



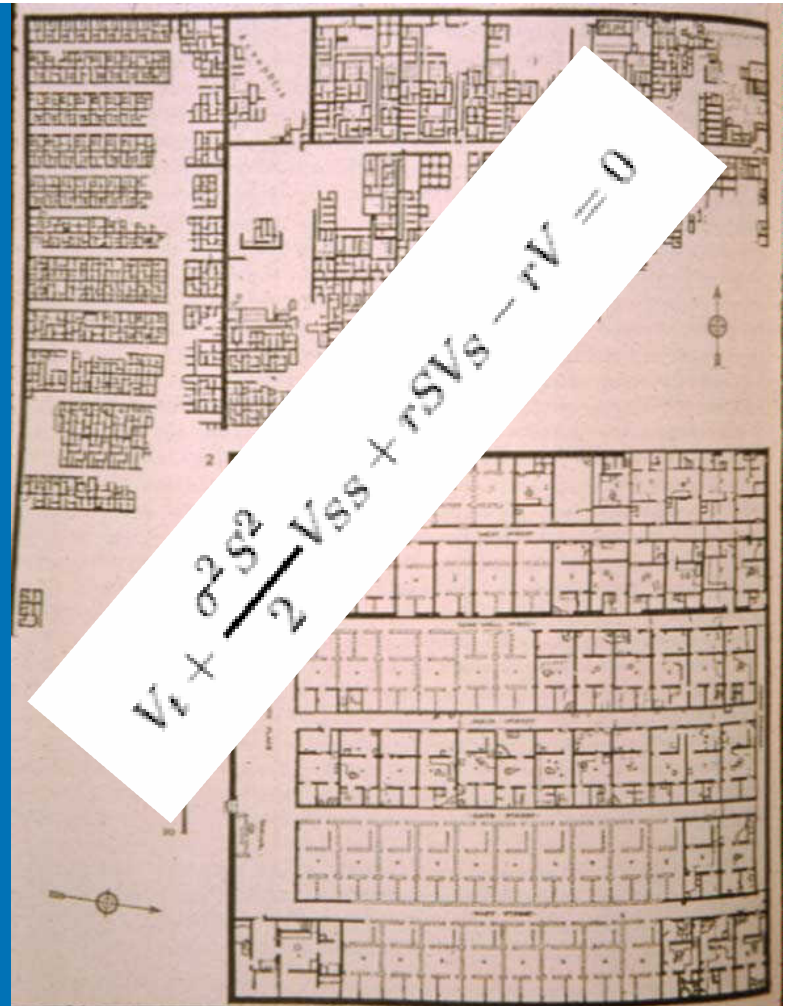
Grid in Financial Services

EGR-RG Workshop

Sept 13, 2006

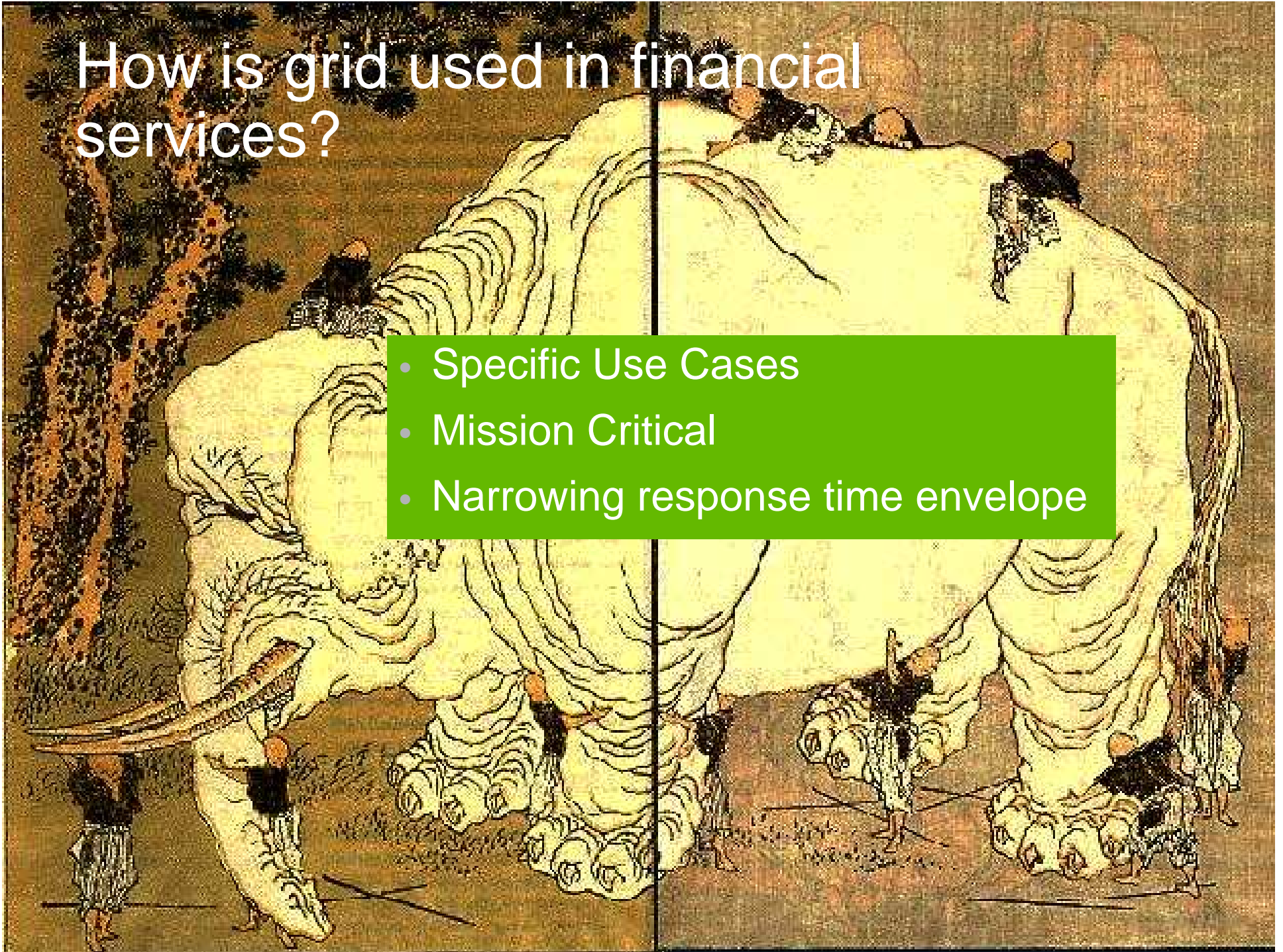
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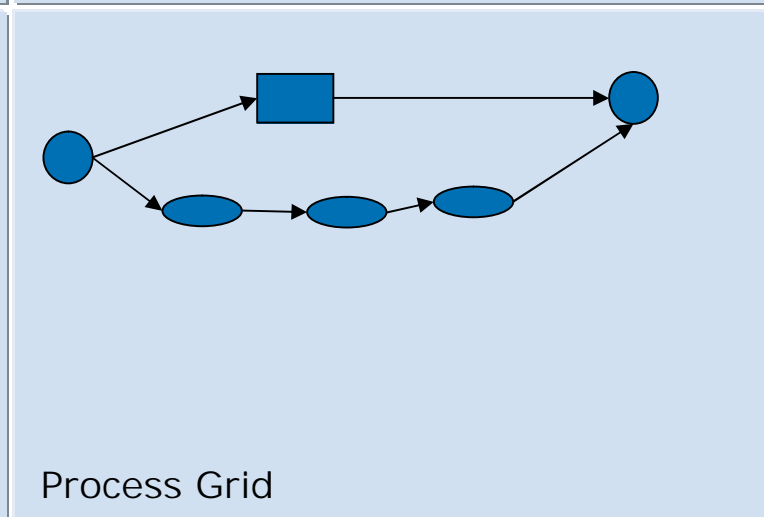
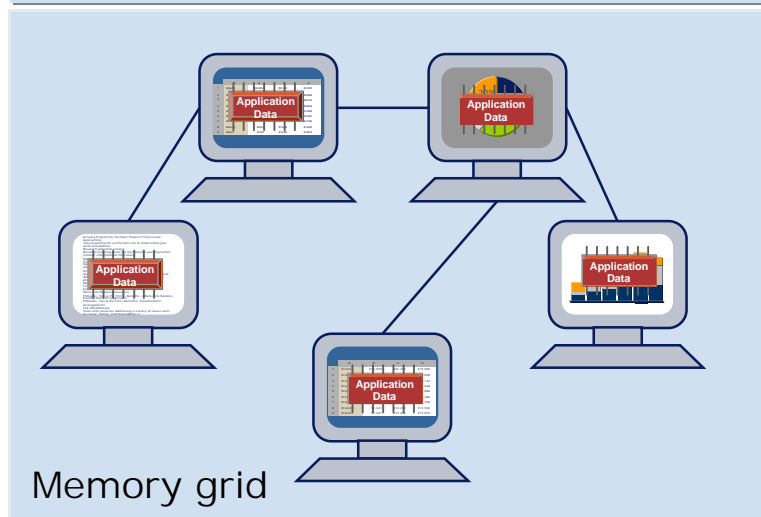
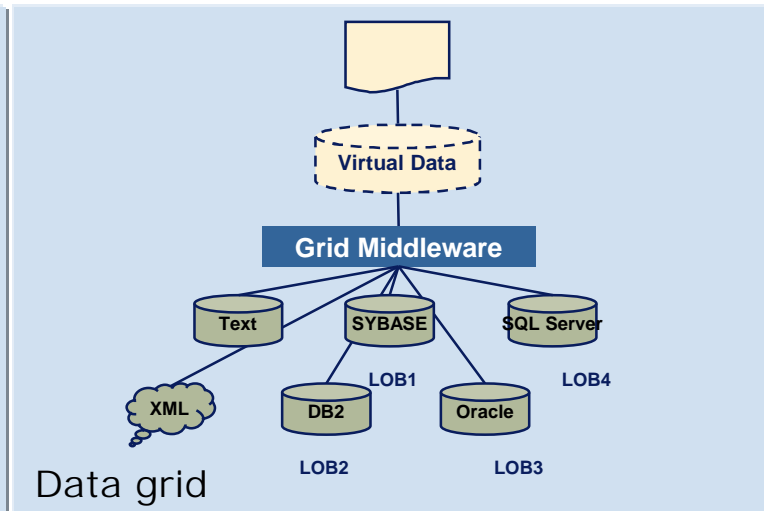
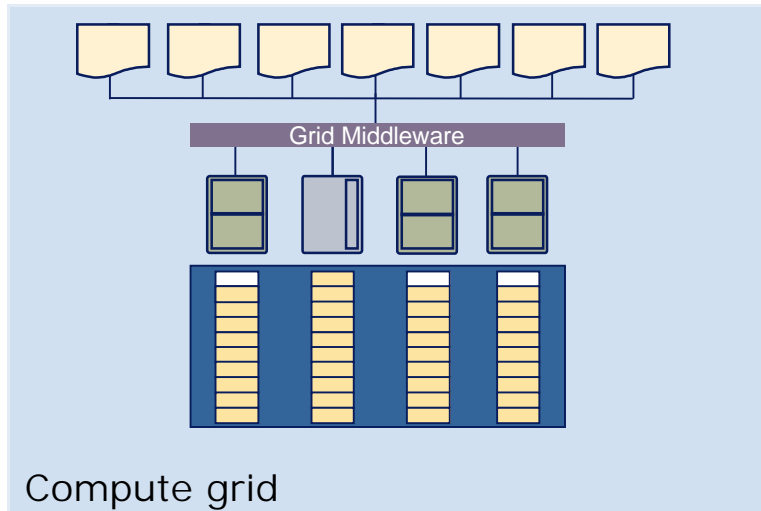


How is grid used in financial services?

- Specific Use Cases
- Mission Critical
- Narrowing response time envelope



Grid Models



Grid Computing for Financial Services

Drivers for Grid

- Real-time calculations is a competitive advantage
 - Discover market opportunities
 - Faster calculations increase profit & reduce loss
- Financial engineering is computationally intensive
 - Modeling Financial Products
 - Derivative Pricing
 - Interest Rate Structures
 - Portfolio Analysis (fair value, rebalance, ...)
 - Evaluate risk (VaR, CVaR, monte carlo ...)
 - Historical Data Analysis
- Scale out is most effective strategy
 - Industry standard technology and open source development to enable use of latest technology
 - Grid to integrates the components

Use Cases

- **Capital Adequacy** – Risk Analytics, Reporting, Compliance
- **Pricing Trades** – Structured Products, Fixed Income, Derivatives, MBO's, CDO's, etc...
- **Equities Trading** – Analysis, Automated Program Trading
- **Asset Management** – Composite Pricing & Exposure, sales expense reporting, etc...
- **Annuity Policy Administration** – account maintenance, reporting, tracking, workflow
- **New Business Processing** – Pricing, booking and processing of Term Life, Property & Casualty, Auto, etc...
- **Capital Risk** – Actuarial analysis & asset liability management
- **Document Generation & Conversion** – Customer statements, compliance documents, account activity, PDF conversions, Compression/De-compression of information
- **Fraud detection management** – Analytical software to minimize fraud

Benefits

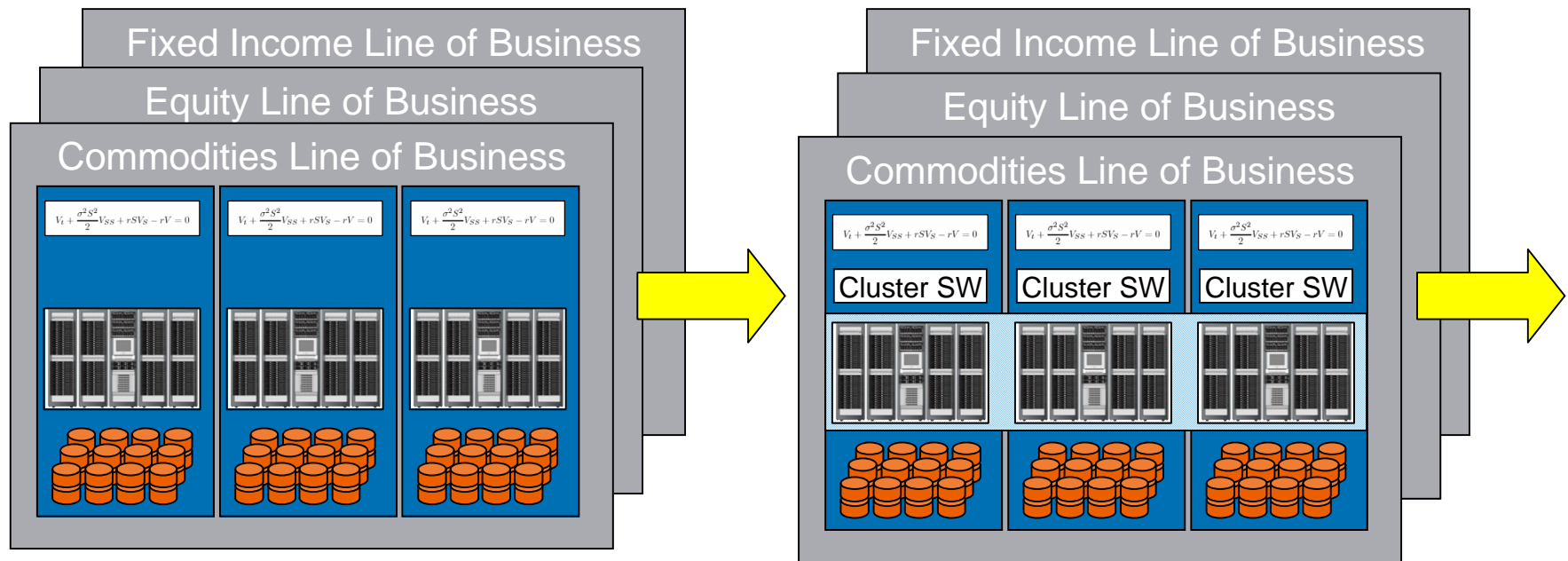
- Competitive Advantage; increase revenue
 - Identify and respond to market opportunities
- Consolidating resources enables new business opportunities
- Free up risk reserve
- Effective utilization of capital investment
 - Enables use of utility services
- Scaleable application framework
- On ramp to agile enterprise

Barriers to Adoption of Grid

- **Security**
 - Industrial Grids today typically do not cross firewalls or administrative domains
- **Standards maturity**
 - Recent direction of Grid & Web service convergence (WS-RF) improves this situation
- **Market development**
 - Software licensing schemes for service-oriented architectures & utility computing
- **Application design**
 - Ability to minimize application changes to take advantage of a Grid-based infrastructure
- **Non-technical**
 - Grids require a different way of thinking about how to deliver IT services
 - The normal resistance to changing behavior is always the toughest hurdle to overcome in technology adoption:
 - **Organizational politics** – adoption of shared resources
 - **Business issues** – chargeback, change of operational and business processes
 - **Expectation management** – time required to evolve technology and applications, realistic capabilities

Evolution towards grid

1 of 2

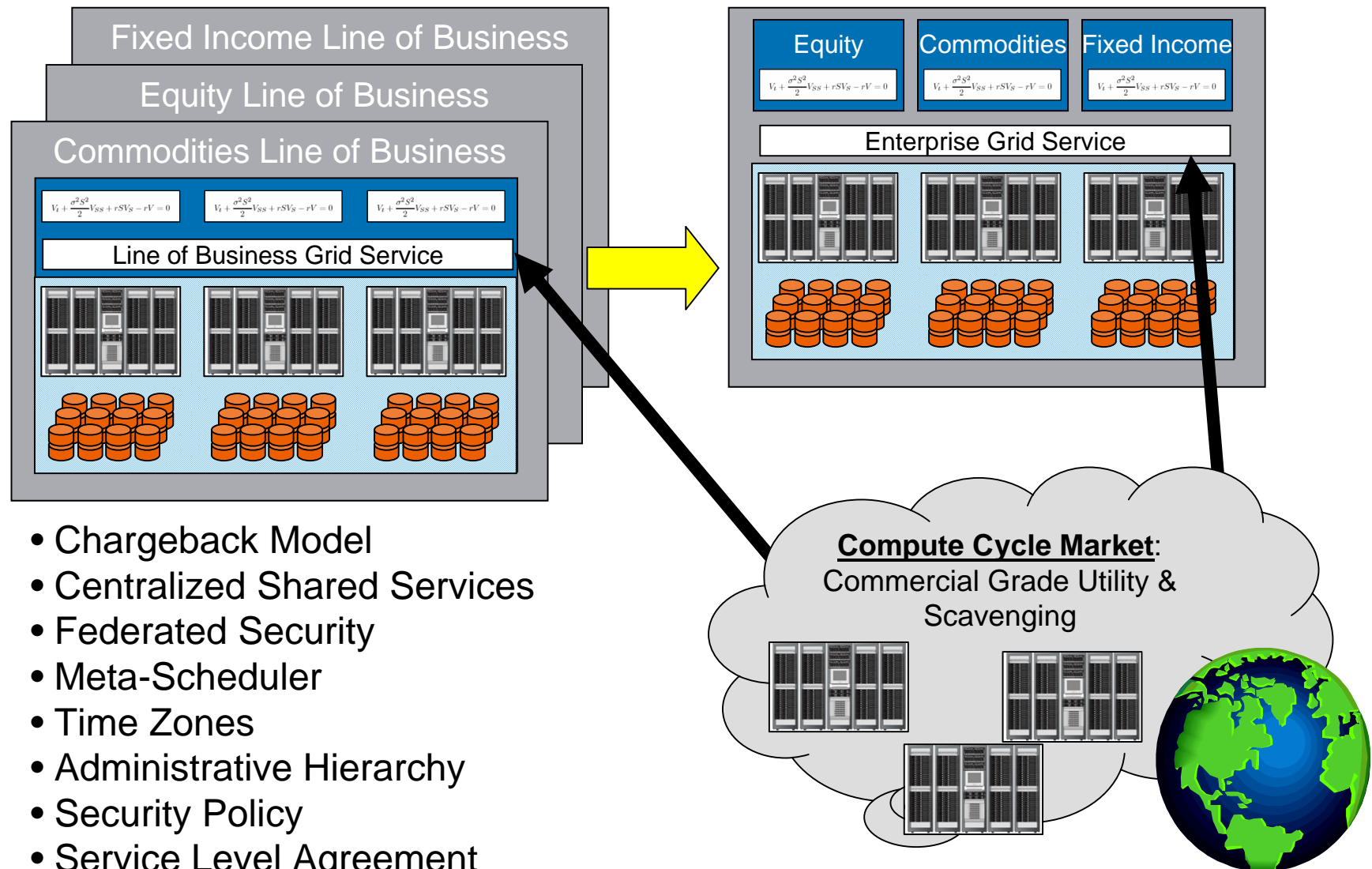


- Standalone Clusters
- Load Balancing in cluster
- Admin Domain / cluster
- Security domain / cluster
- Fault Tolerance
- Disaster Recovery

- Linked Clusters
- Some Resource Sharing
- Single Admin Domain
- Multiple security domains

Evolution towards grid

2 of 2



- Chargeback Model
- Centralized Shared Services
- Federated Security
- Meta-Scheduler
- Time Zones
- Administrative Hierarchy
- Security Policy
- Service Level Agreement

On-ramp to agile enterprise

- Expand usage to non-computational applications
- Improve system utilization & enable scalability
- Mitigate management challenge
- Establish standards to virtualize applications
- Data access key issue
- Foundation for SOA

Financial Industry Needs

- Leverage grid architecture for resiliency
- Grid interoperability standards
- End user experience
 - Simplified job submission & monitoring
- Management standards
 - Graphical management console
- Tight reliable Security Model
 - SOX, ...
- Chargeback models
- Transition / evolution models
- Capacity on demand



i n v e n t



Grid Computing @ The Hartford

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September 25, 2006

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The Hartford

- Almost 200 years old (founded in 1810)
- \$27.5 billion 2005 revenues
- \$285.5 billion 2005 assets
- 30,000 employees worldwide
- Diverse products
 - n Property & Casualty Insurance
 - n Individual and Group Life Insurance
 - n Group Benefits
 - n Individual Annuities
- Not a technology company!

The Catalysts...

- Hedging – Rapid growth in sales of our variable annuity products necessitated the creation of a hedging program to limit our exposure to adverse market conditions.
- Stochastic Modeling - In order to effectively construct our hedge, we needed to understand the behavior of our book of business over a wide range of market scenarios.
- Convergence – Model accuracy increases with more data points (scenarios, cells). More data points require more compute power.
- We needed more power - quickly.

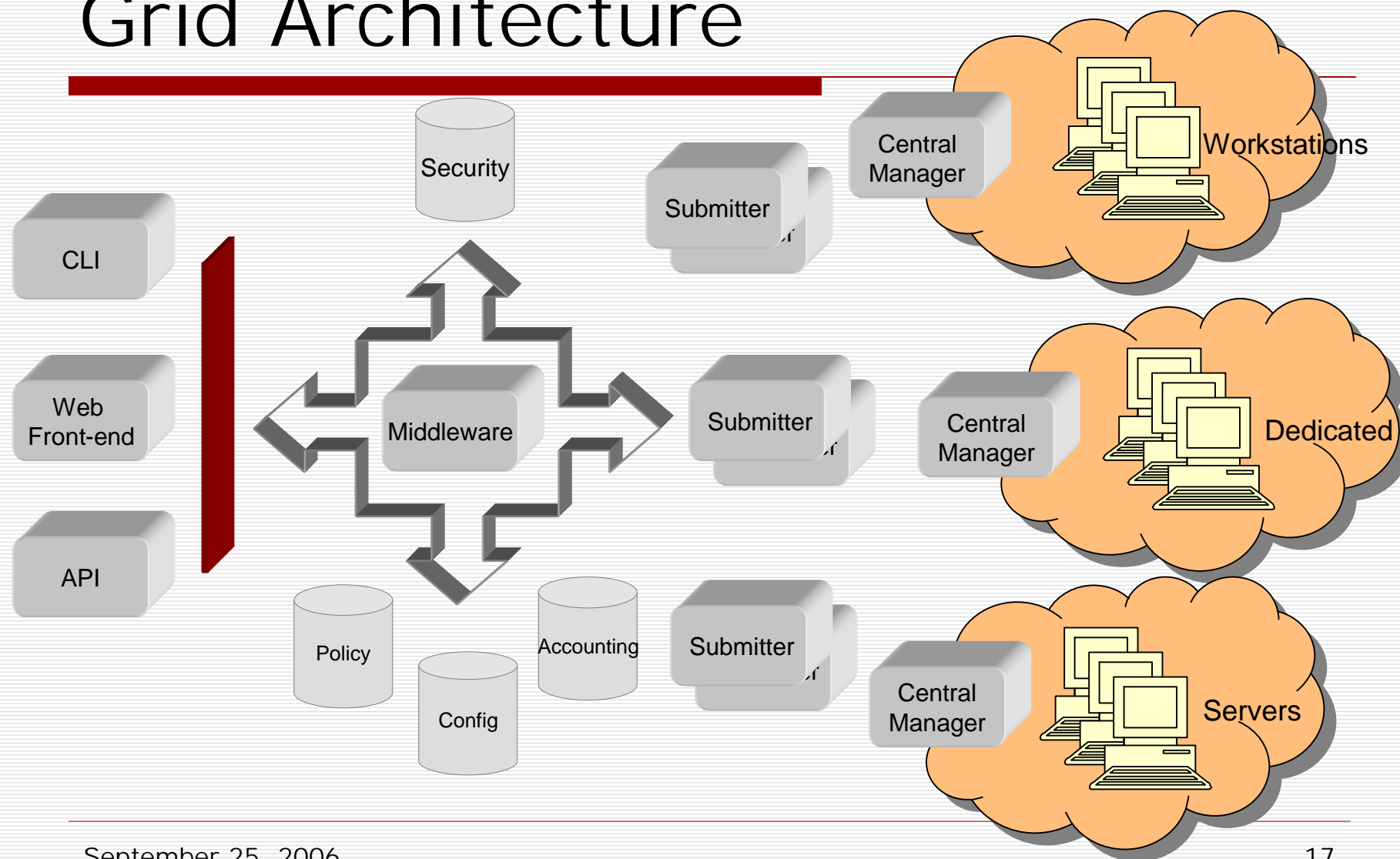
Stop-gap Solutions

- Extend the distributed capabilities of our off-the-shelf modeling tool.
 - n Buy dedicated server-class hardware
 - n Improve networking
 - n Create policies and procedures to improve reliability
- Results...
 - n Largest distributed implementation of modeling tool in the world
 - n Tested to 68 workers
- Still not good enough.
 - n Reliability concerns
 - n Breaking new ground for scalability
 - n Manually intensive operation

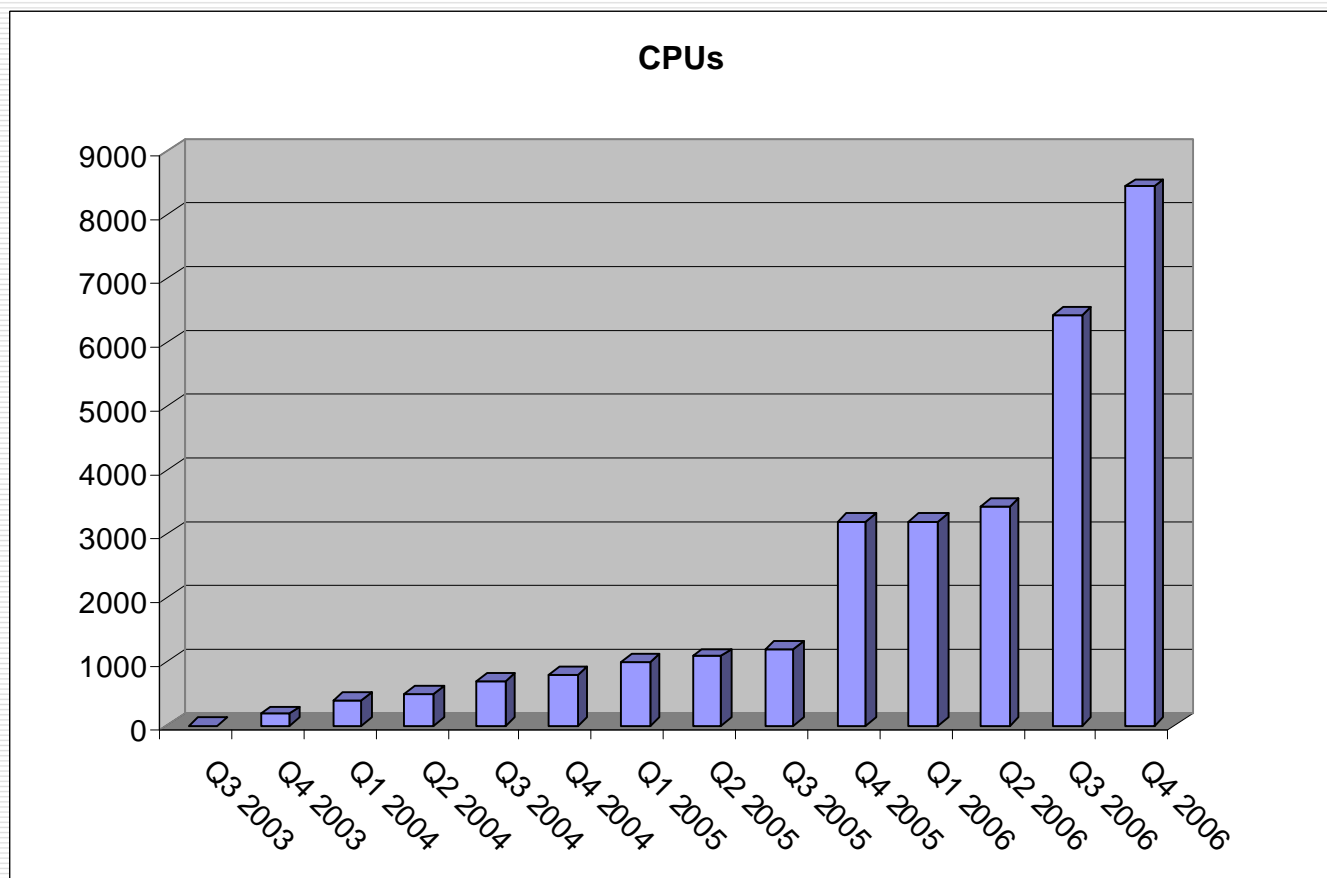
Enter the Grid.

- In Q2 of 2003, a commercial grid vendor approached us with a turnkey grid solution for our modeling tool.
 - n Scalable
 - n Recoverable
 - n Integrated
 - n Not a production release
 - n Very expensive
- At the same time, we hedged our technology bet with an in-house solution using Condor.
 - n Scalable
 - n Mature
 - n Flexible
 - n Free

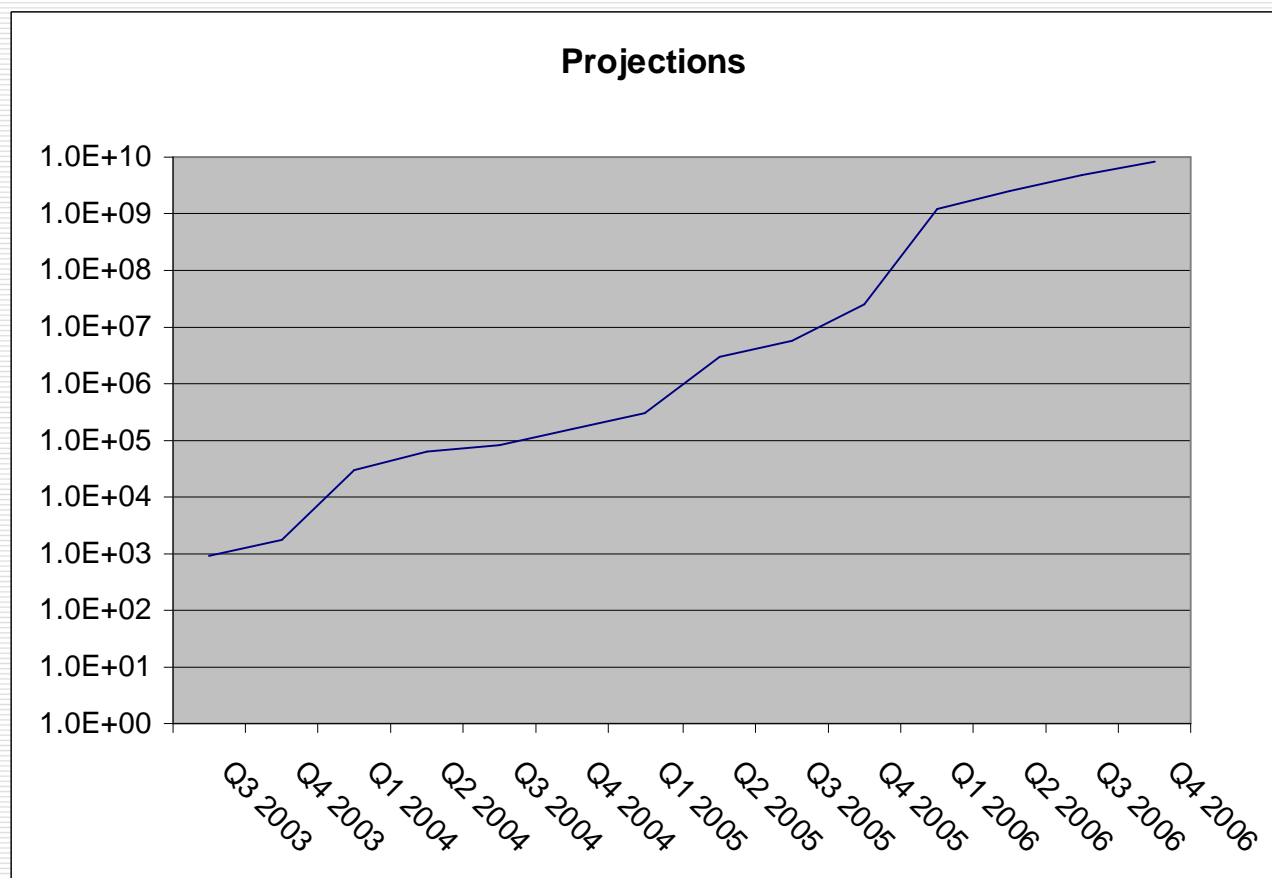
Grid Architecture



Grid Capacity



Grid Utilization



Our Strategy

- Enhanced Operating Environment
 - n End-user automation
 - n Compute pool confederation
 - n Improved security
 - n Comprehensive fair-use policies
 - n Accounting and reporting
- Expand use to shared resources.
 - n 1,000+ file servers unused or underutilized after business hours
 - n 800+ application and database servers
 - n 25,000+ desktops
- Grid-optimized Application Development
- Evangelize