EMC and Grid Computing

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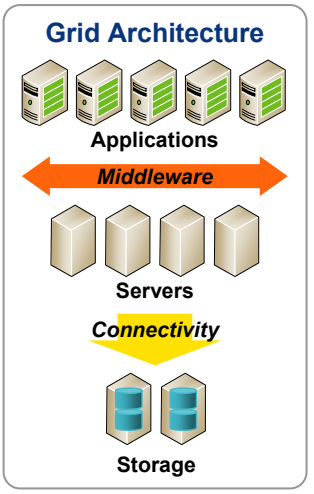
What is a Grid?

"…applying the resources of many computers in a network to a single problem at the same time…"

— SearchCIO.com

"A computing system that is concerned with the integration, virtualization, and management of services and resources in a distributed, heterogeneous environment that supports collections of users and resources (virtual organizations) across traditional administrative and organizational domains (real organizations)"

— *OGSA Glossary*, Global Grid Forum



Grid Computing: An Extreme Example…

SETI@home is a scientific experiment that uses Internet-connected computers in the Search for Extraterrestrial Intelligence (SETI)—you can participate by running a free program that downloads and analyzes radio-telescope data

	Total	Last 24 Hours (New Users)
Users	5,361,313	4,391
Results received	1,779,286,958	5,000,731
Total CPU time	2,228,283.986 years	3610.717 years
Floating point operations	6.523404e+21	1.950285e+19 (225.73 TeraFLOPs/sec)
Average CPU time per work unit	10 hr 58 min 14.0 sec	6 hr 19 min 30.1 sec

SETI@Home website, March 7, 2005

…but not exactly commercial requirements

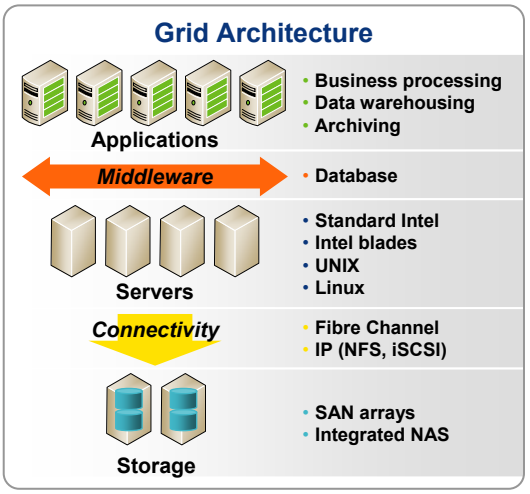
"At 13:30 UTC yesterday the SETI@home upload/download server failed. We've solved the problem, so you should be able to upload results and download new work at this time. There will probably be a long period where the servers are overloaded with backlogged requests. Thank you for your patience."
May 30, 2006

Today's Grid Deployments

	Segment Descriptions	Applications	Examples
Commercial	**"Database grids"**	• Oracle 10*g* • Data mining • Decision support	**Data warehouses:** Oracle 10*g* over grids of Linux servers
	"Application grids"	• CAD prototyping • Digital media • Software development • Trading	**Commercial applications:** Explorations of grids with specialized middleware
	"Compute grids"	• Financial derivatives • Risk analysis • CAE simulation	**Financial industry:** Grids of Linux servers with customized software to run sophisticated analytics
Scientific	**"Compute grids"**	• DNA/genome • Particle physics • University research • Satellite imaging • Oil exploration	**Government Research:** Massive grids of Linux servers with open source file systems performing particle-physics simulations

Database Grids

- Key drivers
  - Lower total cost of ownership by deploying database applications on commodity servers
- Application complexity
  - Low, handled by database middleware
- Information sharing
  - Low to medium
- Storage requirements
  - Scalable performance
  - High availability
  - SAN or NAS access

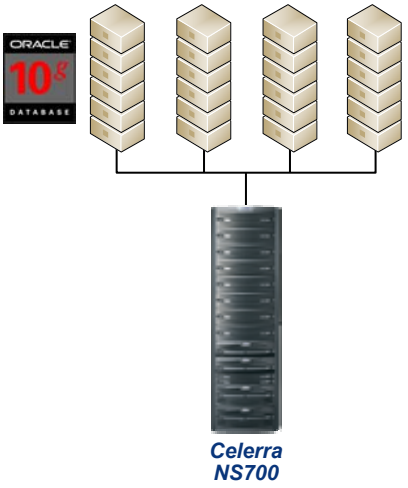


Database Grid Example

An Internet Retailer Deployed an Oracle 10*g* RAC on Dell Servers with EMC Networked Storage

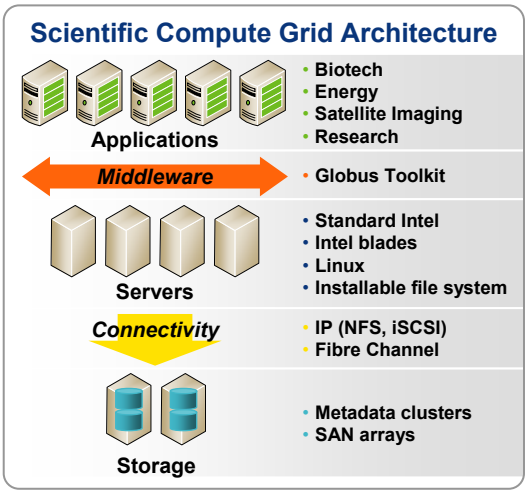
Business Impact

- Provided the flexibility to scale, manage, and grow the IT infrastructure on demand
- Improved service levels
- Lowered total cost of ownership



Scientific Compute Grids

- Key drivers
  - Unlimited scalability by re-architecting applications for grids
- Application complexity
  - High, re-engineering, installable file systems
- Information sharing
  - Highly variable
- Storage requirements
  - High throughput
  - High availability
  - SAN and NAS access



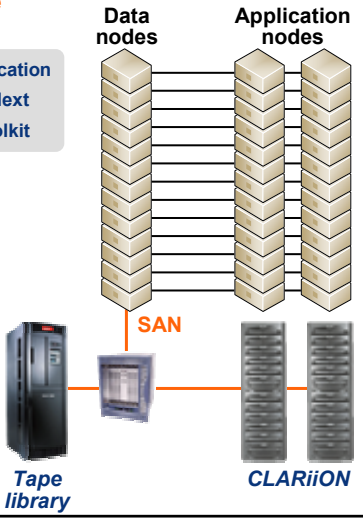
Scientific Compute Grid Example

Energy Corporation Deployed an HPC Geophysical-Analysis Application on Linux Servers with EMC Networked Storage

Business Impact

- Faster job turnaround
- Handles extremely large amounts of data
- Improved flexibility and usage

Custom application
ADIC StorNext
Globus Toolkit



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Project MegaGrid Overview

Best Practices for Enterprise Grid Computing

- Project MegaGrid is designed to reduce the cost, risk, and time to move to Oracle's Grid Computing
  - Grid Computing creates a large, clustered Oracle10g database system running on low-cost Linux servers and networked storage infrastructure

Industry Leaders

- Jointly development by EMC, Oracle, Dell, and Intel to test, prove, and document repeatable methodologies for Grid Computing
- Tests run in joint development facility at Oracle's Global IT Data Center in Austin, TX, using real-world applications

Customer Deliverables

- White papers providing design, deployment, and operational-methodology recommendations

ORACLE DELL intel

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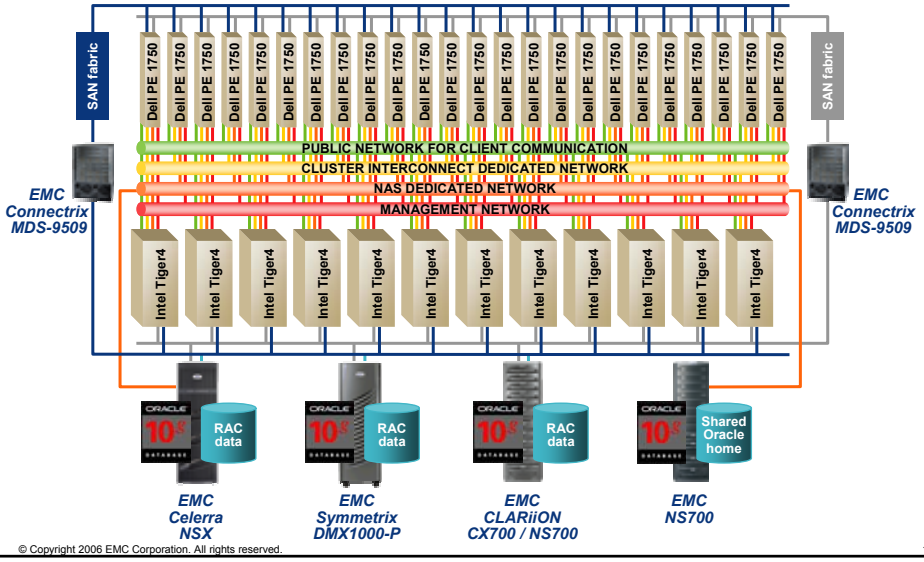
Project MegaGrid: Deployment Architecture



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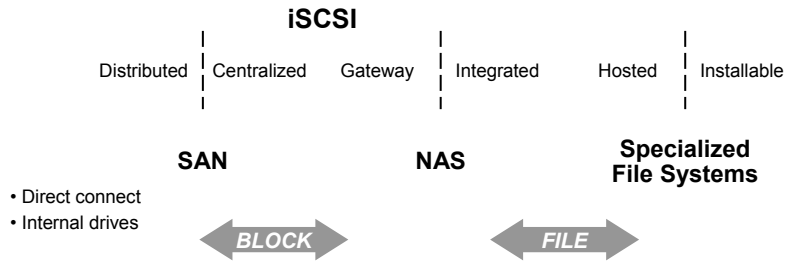
Storage Paradigms for Grids

Different Requirements Lead to Different Storage Architectures

Grid Applications—Storage Requirements

- Performance
- I/O throughput
- Fibre Channel versus IP
- Sharing/no sharing
- Batch versus transactional
- Size of datasets
- File sizes
- Permanent versus throw-away data



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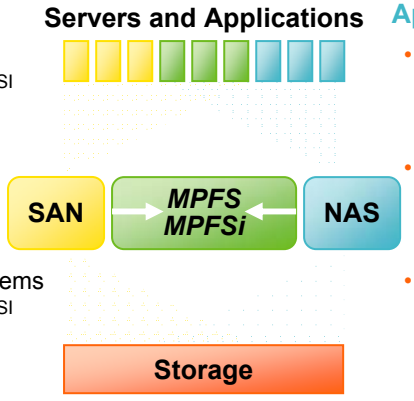
Multi-Path File Systems

Architectures

- SAN
  - Fibre Channel or iSCSI
  - No data sharing
  - High bandwidth
- NAS
  - IP network
  - Data sharing
  - Low bandwidth
- Multi-Path File Systems
  - Fibre Channel or iSCSI
  - Data sharing
  - High bandwidth



Applications

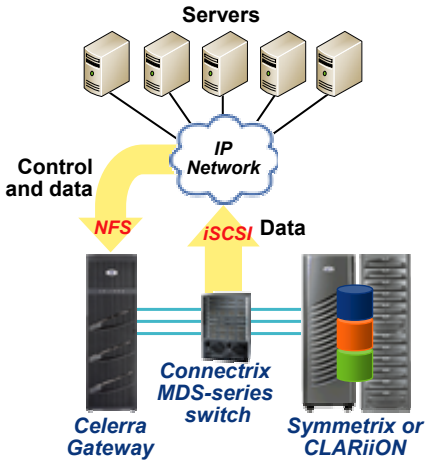
- Media
  - Post-production
  - Streaming video
  - Ad creation
- Grid computing
  - Bioengineering
  - CAD/CAM
  - Financial Analysis
- Large-file processing
  - Image processing
  - Backups
  - Oil and Gas

Multi-Path File Systems deliver the best of both worlds

Celerra Multi-Path File System for iSCSI (MPFSi)

NAS Request, iSCSI Delivery

- Servers connected to storage network via iSCSI
- Servers connected to an out-of-band "metadata" controller
  - Celerra NSX
  - NS Series/Gateway
- Servers send file requests to Celerra via IP
- Data access is done directly via iSCSI

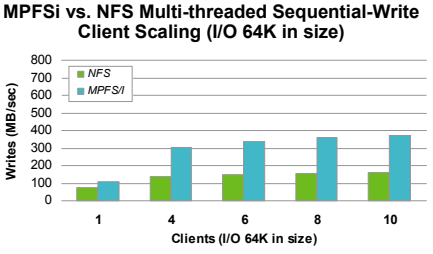


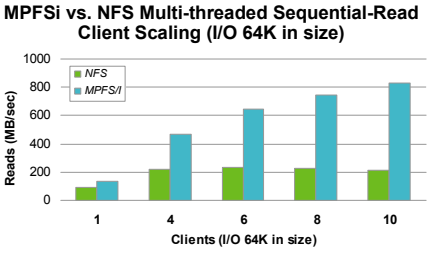
Celerra MPFS for iSCSI

Continued

High-Performance File Sharing

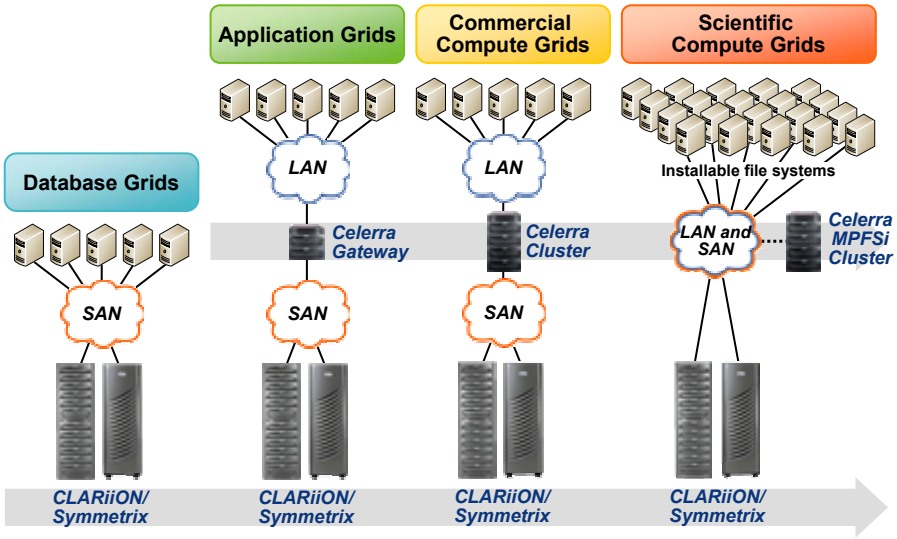
- NAS request via IP
- Data delivery via iSCSI
- Transparent to applications
- Delivers high application performance
- Enhances Celerra scalability
- Greater client scalability at lower cost





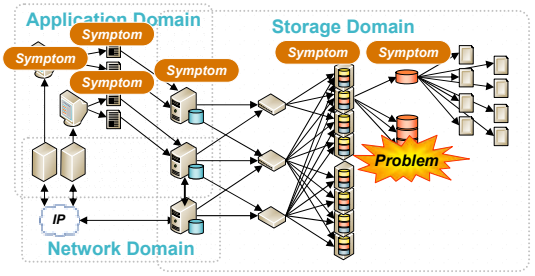
Source: EMC Engineering

EMC Storage: Extensible Architecture



Problems with Managing Grid Computing

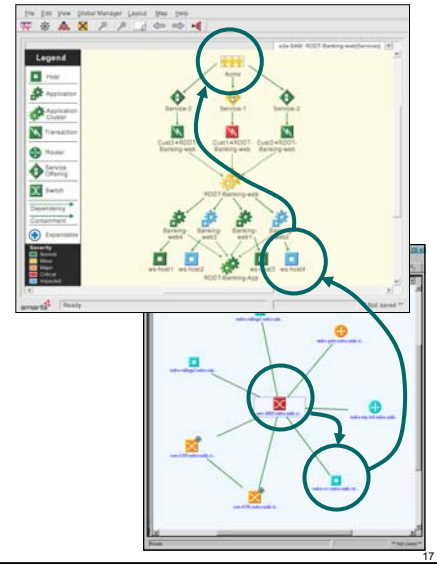
- Too much data, not enough information
  - Too many trouble tickets being opened in the call center—can't keep up
- Difficult to determine the root cause of a problem
  - Can't distinguish among **network, storage,** and **application** faults
- Difficult to gauge the impact of an IT-level problem to the organisation



Management solutions send alarms for everything

EMC Smarts: End-to-End Root Cause Analysis

- Knowledge of all managed elements
  - Network, Network Services, Servers, Applications, Application Services, Storage, Business User Communities
- Knowledge of relationships
  - Within and between these managed elements
- Causal Propagation across managed elements
  - Differentiate symptoms from problems
  - How problems cause symptoms to other nodes
- True “end-to-end” impact analysis from the IT infrastructure to the business user.



EMC Smarts: Managing Services In Real Time

Automated Actionable Intelligence

Analytics
Codebook Correlation Technology™

Abstraction
EMC Smarts Common Information Model™

Data and Event Collection

Applications, Optical, Firewalls, Routers, Video, Switches, IDS, Servers, Databases, Telephony, Storage

With patented, industry-leading technologies

The ICIM Library - Abstraction

- The essential properties of each monitored element apart from application to, or association with, a particular instance
- InCharge (Smarts) Common Information Model (ICIM) library is the abstracted representation of monitored objects within:
  - The Business
  - Applications
  - Infrastructure
- ICIM Library Contains/Defines:
  - Objects & Attributes
  - Complex relationships between objects (topology)
  - Object's common failures and associated symptoms
  - Causality propagation of failures

Analysis: Codebook Correlation Technology™

- **Once Smarts has built the topology repository, the Codebook Correlation is automatically generated.**
- **The Codebook is SMARTS patented, built-in intelligence that automatically adapts to each managed environment.**
- **Smarts identifies the problems that can occur and their patterns of symptoms.**
- **Smarts then monitors for problem symptom signatures.**
- **Once a problem is detected, ICIM is leveraged to trace the spread of the problem and determine business impact.**

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Codebook

Problems

Symptoms

	s0	s1	s2	s3	s0 c0	s0 c1	s1 c0	s1 c1	s2 c0	s2 c1	s3 c0	s3 c1	s0 c0 p0	s0 c0 p1	s0 c1 p0	s0 c1 p1	s1 c0 p0	s1 c0 p1	s1 c1 p0	s1 c1 p1	s2 c0 p0	s2 c0 p1	s2 c1 p0	s2 c1 p1	s3 c0 p0	s3 c0 p1	s3 c1 p0	s3 c1 p1	
s0c0p0l0		1			1		1						1				1												1
s0c0p0l1				1	1						1		1												1				1
s0c0p1l0		1			1		1							1				1											1
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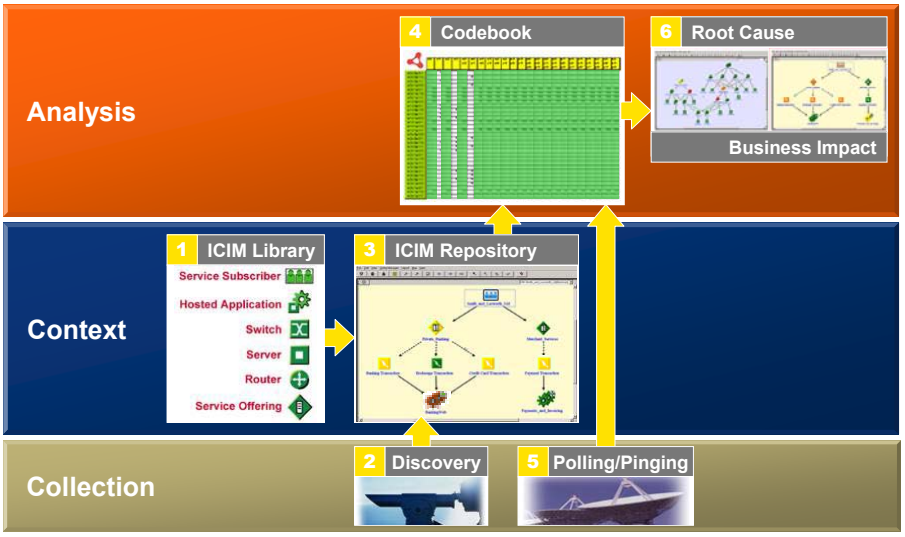
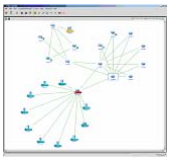
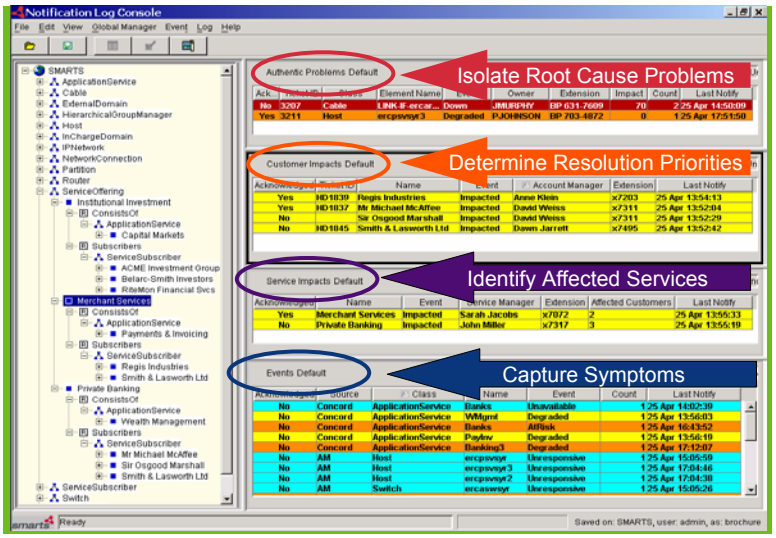
Automating Service Management—Start to Finish



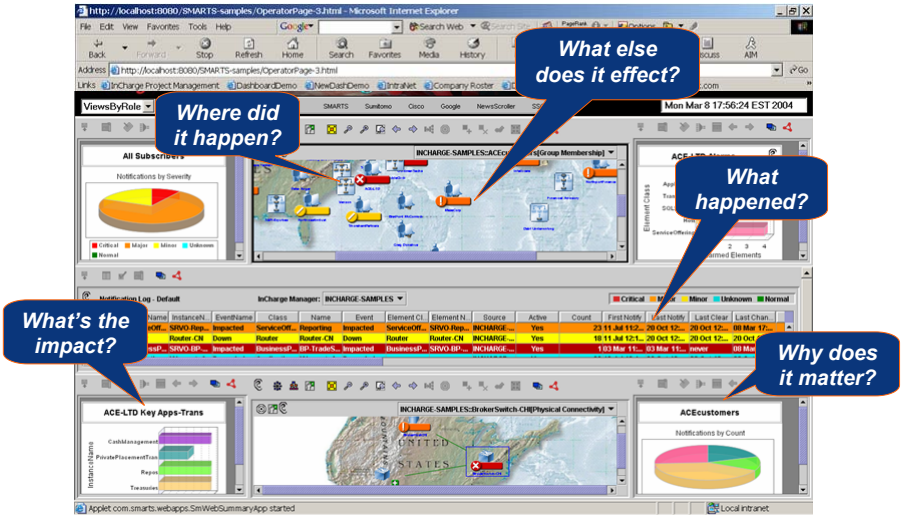
EMC Smarts Automated Actionable Intelligence

Problem View	Topology View	Application View	Dashboard View	Business Impact View
				
What is happening?	***Where is it happening?***	***What does it affect?***	***What's the impact?***	***Why does it matter?***

Single Focal Point – Global Console

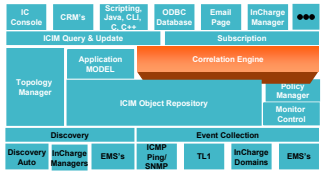


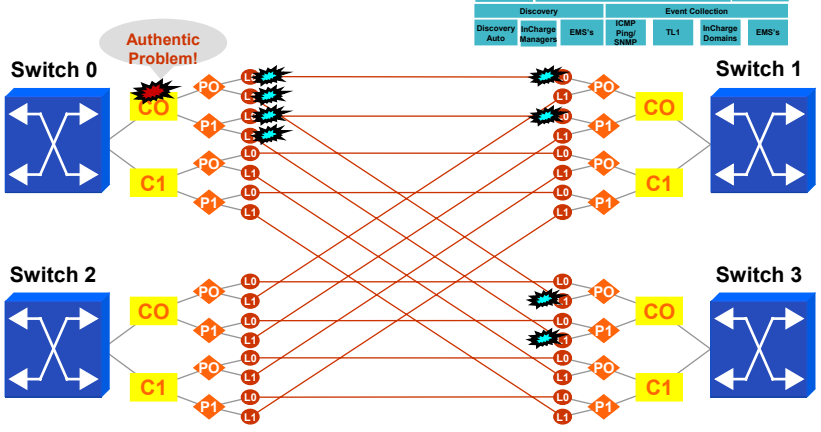
Single Focal Point Dashboard



Example of a Network Problem

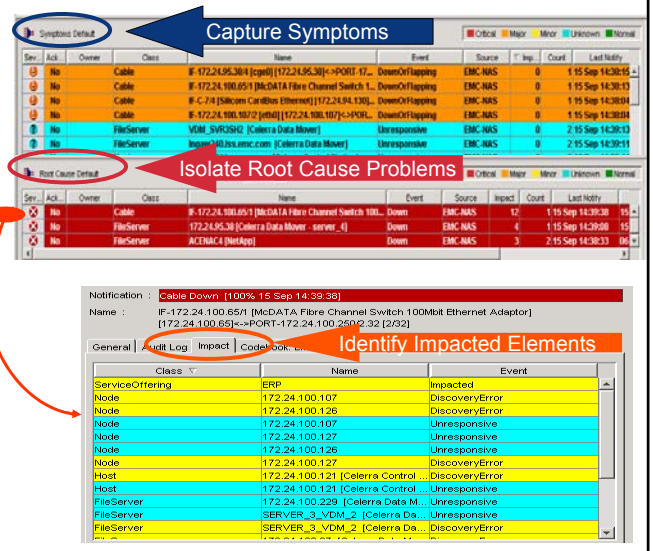
Each instance of problem has a unique *signature* in the symptoms that it causes





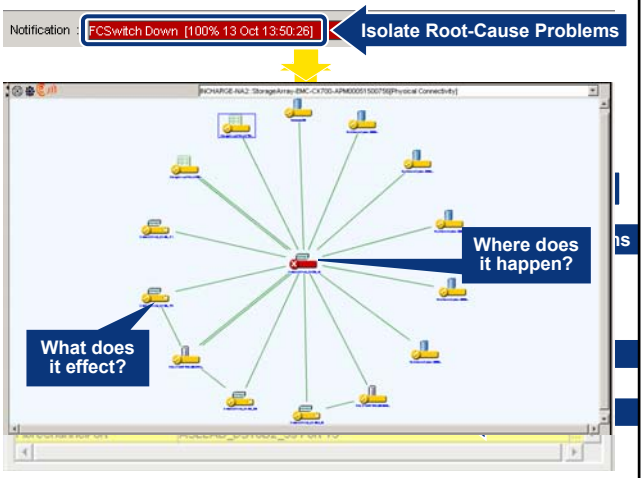
Example of NAS Problem

- Automate real-time root cause and impact analysis
  - Critical IP network connectivity problems, including NAS IP connectivity



Example of SAN Problem

- Automatically diagnose root-cause problem
  - SAN port links and unit failures
  - HBA port links and card failures
- Identify impacted elements
  - Host Devices and File Systems
  - Celerra Data Movers
  - PowerPath Paths



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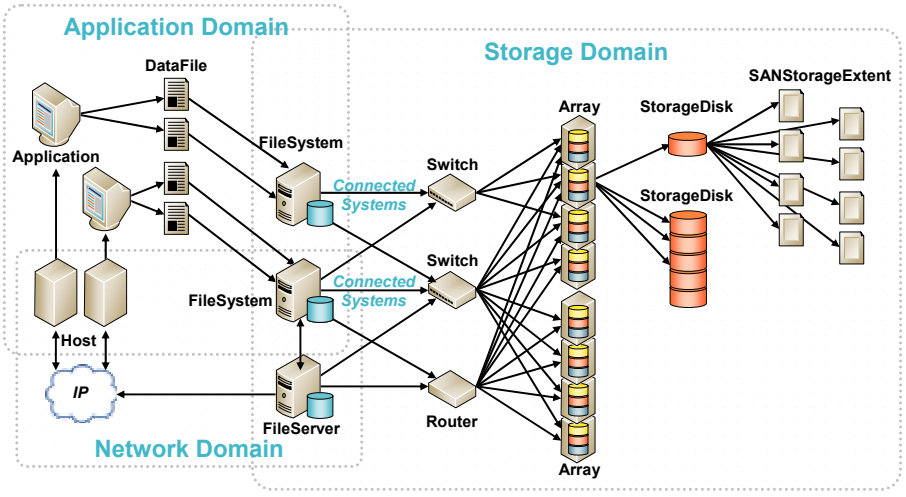
End-to-End Root Cause Analysis



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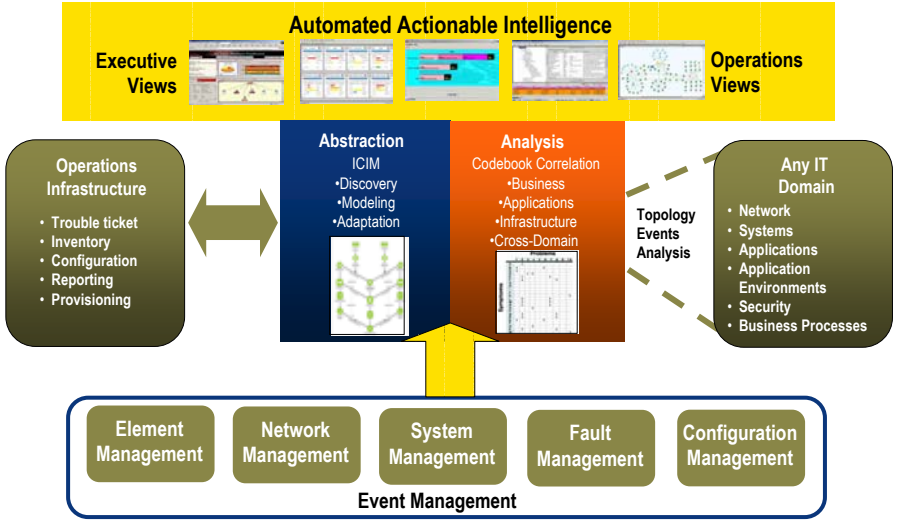
Adding EMC Smarts to Your Environment



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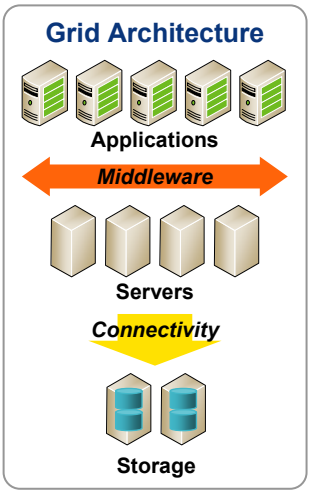
Why EMC for Grid?

- Industry leader in networked storage
  - Fibre Channel and IP connectivity
  - Scalable performance
  - High availability
  - Advanced functionality
  - Multi-Path File Systems
- Automated solutions for managing complex information-technology infrastructures
  - Highly accurate auto-discovery
  - Automated root-cause analysis
  - Cross-domain correlation enables real-time, end-to-end management of today's largest and most complex networked systems
- Key alliances—Project MegaGrid initiative
  - EMC, Oracle, Dell, and Intel
  - Best practices and blueprints



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