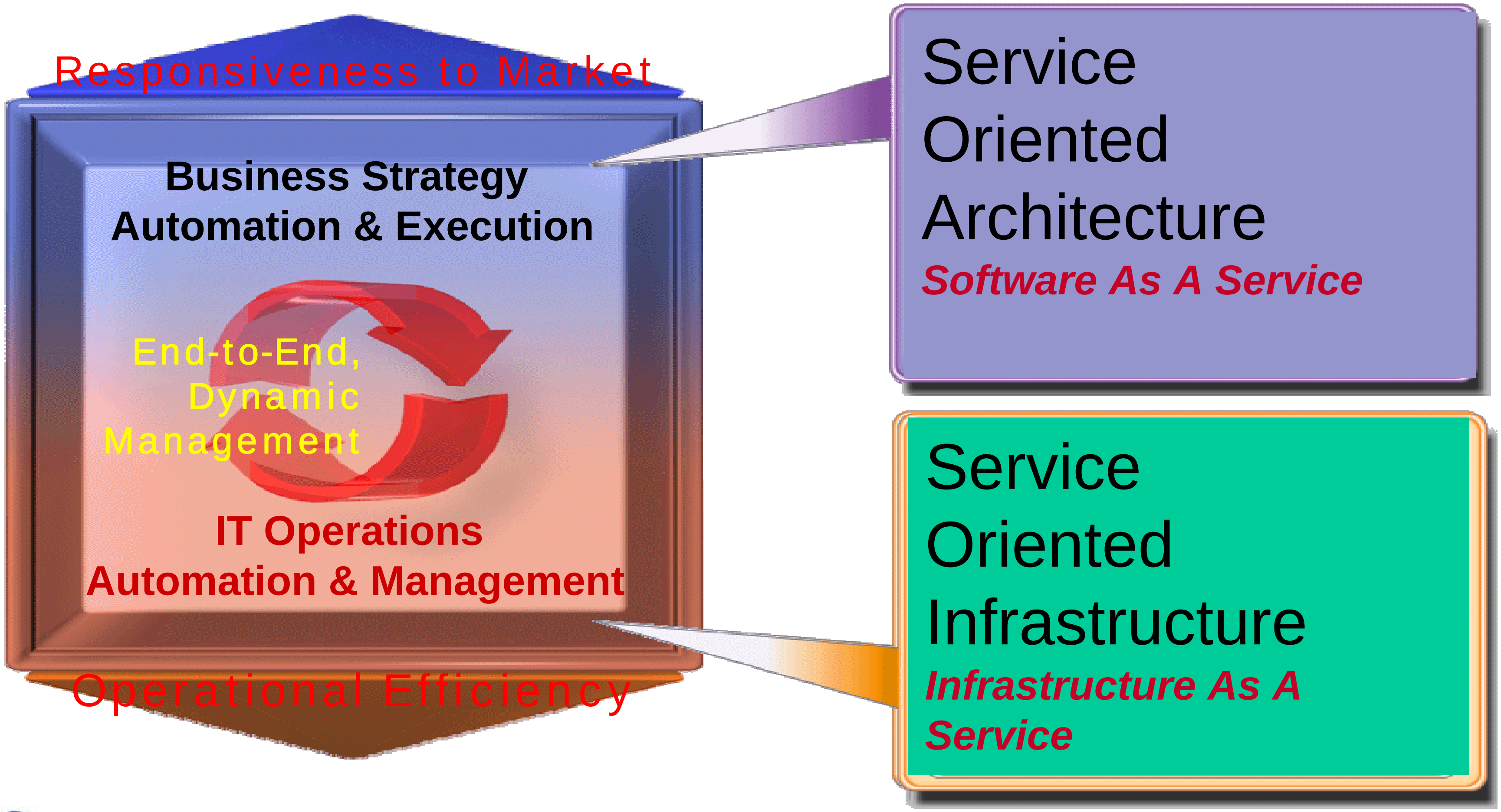
SOA & SOI



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Analyze the Future

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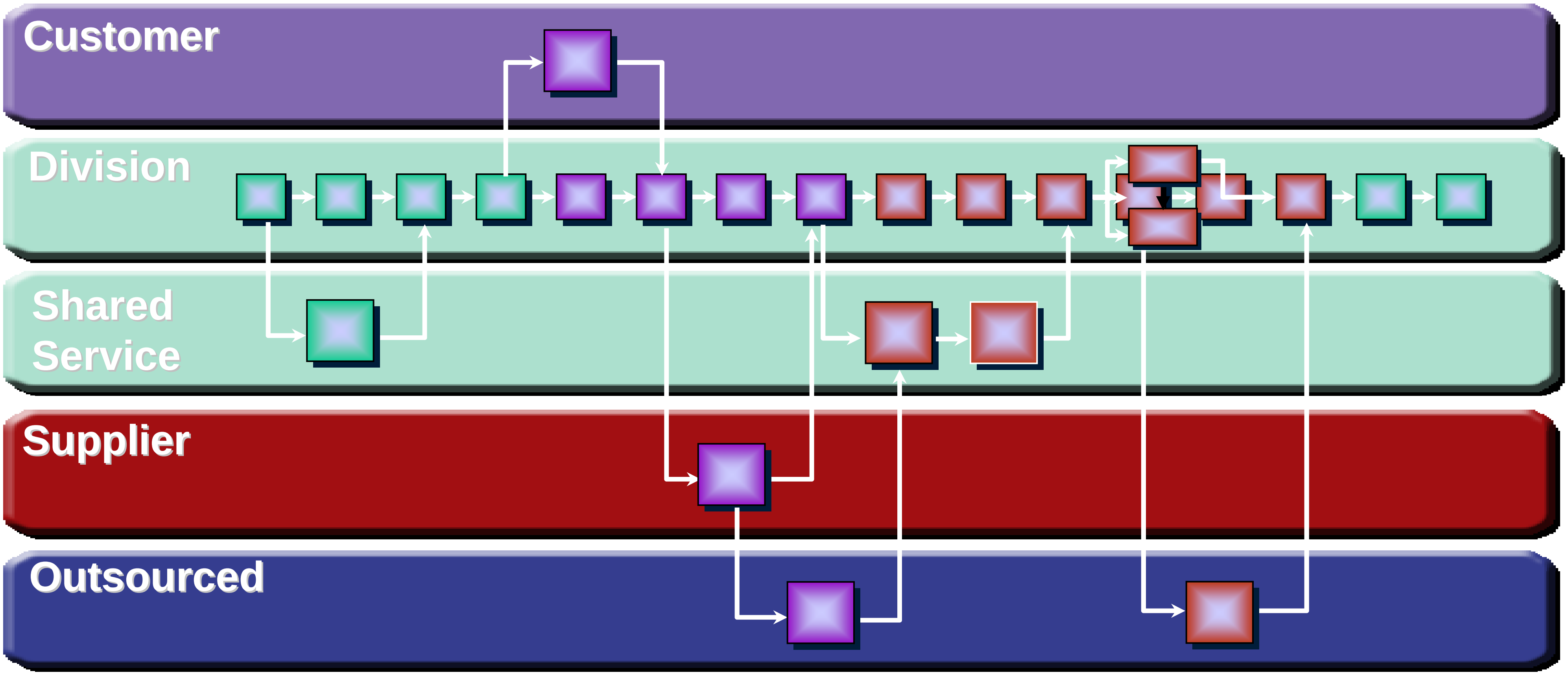
Example: Procure to Pay Process



Change: Customer Order Entry
Change: Serviced Marketing, Billing, Receivables
Change: Supplier Handles Inventory
Change: Shipping by External Company
Change: Collections Outsourced
Change: Process Optimization

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Motivations for Grids

- Scale up computing and/or data sets
- Reduce costs via capex/opex efficiencies
- Reduce time-to-results
- Provide reliability, availability
- Support heterogeneous systems & realities
- Enable collaborations
- Support a market in software services

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Questions?

- Credits:
  - Hiro Kishimoto, *Fujitsu & OGF*
  - Dave Snelling, *Fujitsu & OGF*
  - Franco Travostino, *Nortel & OGF*
  - Angus McCann, *IBM*
  - Ian Osborne, *Grid Computing Now!*
  - Ian Foster, *ANL/Globus*
  - IDC