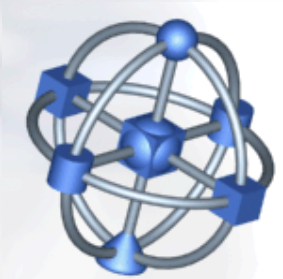
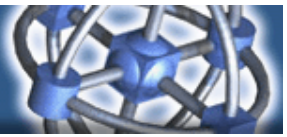
Grid Computing



Intro, Trends and Directions

Detlef Straeten

Executive IT Architect
Distinguished Engineer
Member IBM Academy of Technology



Agenda

- Evolution of Grid
- Architectural background
- Grid in Customer Projects
- Summary
- Questions

Grid Applications: What is in the Press?

SETI

- Search for extra terrestrial life
- Today approx. 4 million computer
- Capacity approx. 100.000 years since intro. in mid 1999.
- Approx. 2.000 machines get added every day
- Kids in the US use it as computer "benchmark" ;-)

Napster

- P2P File Sharing network
- Mainly used for MP3 music file exchange
- Saved $600M in storage & $6M in bandwidth expenses per month (according to Bear Stearns Chris Kwak & Robert Fagin)

Note: Often you will find the term "Business GRIDs", to describe business relationships and associated B2B concepts in a grid-like fashion.

Grid Applications Today and "Why now?"

UK Research Grid

- Collaborative, scientific research
- Test bed for utility computing
- Future commercial applications

The TeraGrid

- Most powerful, heterogeneous Grid

13.6 trillion floating po operations per second
600 terabytes of data
40 gigabits per second

University of Pennsylvania

- National Digital Mammographic Archive
- Medical and diagnostic content

Butterfly.net

- On demand gaming

- Moore's law improvements in computing produce highly functional endsystems
- The Internet and burgeoning wired and wireless provide universal connectivity
- Changing modes of working and problem solving emphasize teamwork, computation
- Network exponentials produce dramatic changes in geometry and geography

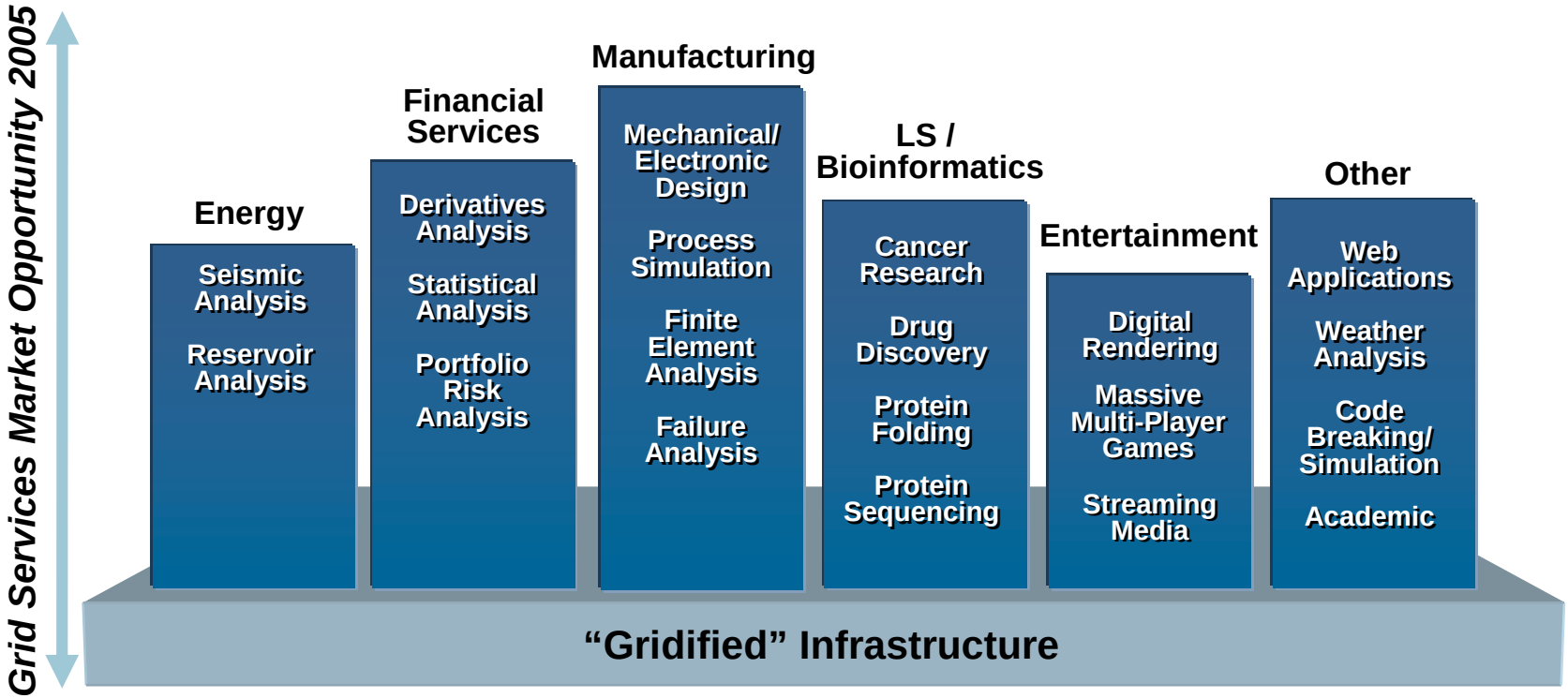
Note: Politicians have discovered Grids as the means to increase competitive advantage for their respective economies (EU, Japan,...)!!

Let's recap: Grid Computing Capabilities

- **Infrastructure Optimization**
  - **Workload Management and Consolidation**
  - **Reduced Cycle Times**
- **Increased Access to Data and Collaboration**
  - **Federation of Data**
  - **Global Distribution**
- **Resilient / Highly Available Infrastructure**
  - **Business Continuity**
  - **Recovery and Failover**
- **And a pretty cool base for High Performance Computing**

Industry Applications

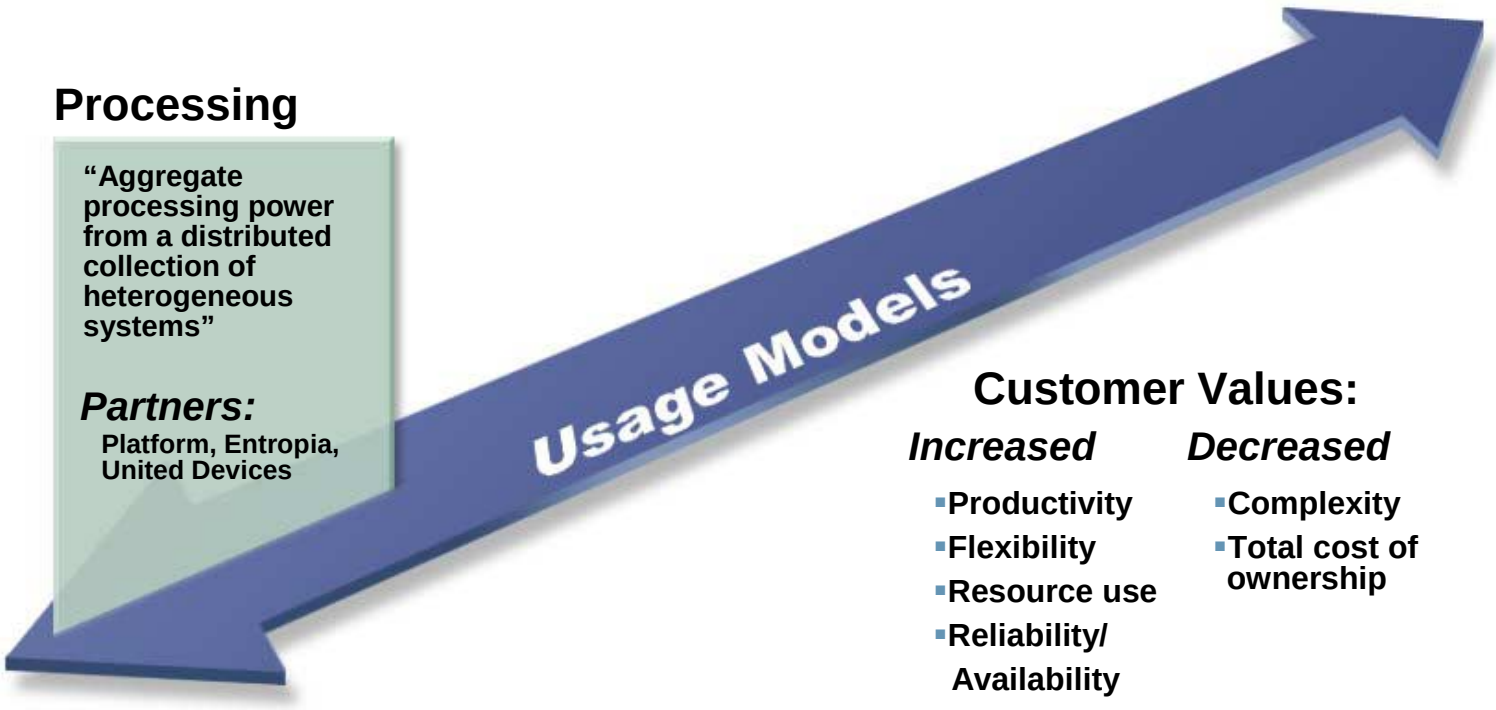
Unique by Industry with Common Characteristics



Sources: IDC, 2000 and Bear Stearns- Internet 3.0 - 5/01 Analysis by SAI

Uses of Grid Technology

4 Models, Unique Value Propositions



Uses of Grid Technology

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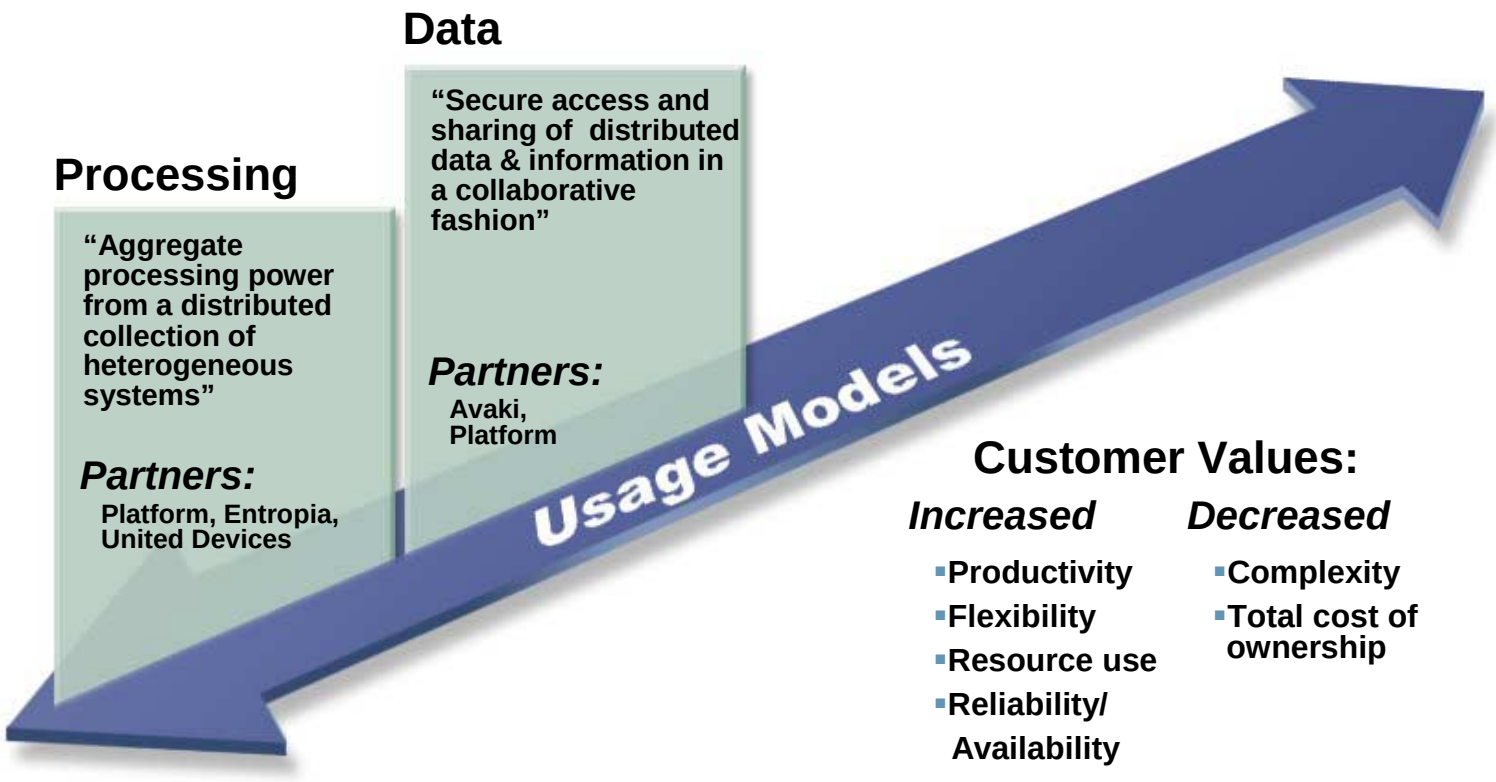

Uses of Grid Technology

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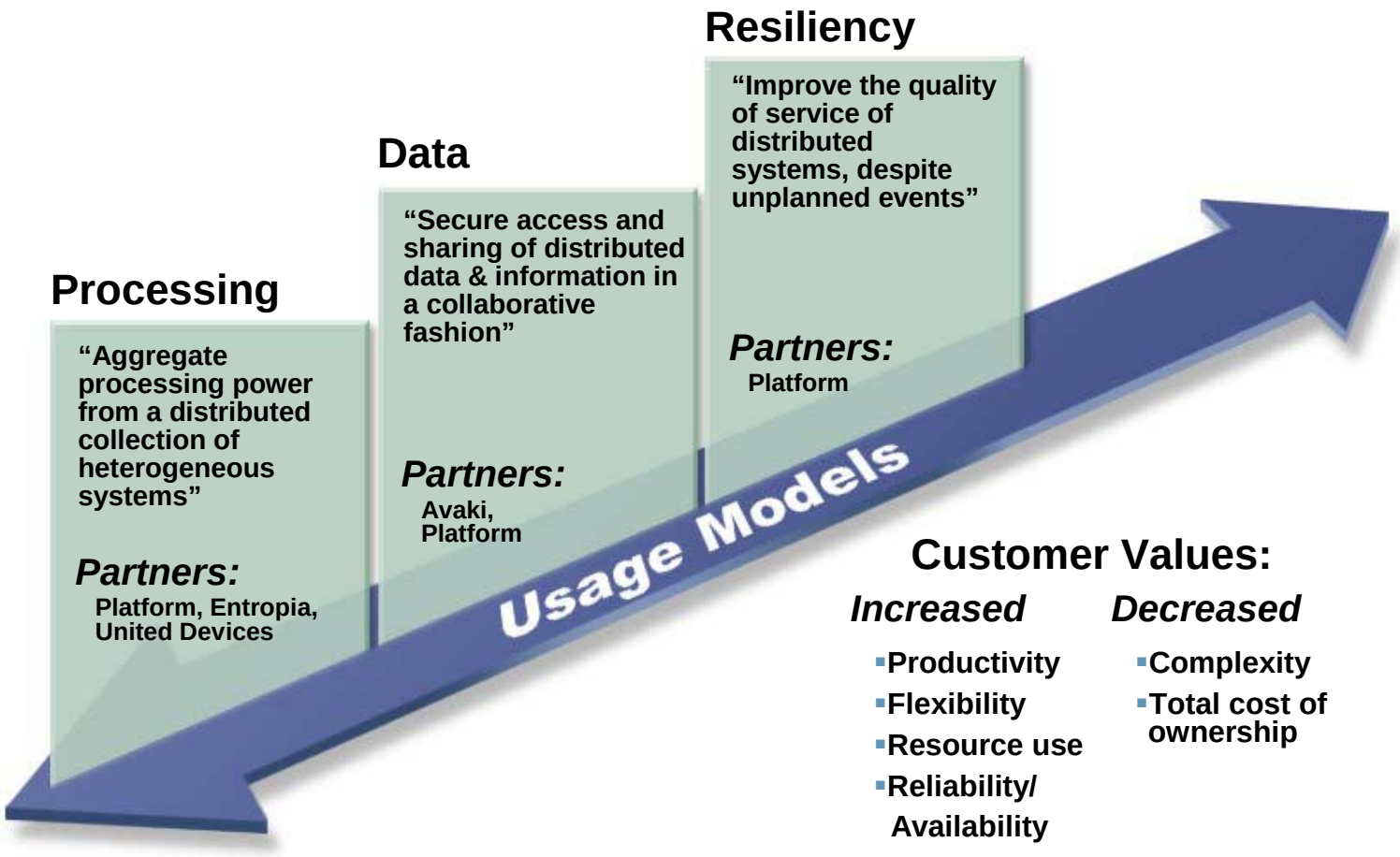

Uses of Grid Technology

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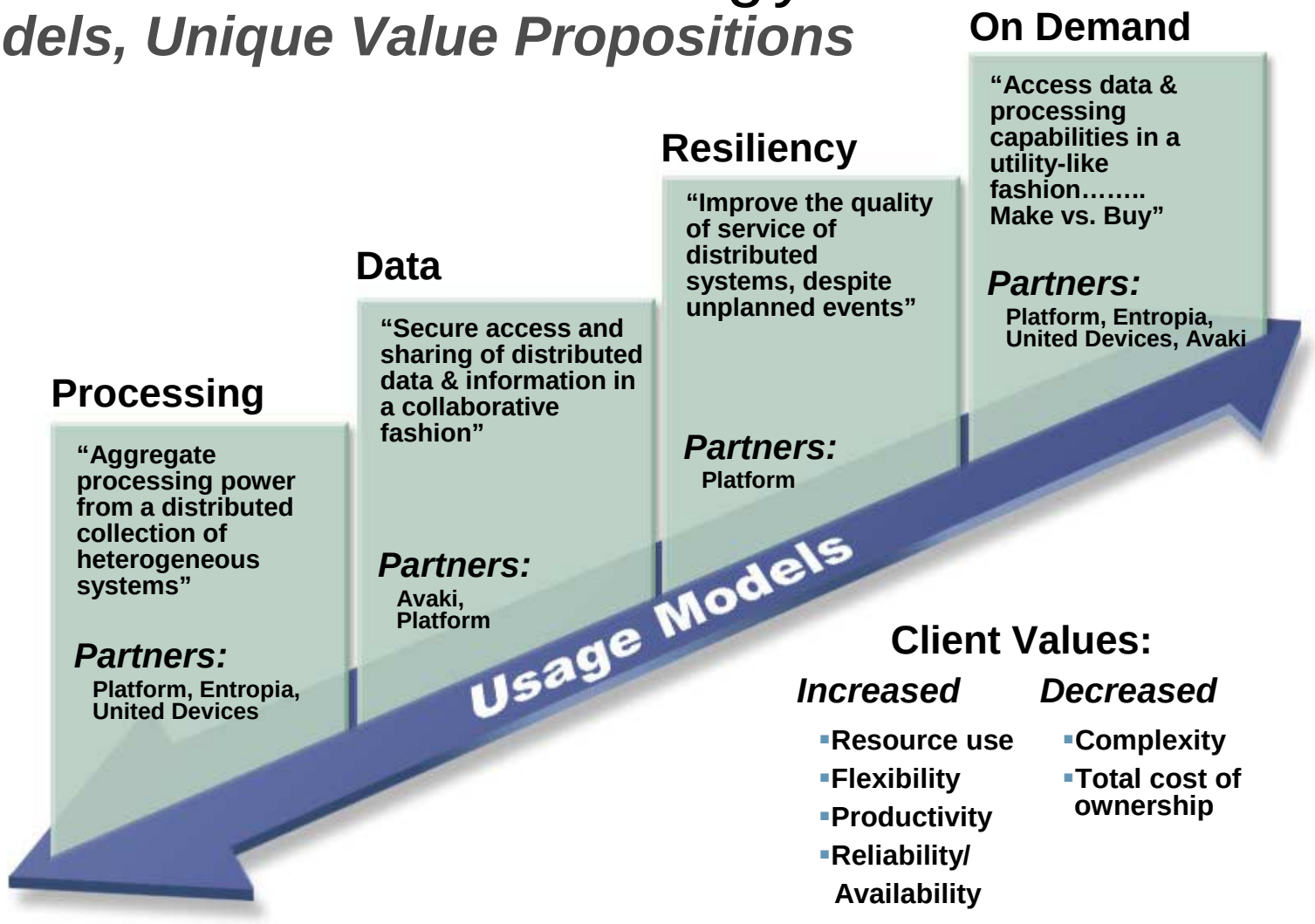
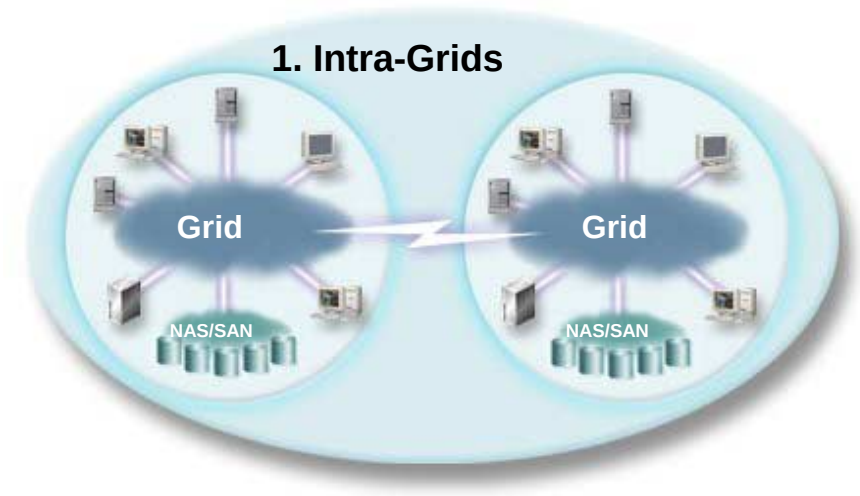


Grid Deployment Options

A Function of Business Need, Technology and Organizational Flexibility



Note: Execution logic can be "mobile" or "resident".

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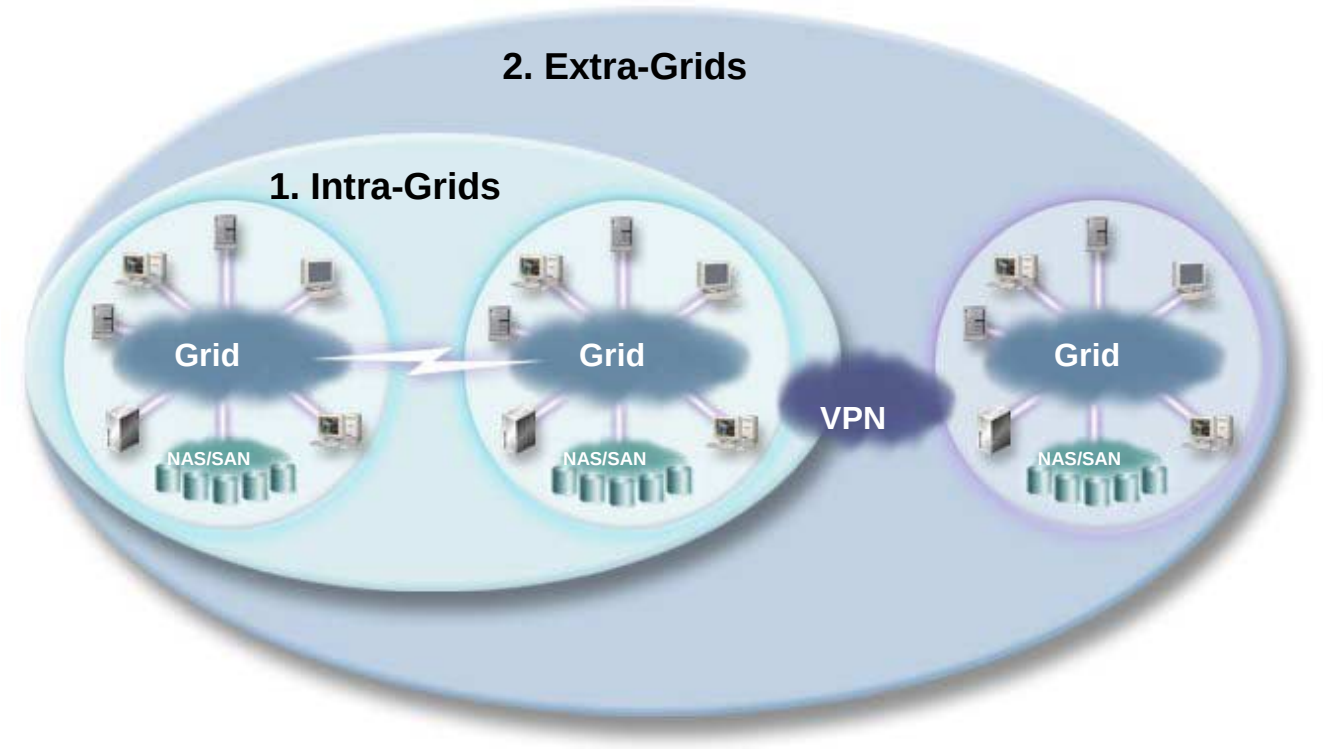

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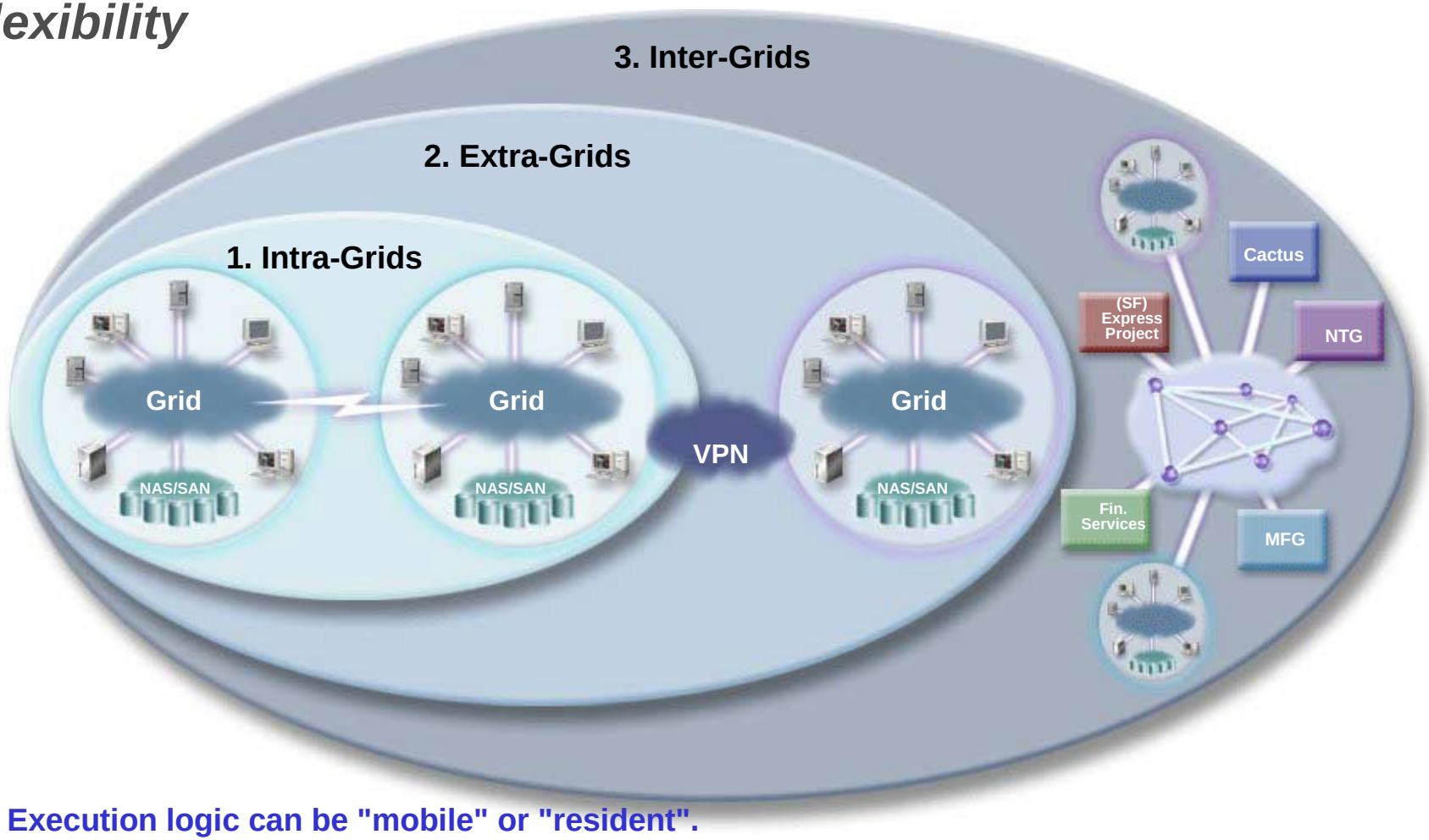

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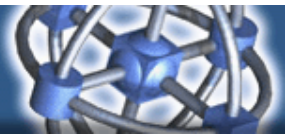


Grid Defined

The Grid problem:

- **Resource sharing & coordinated problem solving in dynamic, multi-institutional virtual organizations**

- **The Grid is a system that:**

  - **coordinates resources that are not subject to centralized control (resources and users live within different domains (admin, technology,...))**

  otherwise: It would be a local management system

  - **uses standard, open, general-purpose protocols and interfaces**

  otherwise: It would be an application-specific system

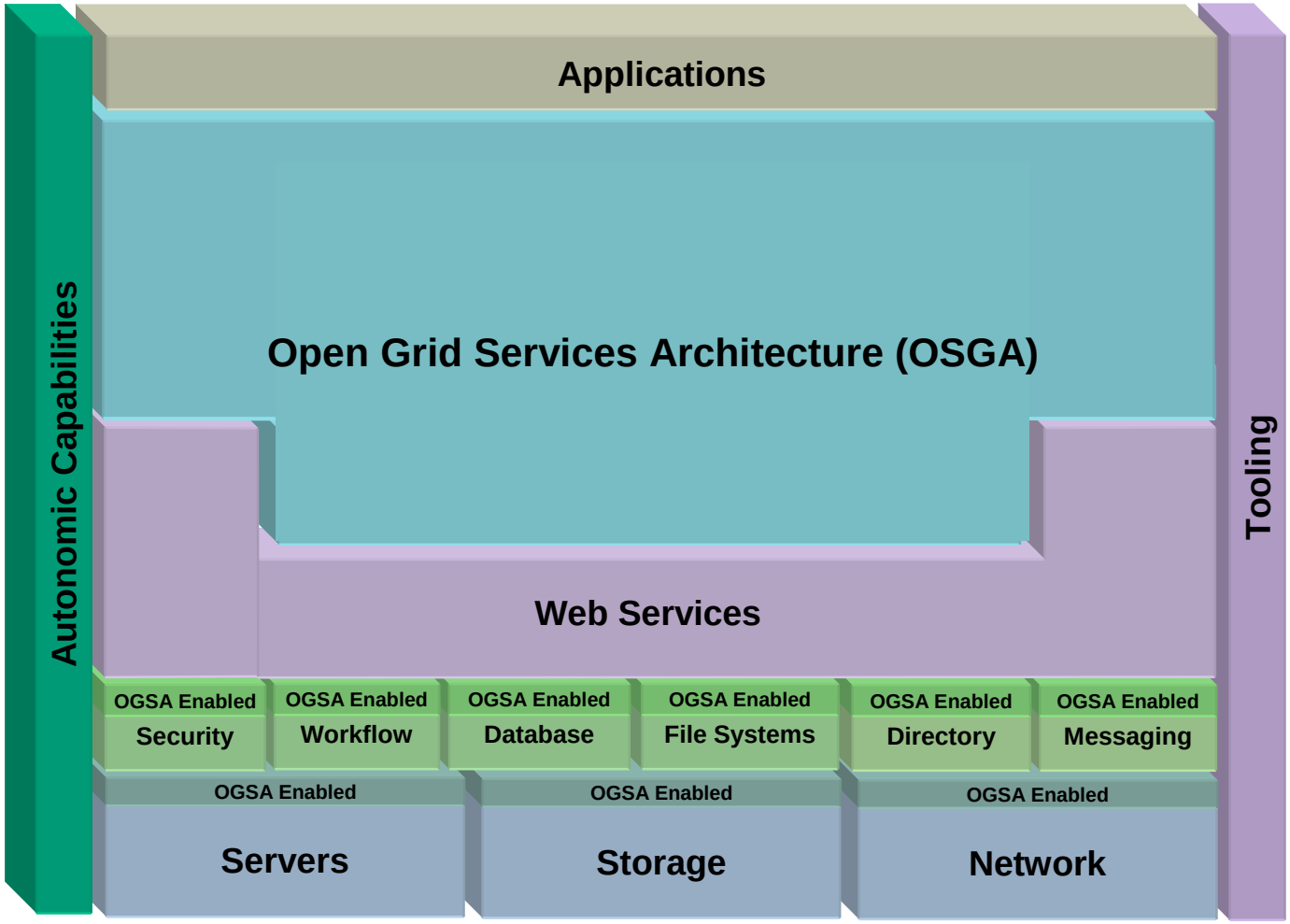
  - **delivers non-trivial qualities if service (response time, throughput,...)**

  otherwise: It would be of limited commercial use

Foster & Kesselman (Nov. 2002)

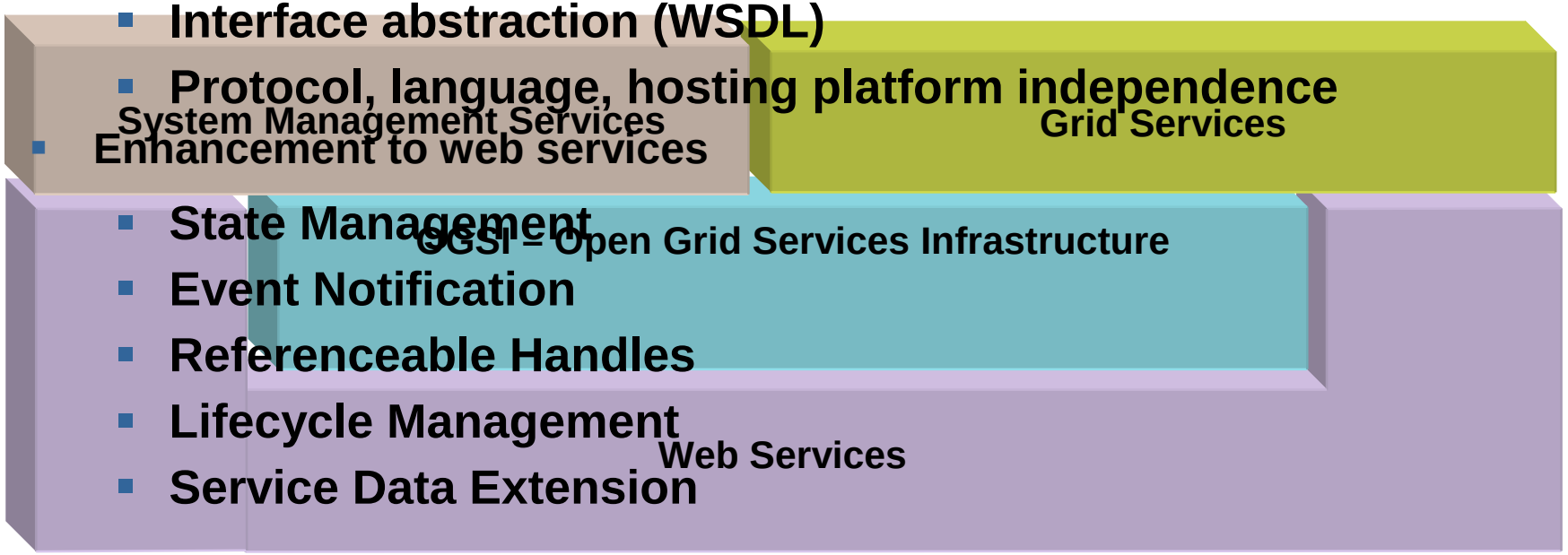
Architecture Framework

OGSA Structure



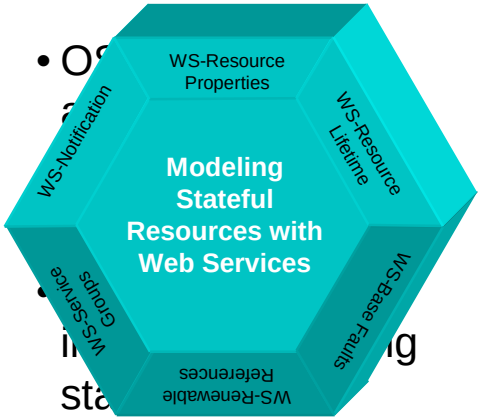
Architecture Framework

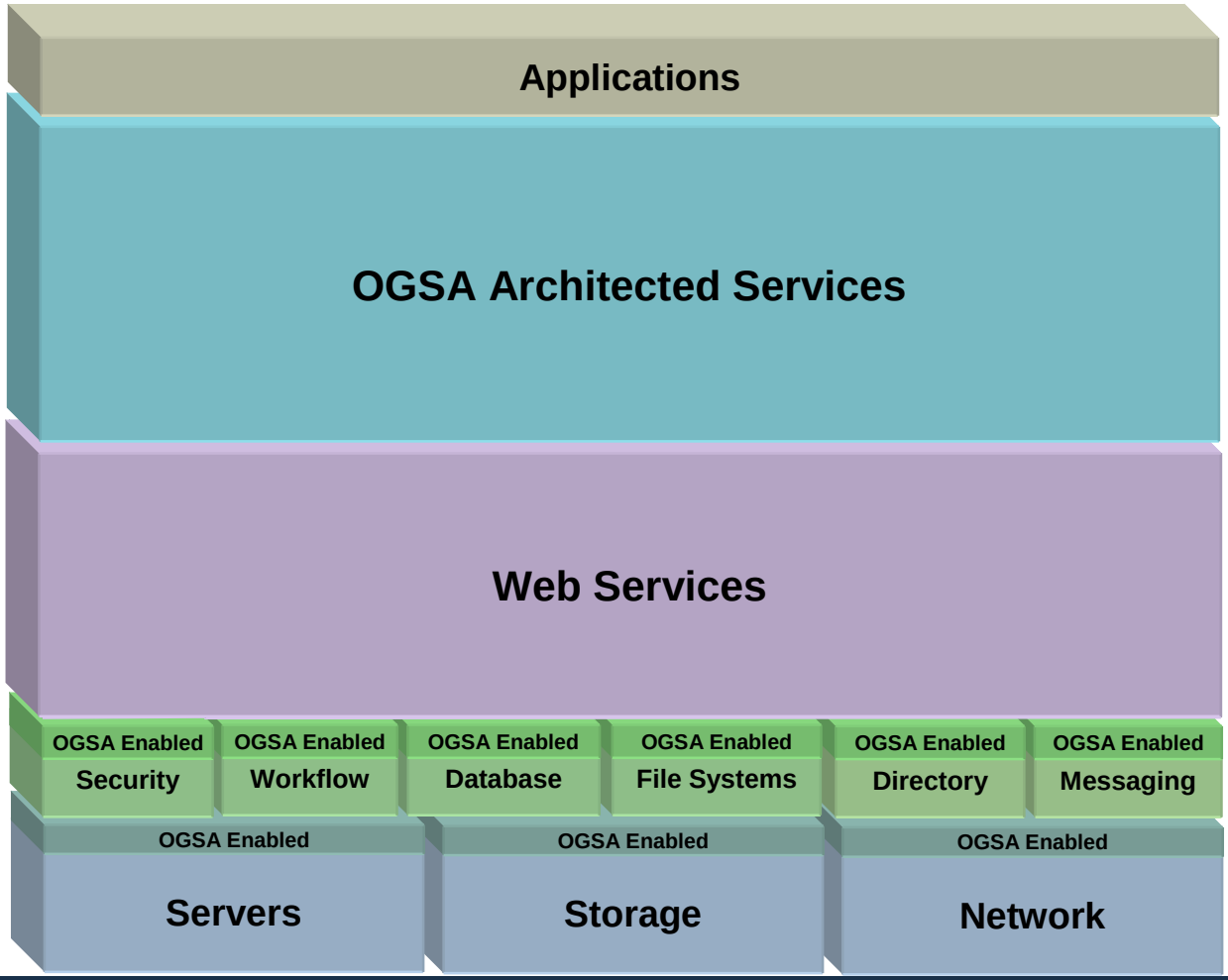
- **Exploits existing web services properties**
  - **Interface abstraction (WSDL)**
  - **Protocol, language, hosting platform independence**
- **Enhancement to web services**
  - **State Management**
  - **Event Notification**
  - **Referenceable Handles**
  - **Lifecycle Management**
  - **Service Data Extension**

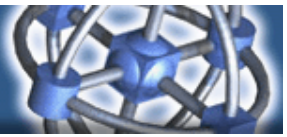


WS-Resource Framework & WS-Notification are an evolution of OGSI

- OGSA Services can be defined and implemented as Web services
- OG
- sta
  services development tools
- Grid applications will NOT require special Web services infrastructure



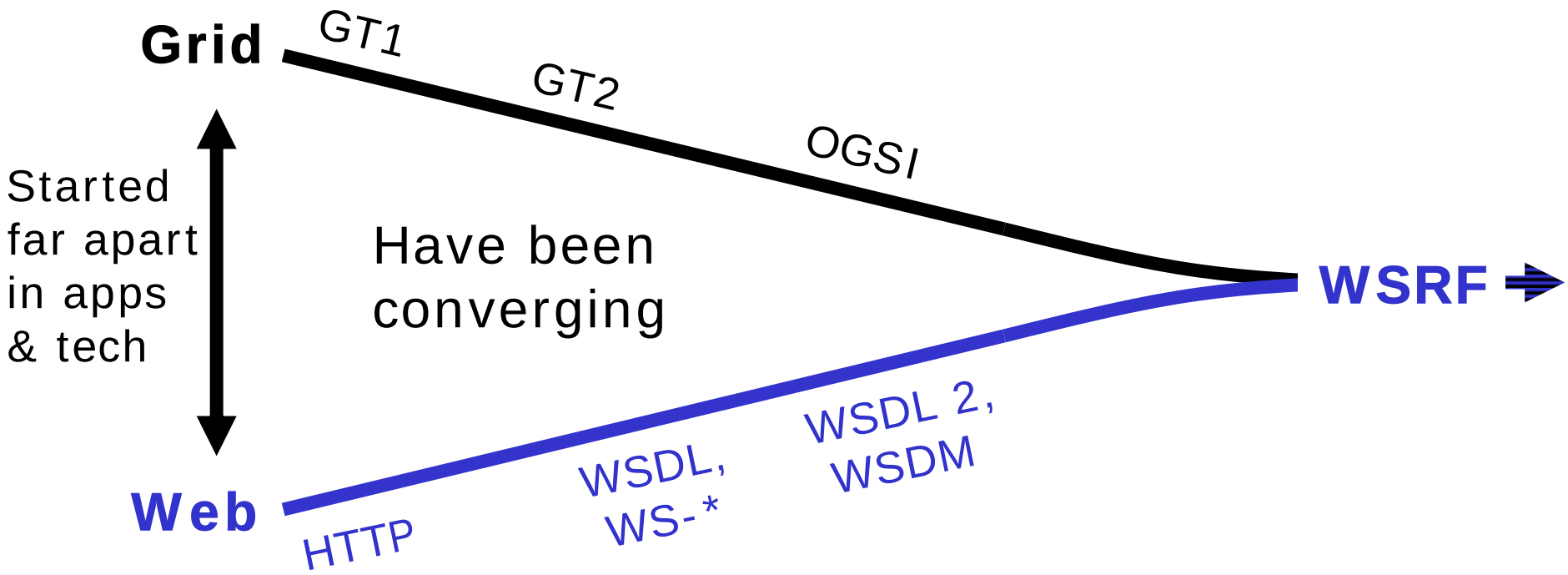




How these proposals relate to OGSA

OGSI	WSRF
Grid Service Reference	*WS-Addressing* Endpoint Reference
Grid Service Handle	*WS-Addressing* Endpoint Reference
HandleResolver portType	WS-RenewableReferences
Service data defn & access	WS-ResourceProperties
GridService lifetime mgmt	WS-ResourceLifetime
Notification portTypes	WS-Notification
Factory portType	Treated as a pattern
ServiceGroup portTypes	WS-ServiceGroup
Base fault type	WS-BaseFaults

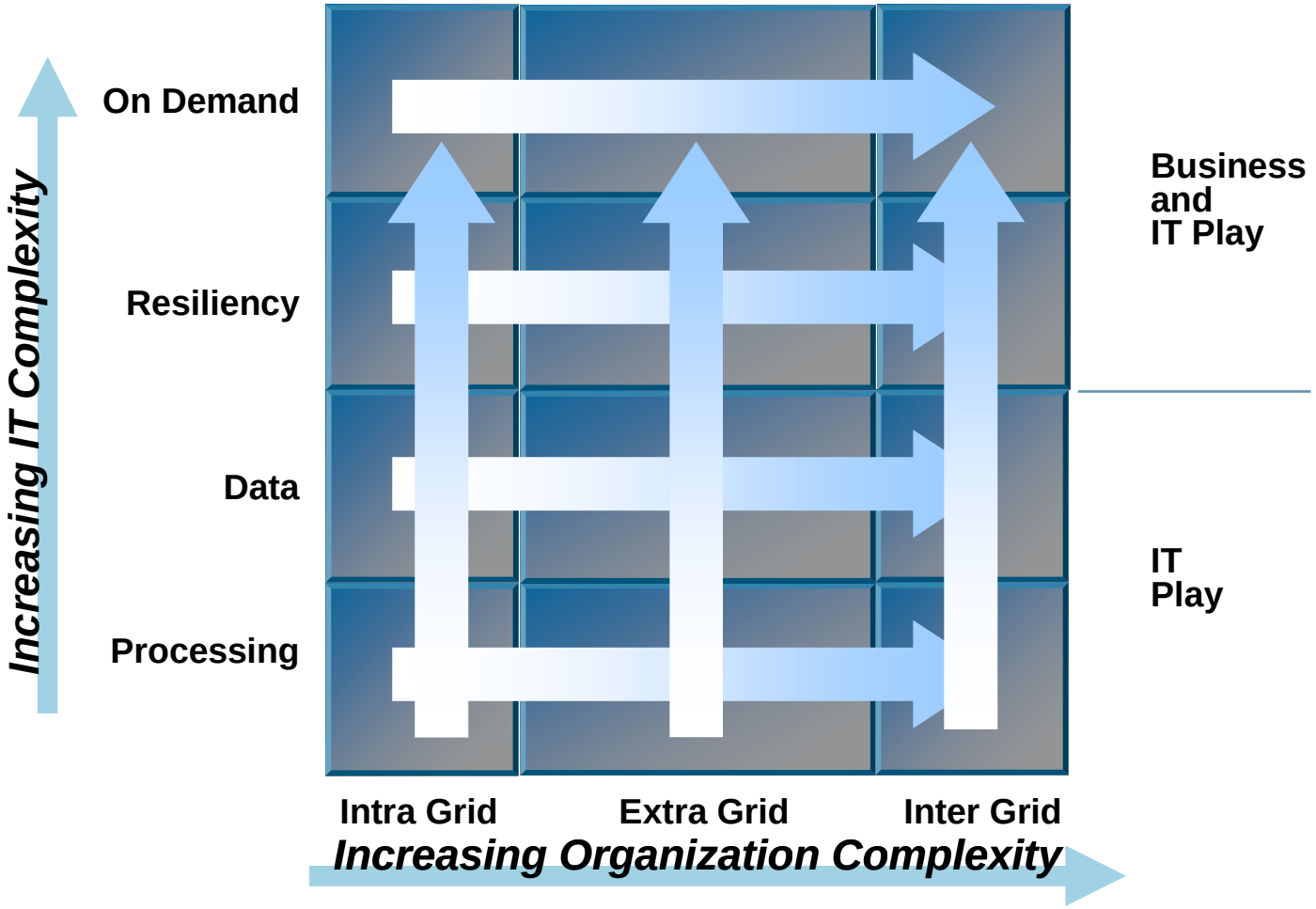
Grid and Web Services: Convergence



The definition of WSRF means that Grid and Web communities can move forward on a common base

Grid Adoption Framework

Several Logical Paths to Implementation



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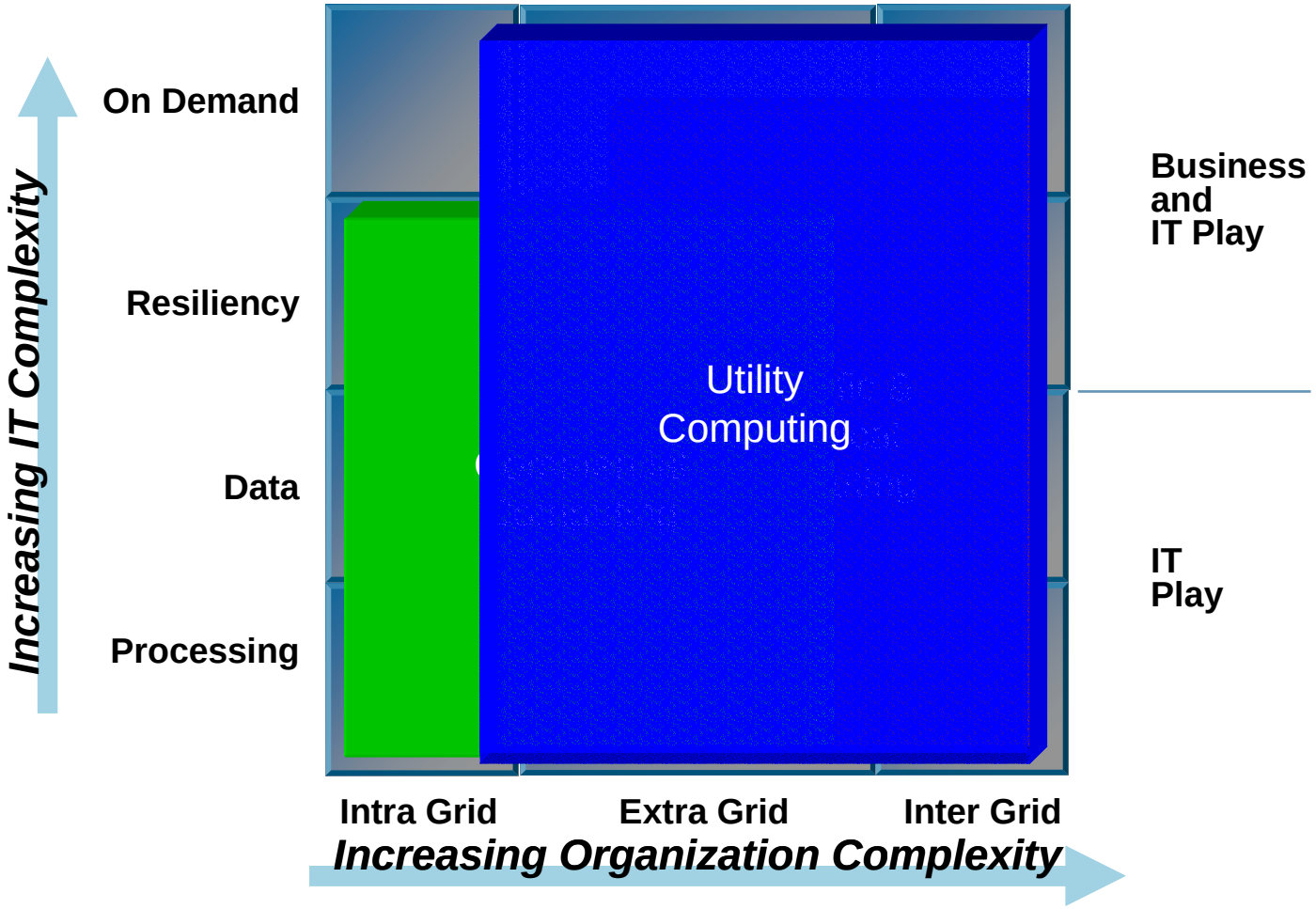
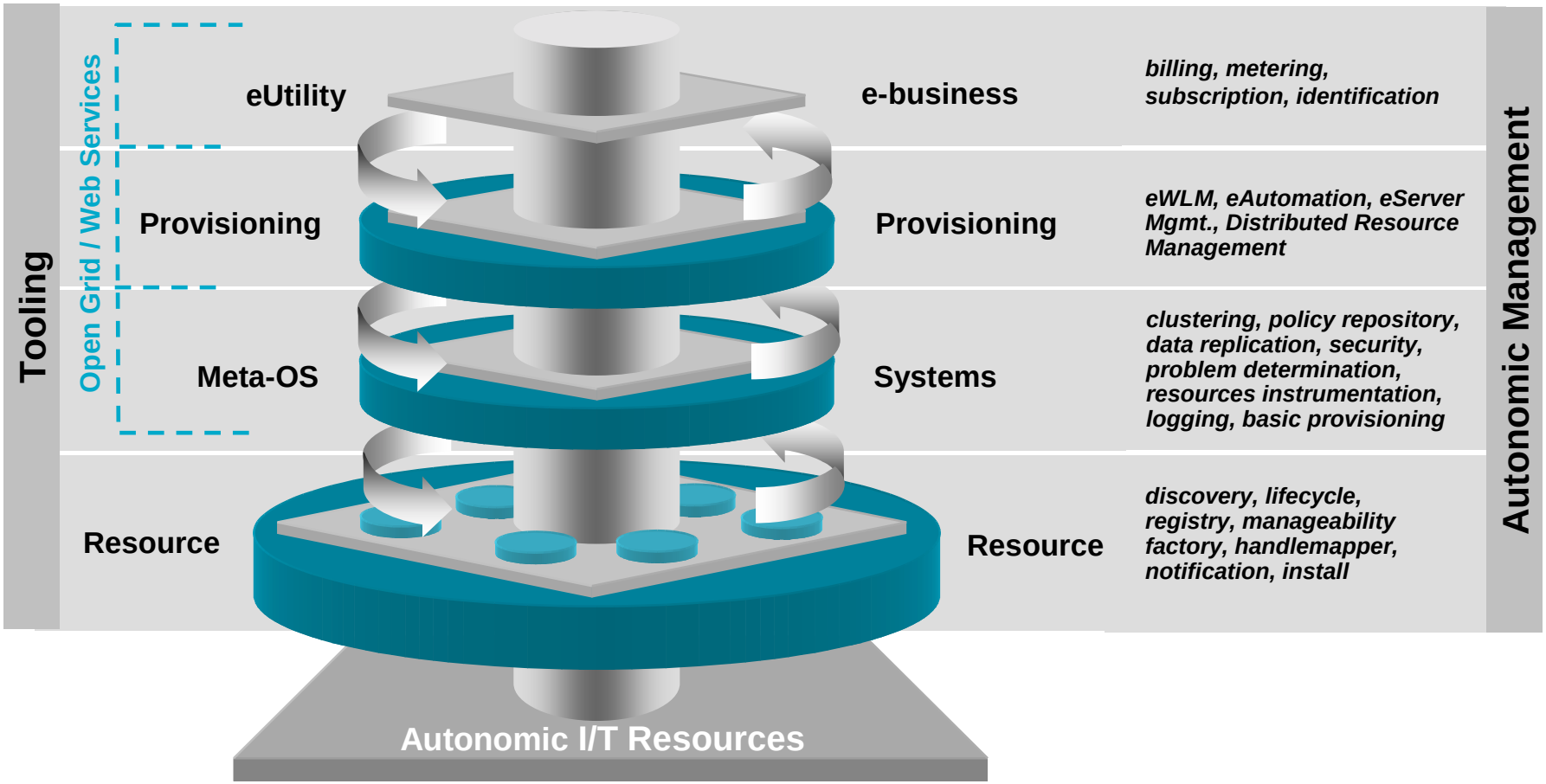


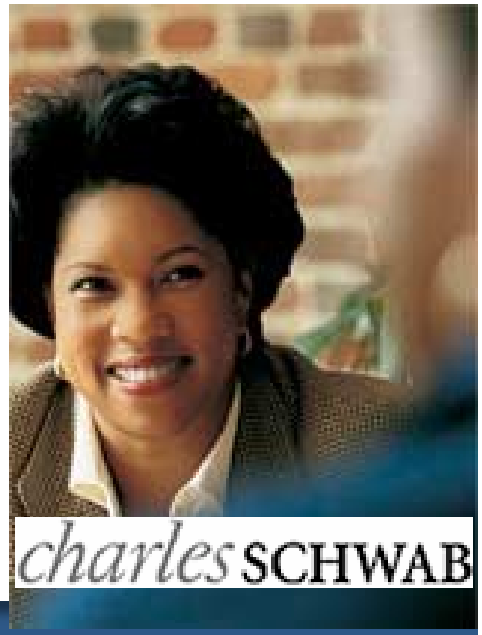
Where do Grids play?



Charles Schwab

Business Analytics

- **Reduced the processing time on an existing wealth management application, from more than four minutes to fifteen seconds**
- **Will allow Charles Schwab to increase customer satisfaction by responding to inquiries in real time…while the customer is on the phone**
- **Schwab is now planning to leverage Grid computing into other key business areas**



"We believe that Grid computing … has the potential to greatly improve our quality of service and be a truly disruptive technology."

Oren Leiman, Managing Director, Charles Schwab

Royal Bank of Canada Insurance

Business Analytics

- **Policy valuation application takes 18 hours to process**
- **Job executed across 4 separate NT processors with manual job scheduling being performed by a highly paid actuary – who spent up to 75% of job being an IT operator**
- **With Grid, job runs in 34 minutes, and job scheduling is automated, freeing up actuaries to focus on their core job**
- **Can now run more complex scenarios to reduce risk**

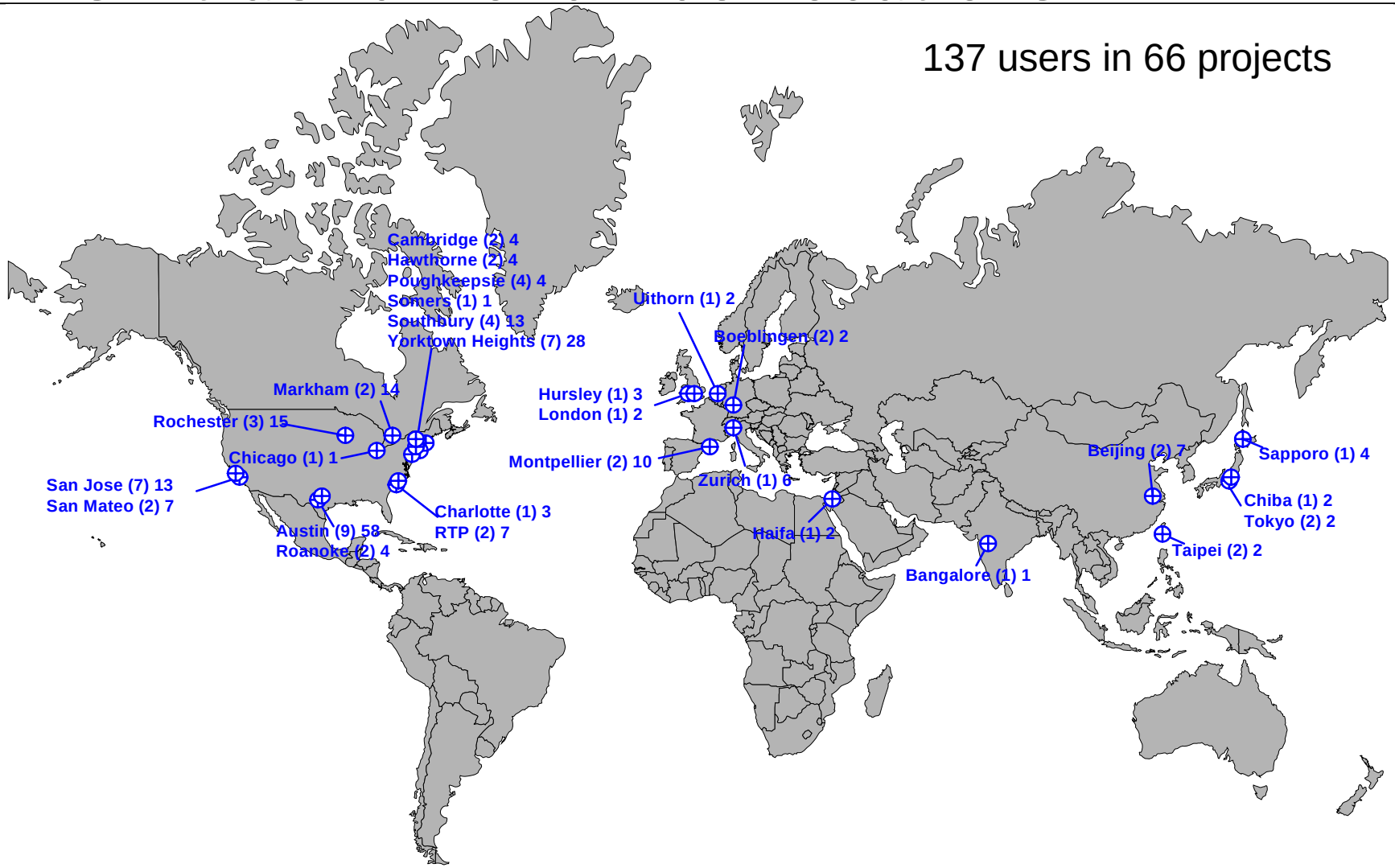
RBC Insurance

Smart insurance decisions.

bright solutions®

IBM's intraGrid Worldwide Locations

137 users in 66 projects



IBM

Engineering and Design

Microprocessor Design

- Continually unlocking infrastructure value by driving utilization rates above 70%
- Lower error rates in designs leads to higher quality, reduced development cycle time and cost avoidance
- Faster time to market by cutting development time
- Enabling IBM's leadership in microprocessor technologies

Z Series Design

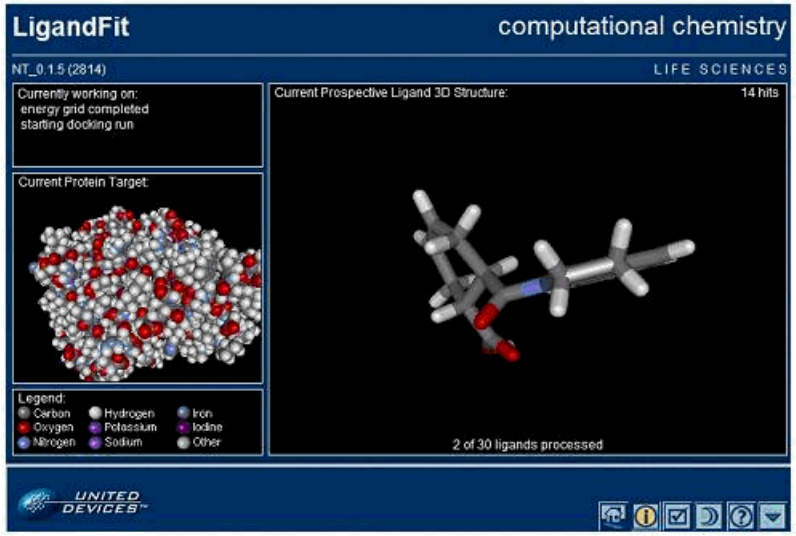
- Lower total cost of ownership by using the Grid for On Demand processing power
- Increased fault tolerance by reducing the dependency on a single cluster
- Isolation of software errors to individual clusters reduces impacts to a local cluster

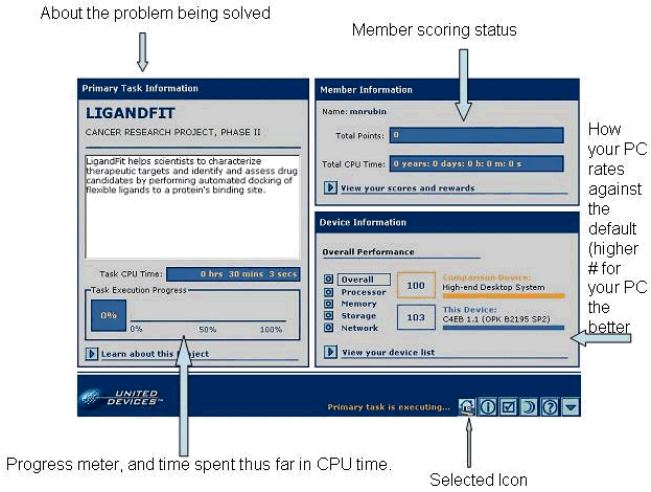
IBM Boeblingen LabGrid

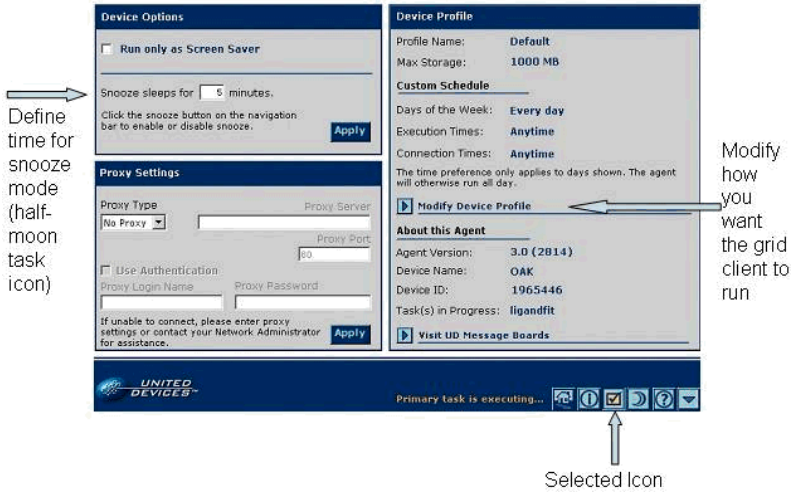
Grid Application: Functional Verification of zSeries Processor Units

- **Random unit simulation, simulation environment/model on AFS (shadowed once a day to participating AFS cells)**
- **Input data: None (Random start seed)**
- **Output data, Testcase passed: Statistics, summary, coverage, ~150 kB**
- **Output data, Testcase failed: Statistics, summary, coverage, debug info, ~1.5 MB**
- **Testcase runtime determined by clock cycles simulated (130k cycles, <10min runtime, depending on machine)**

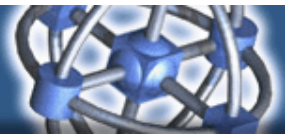
Vaccine Research







What is the Smallpox Research Grid Project?
The grid computing project uses many PCs to analyze DNA in the different forms of smallpox virus.
By understanding the genetic makeup, scientists can design vaccines and treatments.



Questions?