



IBM Software Group

Ensuring Service Delivery

IBM Tivoli System Automation

Tivoli software



ON DEMAND BUSINESS™

Agenda

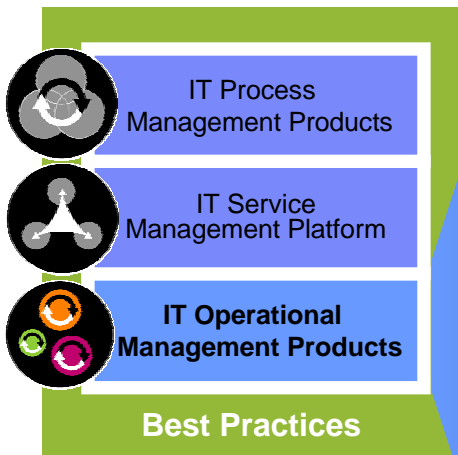
- IT Service Management and System Automation
- The System Automation Portfolio
 - ▶ System Automation for z/OS
 - ▶ System Automation for Multiplatforms
 - ▶ System Automation for Integrated Operations Management
- Disaster Recovery Issues



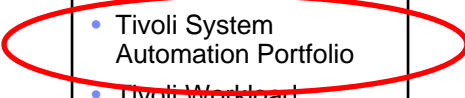
IT Operational Management Products

Integrated across disciplines through ITSM Platform and to IT Process Management Products

IBM IT Service Management

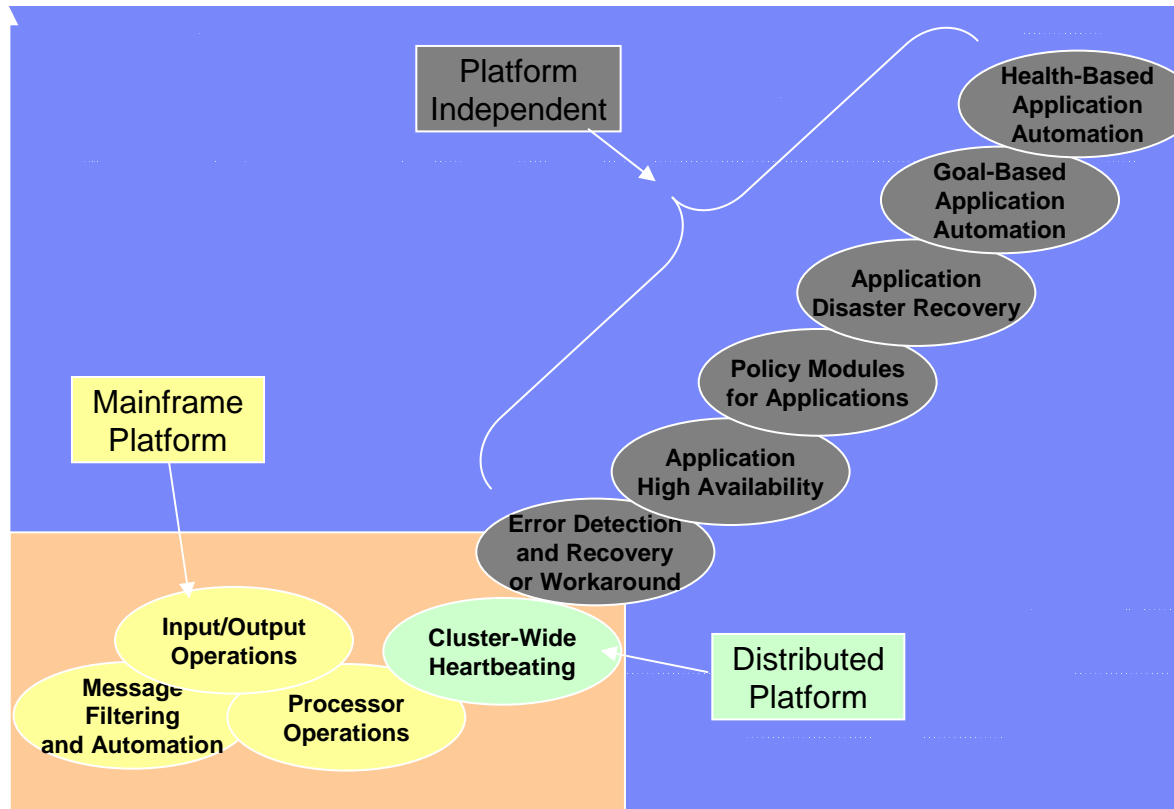


Business Application Management	Server, Network & Device Management	Storage Management	Security Management
<p>Products include:</p> <ul style="list-style-type: none"> ▪ Tivoli Composite Application Management • Tivoli Business Systems Manager • Tivoli Service Level Advisor • Netcool/Impact and Netcool RAD • Netcool Monitors • Tivoli Intelligent Orchestrator • Tivoli License Compliance Manager • Tivoli License Compliance Manager of z/OS • Tivoli Contract Compliance Manager 	<p>Products include:</p> <ul style="list-style-type: none"> ▪ Tivoli Enterprise Console • Tivoli Monitoring • Tivoli OMEGAMON • NetView Portfolio • Netcool/OMNIBus • Netcool/Proviso • Netcool/Precision • Netcool Monitors • Tivoli Remote Control • Tivoli System Automation Portfolio • Tivoli Workload Scheduler • Tivoli Provisioning Manager • Tivoli Configuration Manager • Tivoli Decision Support for z/OS 	<p>Products include:</p> <ul style="list-style-type: none"> • Tivoli Storage Manager • Tivoli Continuous Data Protection for Files • TotalStorage Productivity Center • Mainstar 	<p>Products include:</p> <ul style="list-style-type: none"> • Netcool For Security management • Tivoli Access Manager • Tivoli Identity Manager • Tivoli Federated Identity Manager • Tivoli Directory Server • Tivoli Directory Integrator • Security Compliance Manager • Vanguard



Goal of Tivoli System Automation

Ensure Service Continuity of Applications Through Platform-Independent Autonomic Capabilities



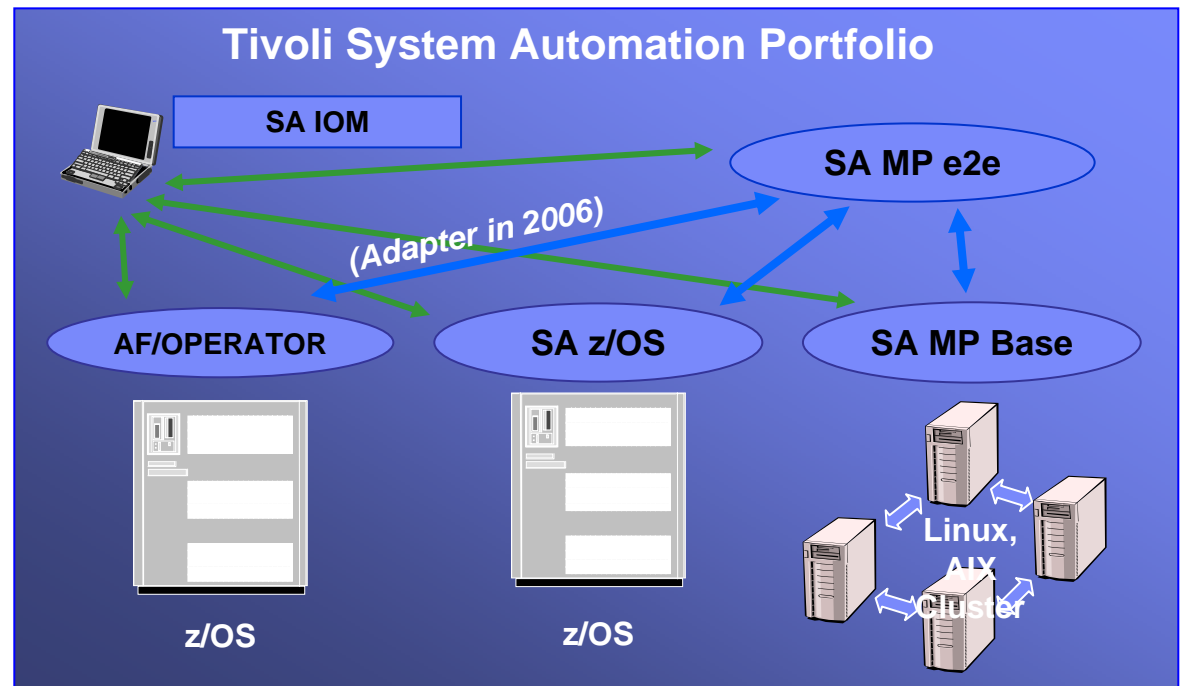
Autonomic Capability



The System Automation Portfolio Delivers High Availability and Disaster Recovery Capabilities for Mission-Critical Applications

- System Automation (SA) reduces planned and unplanned downtime by automating
 - ▶ Recovery or work-around of failed application components and resources
 - ▶ Complex operational tasks such as moving applications and workloads from one system to another
 - ▶ z/OS management including message, I/O and processor operations

- **SA z/OS** provides application high availability and advanced z/OS and Sysplex management
- **AF/OPERATOR** provides automated z/OS management for simpler environments
- **SA Multiplatforms** provides high availability for entire multi-tiered applications and applications running in server clusters
- **SA Integrated Operations Management** provides secure outboard automation for z/OS and distributed systems, and remote IPL and console consolidation for z/OS



System Automation for z/OS



System Automation for z/OS (SA z/OS) is the Premier Application HA/DR and Event Management Solution for Mission-Critical z/OS Workloads



- Goal-based automation engine drives the observed state of all resources to meet desired states
 - ▶ Complex resource relationships and dependencies are maintained throughout the automation framework
- Application HA/DR
 - ▶ Recover or work around failed application resources
 - ▶ Restart applications on different systems within the same site or in remote site
- Systems operations
 - ▶ Monitor and manage sub-system processes, messages and alerts
 - ▶ Automate complex and repetitive tasks
- I/O operations
 - ▶ Manage I/O fabric including ESCON and FICON directors
 - ▶ Change I/O configuration on the fly
 - ▶ Safe through system integrated switching
- Processor operations
 - ▶ Initiate program load, configure, recover and shut down servers

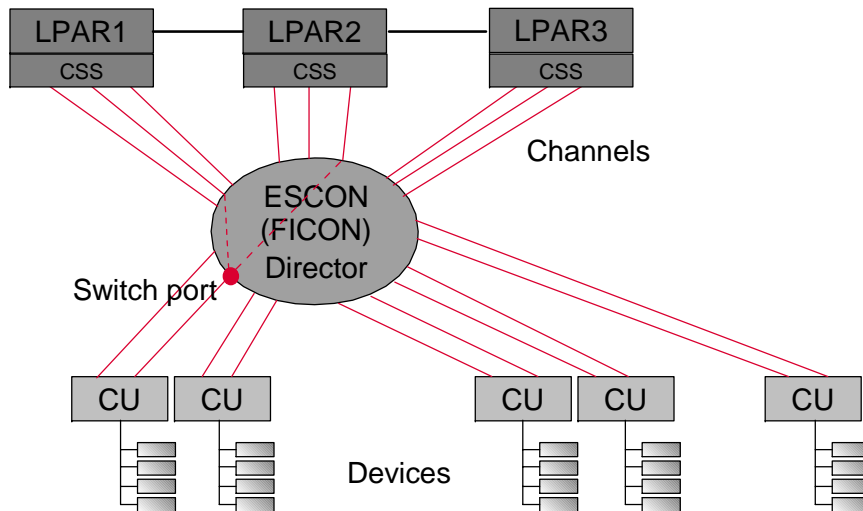


The Goal-Based Automation Engine Drives the Entire System to Ensure Maximum Availability as Deviations Occur to Individual Resources



- The SA z/OS automation engine tracks resource states based on observations
 - ▶ 5 regular states including Normal, Warning, Minor, Critical and Fatal
 - ▶ Unknown state has not yet been determined
 - ▶ Failed state reschedules the observation
 - ▶ Broken state indicates failed observation which has also stopped
- SA z/OS continuously determines the accumulated health state of the entire system
- Action is triggered based on automation policies, manual requests, resource relationships and individual resource health states

SA z/OS Provides the Foundation for Automating Within and Across Sysplex Environments



- SA z/OS is uniquely “Sysplex aware” with automated I/O and Processor Operations
- Make changes on the fly and SA z/OS incorporates all device and resource states and relationships into its decision-making framework to ensure overall system availability and integrity

- I/O Operations provides a single point of control for managing and verifying the entire I/O fabric
 - Virtualized single system image for multi-system environments
 - Single operation to dynamically change I/O configurations across multiple systems or Sysplexes
 - Identify actual system images with connectivity to affected resources
 - Virtualizes channel management by pooling channels and dynamically assigning to different CUs, optimizing channel workload

- Processor Operations provides a single point of control for server level tasks
 - Single platform for eServer consoles to initiate, configure recover and shut down servers
 - Common commands for all supported hardware and operating systems including z/OS, OS/390, Linux on zSeries, z/VM, VSE and TPF
 - Easily configurable via a customization dialog

SA z/OS Reduces Operational Complexity with Advanced Message Automation for Critical z/OS Sub-Systems

- SA z/OS ships with self-configured automation modules

- ▶ Providing even faster setup and implementation
- ▶ Reducing customization efforts and recycling



- | | | |
|-------------------------|-------------------|---|
| ✓ MVS messages | ✓ TCP/IP | ✓ MQSeries |
| ✓ JES2 | ✓ OMPROUTE | ✓ DB2 |
| ✓ JES3 | ✓ RESOLVER | ✓ IMS |
| ✓ OMVS | ✓ ZFS | ✓ FDR |
| ✓ VTAM | ✓ RMF | ✓ CICS |
| ✓ TSO | ✓ RMF Monitor III | ✓ CMAS |
| ✓ NetView SSI | ✓ VLF | ✓ IRLM |
| ✓ NetView Application | ✓ DLF | ✓ NFS Server |
| ✓ Automation Manager | ✓ LLA | ✓ TPX (Terminal Productivity Executive) |
| ✓ SysOps | ✓ APPC | ✓ WebSphere |
| ✓ ProcOps | ✓ ASCH | ✓ MQ |
| ✓ I/O Ops | ✓ TWS | ✓ OMEGAMON – Big 4 |
| ✓ SA Product Automation | ✓ RACF | |
| ✓ RODM | ✓ DFHSM | |
| ✓ GMFHS | ✓ DFRMM | |



SA z/OS Delivers Advanced HA/DR Capabilities for Mission-Critical Applications and Middleware

- Single point of HA/DR control for z/OS applications
 - ▶ Start, stop or restart applications in the same system, or failover workloads to another system
 - ▶ Manages application resource relationships and dependencies to ensure each resource restarts in the correct sequence in the correct system
 - ▶ Provides the ability to group resources to further ease complexity

- Ships with plug and play automation modules for many z/OS applications and middleware including SAP, WAS, WAS MQ and DB2
 - ▶ Structured based on sophisticated knowledge of the application and on best practice observed in the field
 - ▶ SA z/OS allows for dynamic mass importing of entire application groups into existing, already running configurations
 - ▶ Provides faster time to value, eliminates coding errors
 - ▶ Provides re-usable application automation for use elsewhere in the enterprise

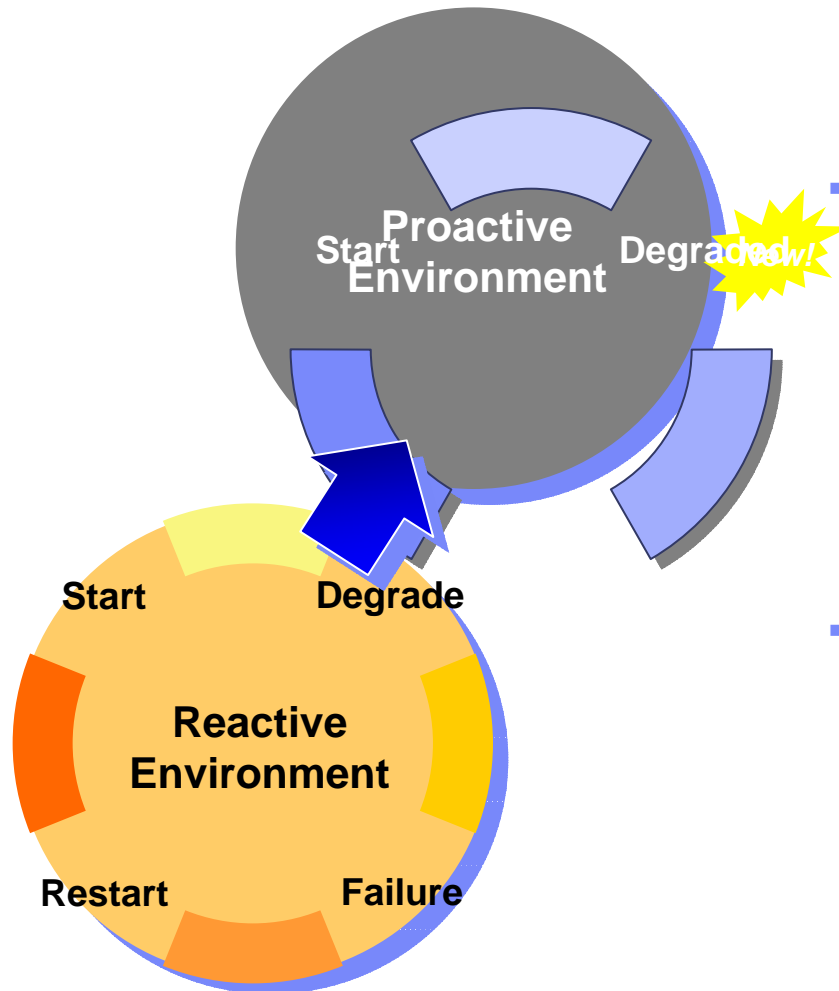


SA z/OS Maximizes Application and Middleware Availability and System Integrity

- WebSphere example: SA z/OS ensures proper startup and shutdown sequences and delivers near-continuous availability
- Plug and play automation module for WebSphere is pre-wired to ensure
 - ▶ Quick starts, stops and recovery of all pre-requisites and components of WebSphere in the correct order in the correct system
 - ▶ When a resource fails and is recovered, SA z/OS automatically restarts all dependent resources
 - ▶ When restarting vital components fails, SA z/OS automatically moves WebSphere to another image
 - ▶ Clean up of server address spaces that WebSphere is unable to terminate during end processing



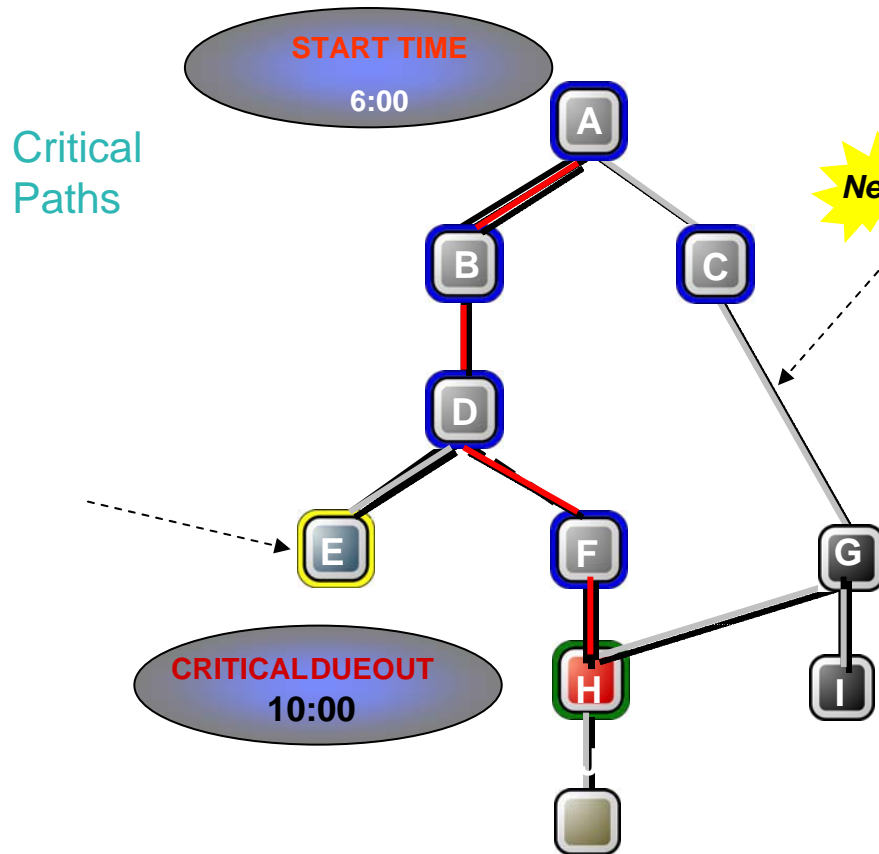
SA z/OS and OMEGAMON Enable the Detection And Resolution of Application Performance Degradation Before Failures Occur



- OMEGAMON quickly detects degraded health states of the application by taking a broad range of performance and availability measurements
- SA z/OS factors OMEGAMON information into its automation framework periodically or based on events to
 - ▶ Eliminate bottlenecks
 - ▶ Provision additional resources
 - ▶ Move workloads
 - ▶ Prepare for planned outages
- Provides the ability to quickly react and resolve exceptional conditions
 - ▶ For example when SA z/OS observes an IMS health state of “Critical” based on OMEGAMON performance information, it starts a new server instance to ensure optimum system performance



SA z/OS and Tivoli Workload Scheduler (TWS) Proactively Manage Critical Paths to Meet Strict Scheduling Deadlines



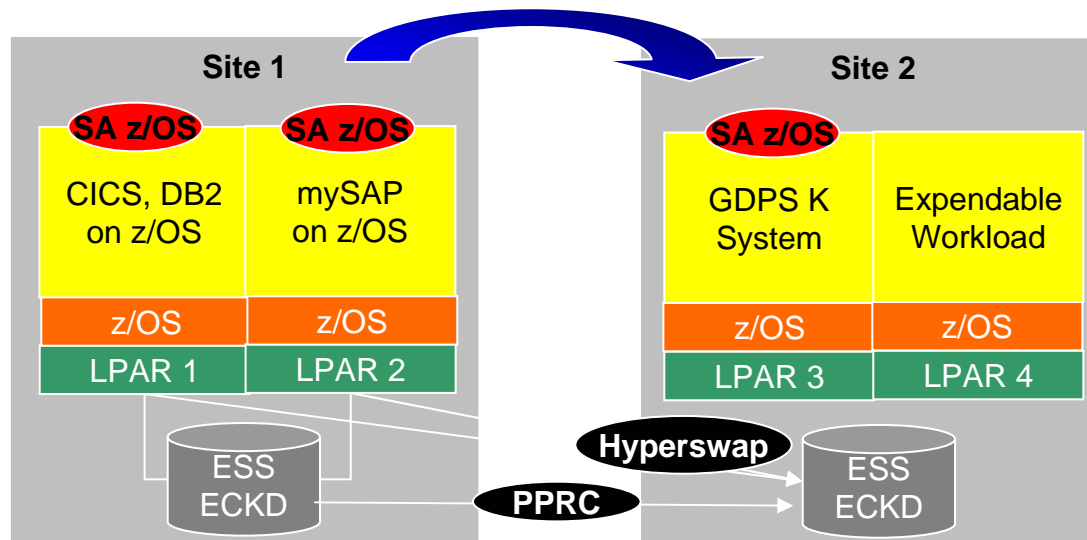
- TWS delivers centralized management for planning and controlling enterprise-wide production workloads

TWS provides high visibility and high degree of control of the SA z/OS automation framework

- ▶ Identify all critical paths during plan design with TWS
- ▶ Issue and monitor SA z/OS commands from TWS
- ▶ Modify in-flight or in advance by making changes from TWS, including prioritizing critical paths, automatically changing the goals in SA z/OS
- ▶ Perform “non-job” functions such as starting/stopping application groups within TWS and executed by SA z/OS
- ▶ Provide security/audit trail throughout the process

Leverage SA z/OS in the Datacenter for Complete Enterprise DR Capabilities with GDPS®

- IBM Global Services offers a broad range of enterprise DR solutions
 - ▶ Geographically Dispersed Parallel Sysplex (GDPS) offerings
 - ▶ GDPS provides a single point of control to manage multiple HA/DR technologies for continuous application and data availability even in the event of a major catastrophe
 - ▶ SA z/OS provides the foundation for GDPS to quickly move, restart and recover entire workloads from one site to another over any distance, including the automation framework for overall system recovery, application failover, Processor and I/O Operations, remote copy configuration and management of storage subsystems
- New!** SA z/OS ships with GDPS plug and play automation modules for quick setup and implementation and seamless operations



SA z/OS is Integral to All GDPS Offerings

Continuous Availability of Data (Single Site)

Solution	Target Customer	Value
GDPS/PPRC HyperSwap Manager (Single site)	Parallel Sysplex	Continuous Availability of Data

Unlimited Distance D/R (2 sites)

Solution	Target Customer	Value
RCMF/XRC	Disk Mirroring	XRC Management Ease of Use
GDPS/XRC	DR (zSeries Only)	Site failover RTO = 1-2 hrs; RPO < 1 min
GDPS/Global Mirror	DR (zSeries & Open data)	Site failover RTO = 1-2 hrs ; RPO < 1 min

Metropolitan Distance CA/DR (2 sites)

Solution	Target Customer	Value
RCMF/PPRC	Disk Mirroring	PPRC Management Ease of Use
GDPS/PPRC HyperSwap Manager	Entry Level Disaster Recovery (DR)	Planned & Unplanned reconfiguration RPO=0; RTO depends on customer automation
GDPS/PPRC Sysplex/PPRC across 2 sites Prod systems in same site or Prod systems in 2 sites)	DR for zSeries and Open Data Continuous zSeries Data availability	Planned & Unplanned reconfiguration RPO=0; RTO< 1 hr
GDPS/PPRC BRS configuration Sysplex in one site PPRC across 2 sites	DR for zSeries and Open Data	Planned & Unplanned reconfiguration RPO=0; RTO< 4 hrs

CA/DR 3 sites (Metro + Unlimited Distance)

Solution	Target Customer	Value
GDPS/PPRC & GDPS/XRC (z/OS data only)	Economically essential businesses; Ultimate Bus Continuity	Metro distance CA for zSeries data & unlimited distance DR
GDPS Metro/Global Cascading (z/OS & Open Data)	Economically essential businesses; Ultimate Bus Continuity	Metro distance CA & unlimited distance DR



System Automation for Multiplatforms



System Automation for Multiplatforms (SA MP) Includes Two Orderable Components

▪ **SA MP Base Component**

- ▶ Automates failover, stop, start, restart in place and move operations for applications running in homogeneous clusters within the datacenter and across sites
- ▶ Supports AIX 5L and Linux including Linux on zSeries
 - Additional platform support in plan
- ▶ No distance limitations to failover capabilities
 - Communication based on TCP/IP



SA MP End-to-End Component

- ▶ Provides single point of HA/DR automation for composite applications with resource relationships spread across heterogeneous clusters
- ▶ Unique capability to manage HA/DR automation across both distributed and zSeries platforms



SA MP Base Component Maximizes Application Availability by Providing More Than Simple Failover Capabilities

- Delivers autonomic self-healing capabilities for applications
 - ▶ Provides fast detection of outages by monitoring (heartbeating) all resources in the cluster
 - ▶ Factors sophisticated knowledge of application components and their relationships into decision-making framework
 - ▶ Delivers quick and consistent recovery of failed resources either in place or on another system in the cluster

- Implements goal-based HA/DR automation
 - ▶ The goal is to drive the observed state of each application resource and component to the desired state while maintaining resource relationships and dependencies
 - ▶ Manual requests (including start, stop and move) change the goals
 - ▶ Resources can be grouped so the entire group is acted upon as a single resource to ease complexity and management

- Ships with over 40 plug and play automation modules for added value and even faster setup and implementation
 - ▶ Preconfigured for each application and based on best practices





Partial List of Plug and Play Automation Policy Modules

- Web Servers

- ▶ Apache Web Server
- ▶ IBM HTTP Server



- Groupware

- ▶ Sendmail 8.11



- Data Management

- ▶ DB2 8.x ESE
- ▶ DB2 7.x WE, EE
- ▶ Oracle 9i
- ▶ Oracle 8i



- Shared File Systems

- ▶ NFS Server
- ▶ NFS Client
- ▶ Samba



- WebSphere

- ▶ WAS
- ▶ WAS Retail Server
- ▶ MQ



- Systems Management

- ▶ Tivoli Enterprise Console 3.8



- SAP

- ▶ mySAP Application Server
- ▶ mySAP Enqueue Server



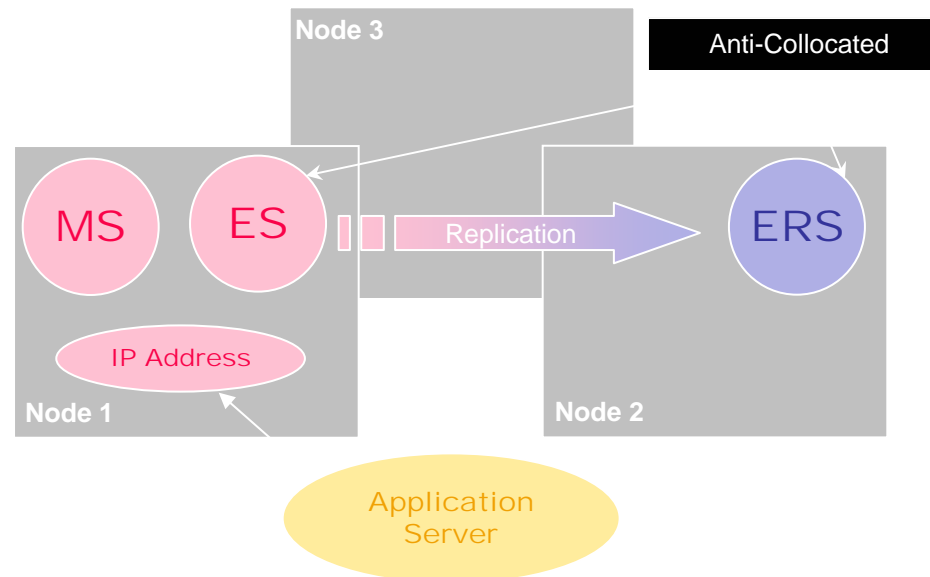
- Basic Functions:

- ▶ IP failover
- ▶ IP Local NIC Recovery
- ▶ File System Mount/Unmount
- ▶ Generic application kit



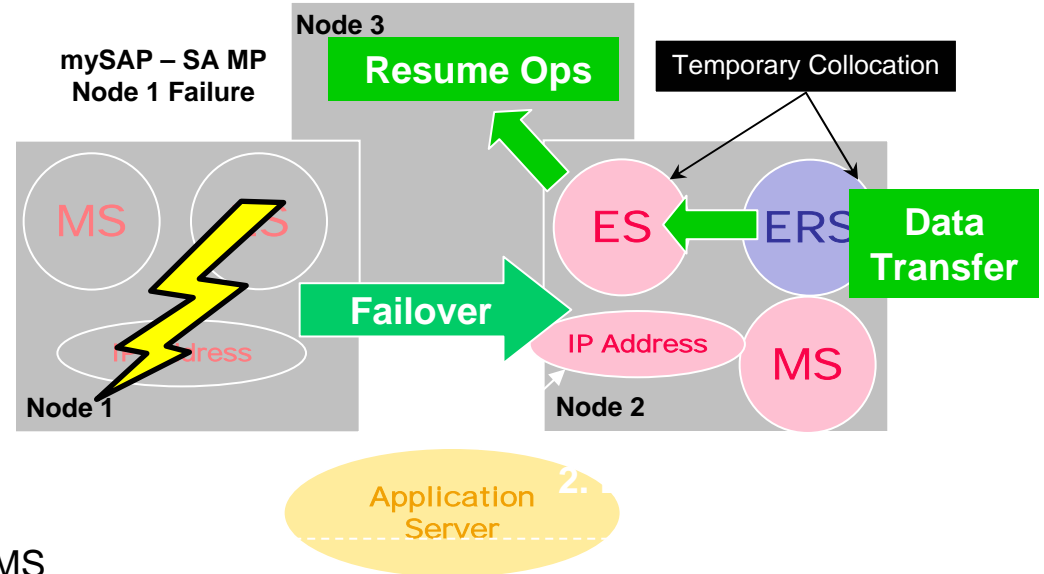
SA MP Base Component Ensures Failsafe Application Startup and Shutdown

- **mySAP Example: SA MP ensures startup and shutdown steps are carried out in the correct sequence in the correct nodes**
- In SAP Central Services under normal operations, the Message Server (MS), the Enqueue Server (ES) and the Virtual IP Address run in the same cluster node
- Business critical data (critical system lock table) is constantly replicated to the additional Enqueue Replication Server (ERS), which runs in a separate node from the MS and ES
 - ▶ Running the ERS in a different node disperses the data and eliminates single points of failure for critical data




SA MP Base Component Ensures Fast and Complete Application Recovery

- mySAP Example: SA MP resumes normal SAP operations within seconds or minutes instead of hours - the operator is able to focus on root cause analysis and prevention of future occurrences**
- Step 1. If Node 1 fails, SA MP moves the MS, ES and Virtual IP address to Node 2 with the ERS and reconnects the Application Server with the IP address on Node 2
- Step 2. SA MP waits for data transfer from the ERS to the ES through shared memory
- Step 3. SA MP then either moves the ES, MS and IP Address to Node 3 if available, or moves them back to Node 1 when it becomes available again if Node 3 is not available



SA MP Base Component Maximizes System Integrity with Innovative Quorum and Tie-Breaking Concepts

- What happens when the communication (heartbeat) between two nodes fails and two sub-clusters are formed?
- Majority Wins
 - ▶ The sub-cluster with the majority of nodes wins and has operational quorum
- What if the sub-clusters have an even number of nodes?
 - Operator tie-breaker
 - Manual intervention by an operator to resolve operational quorum
 -  Automatic disk tie-breaker for shared disk environments
 - The sub-cluster that connects to the SCSI first (disk locking) wins the tie-breaker and has operational quorum
 - Automatic network tie-breaker for diskless tie-breaking
 - First sub-cluster to ping the gateway wins quorum and takes over critical resources
 - Avoids split-brain scenarios while reducing hardware requirements
- SA MP also allows you to define critical resources to further ensure system integrity
 - ▶ If a node running critical resources fails and loses operational quorum, SA MP immediately starts the critical resources on a separate node and performs a hard reboot on the failed node to guarantee critical resources run only on one node

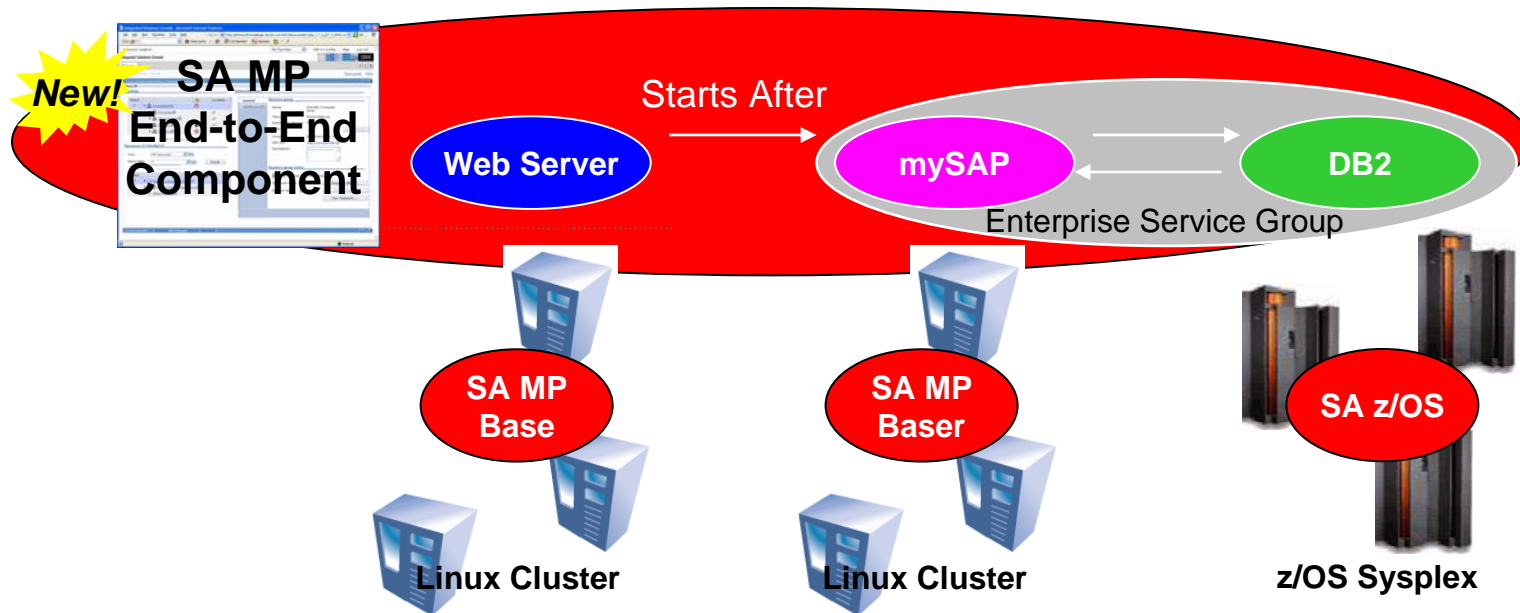
SA MP Base Component is Leveraged in Several Other IBM Offerings

- Provides database failover capabilities for IBM DB2 Enterprise Edition on Linux and DB2 Workgroup Edition on Linux with HA/DR
 - ▶ Included with purchase of DB2, for use only with DB2
 - ▶ Includes automation module structured specifically for DB2
 - ▶ Won Best Clustering Solution at LinuxWorld 2004
- Provides Point of Sale (POS) application and middleware HA in the IBM WebSphere Retail Server (WRS) offerings
 - ▶ Includes large scale rollout in individual retail stores
- Provides application HA in the IBM Dynamic Infrastructure (IDI) for SAP
- Provides DR capabilities for Linux on zSeries applications running under z/VM in GDPS offerings



SA MP End-to-End Component Extends HA/DR Capabilities Across the Entire Multi-Tiered Application Topology

- Provides unique single point of control for HA/DR automation across heterogeneous, distributed applications
- Extends goal-based automation to the entire application topology
 - ▶ Automatically maintains cross-cluster resources and dependencies when driving observed resource states to desired states
 - ▶ Manages HA/DR operations cascading through the entire topology so all resources start, stop or move in the right sequence in the right system
 - ▶ Initiate start, stop and move operations with a single click



SA MP End-to-End Component Integrates with Existing System Automation Products to Speed Implementation and Ease System Complexity



New!

- z/OS Integration

- ▶ SA MP End-to-End Component utilizes an adapter infrastructure to integrate with System Automation for z/OS (SA z/OS)
- ▶ Automatically harvests application resource relationships and dependencies from SA z/OS

- Distributed Platform Integration

- ▶ SA MP End-to-End Component includes the Base Component
- ▶ For existing SA MP Base Component installations, the End-to-End Component automatically harvests Base Component application resource relationships and dependencies

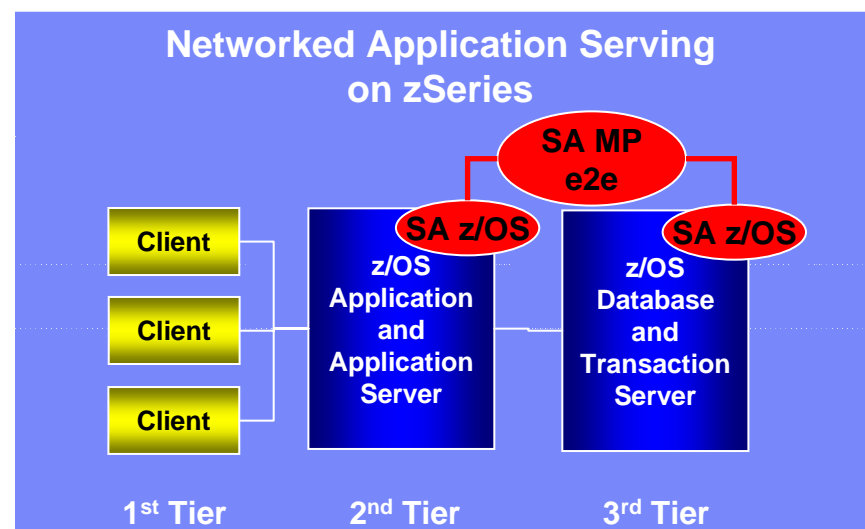
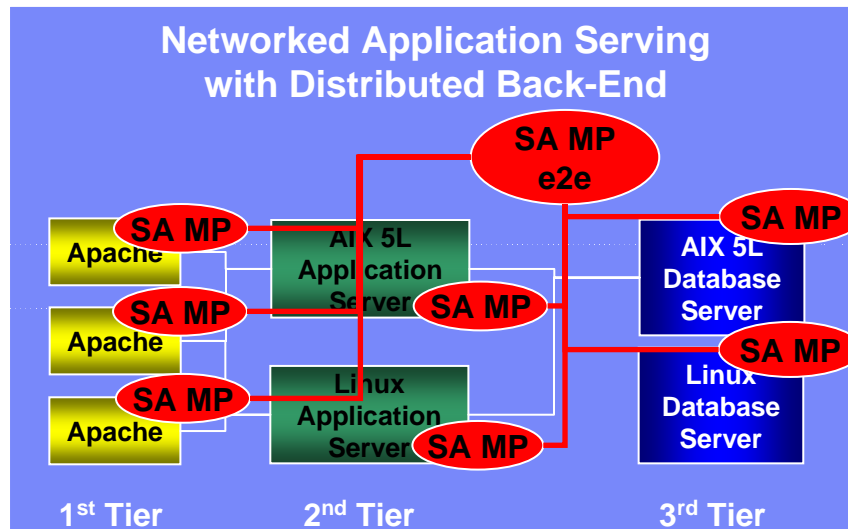
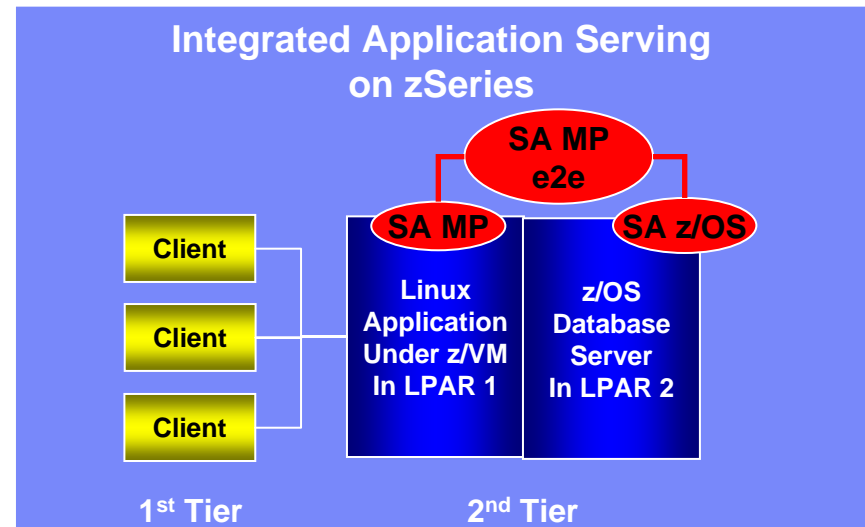
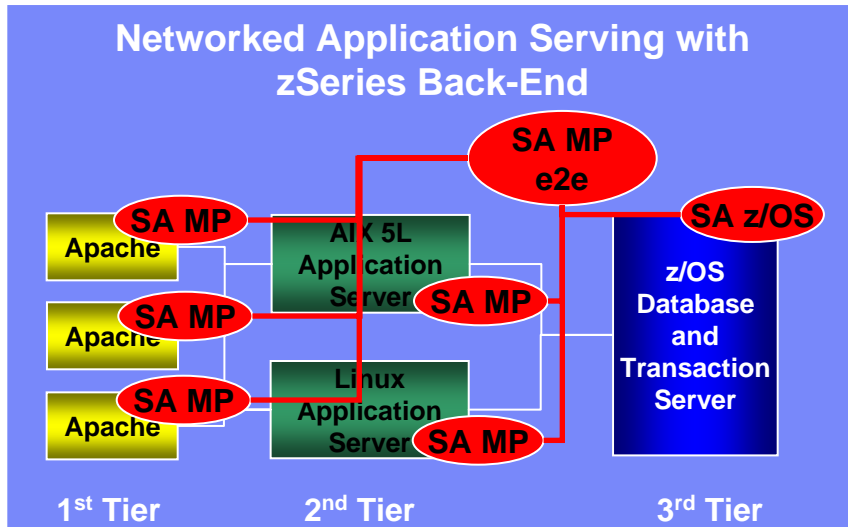


New!

- View and manage all application domains across z/OS and distributed platforms through a single Web-based console



SA MP End-to-End Component is Highly Flexible and Easily Configured to Individual Environments and HA/DR Demands

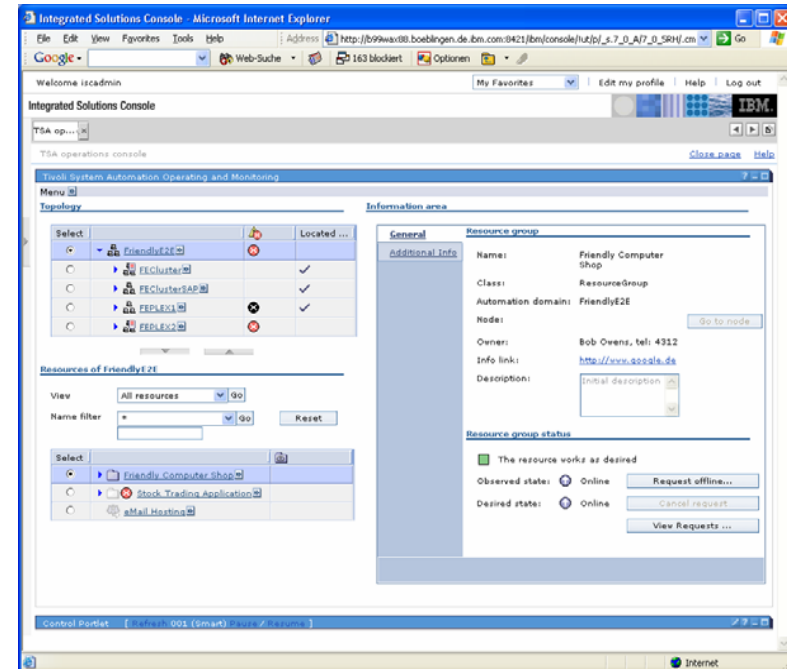


Both SA MP Components Include an Intuitive Web-Based Operations Console

- One console to access all System Automation domains
 - ▶ Consistent look and feel while controlling resources on different platforms
 - ▶ Shows aggregated and detailed resource states and relationships
 - ▶ Initiate actions across the entire multi-tiered application topology with a single click
- Web-based console can be accessed with any available browser
- Included with SA MP Base Component and SA MP End-to-End Component



New!



SA MP's Console Features Aggregated and Detailed View of Application Resources

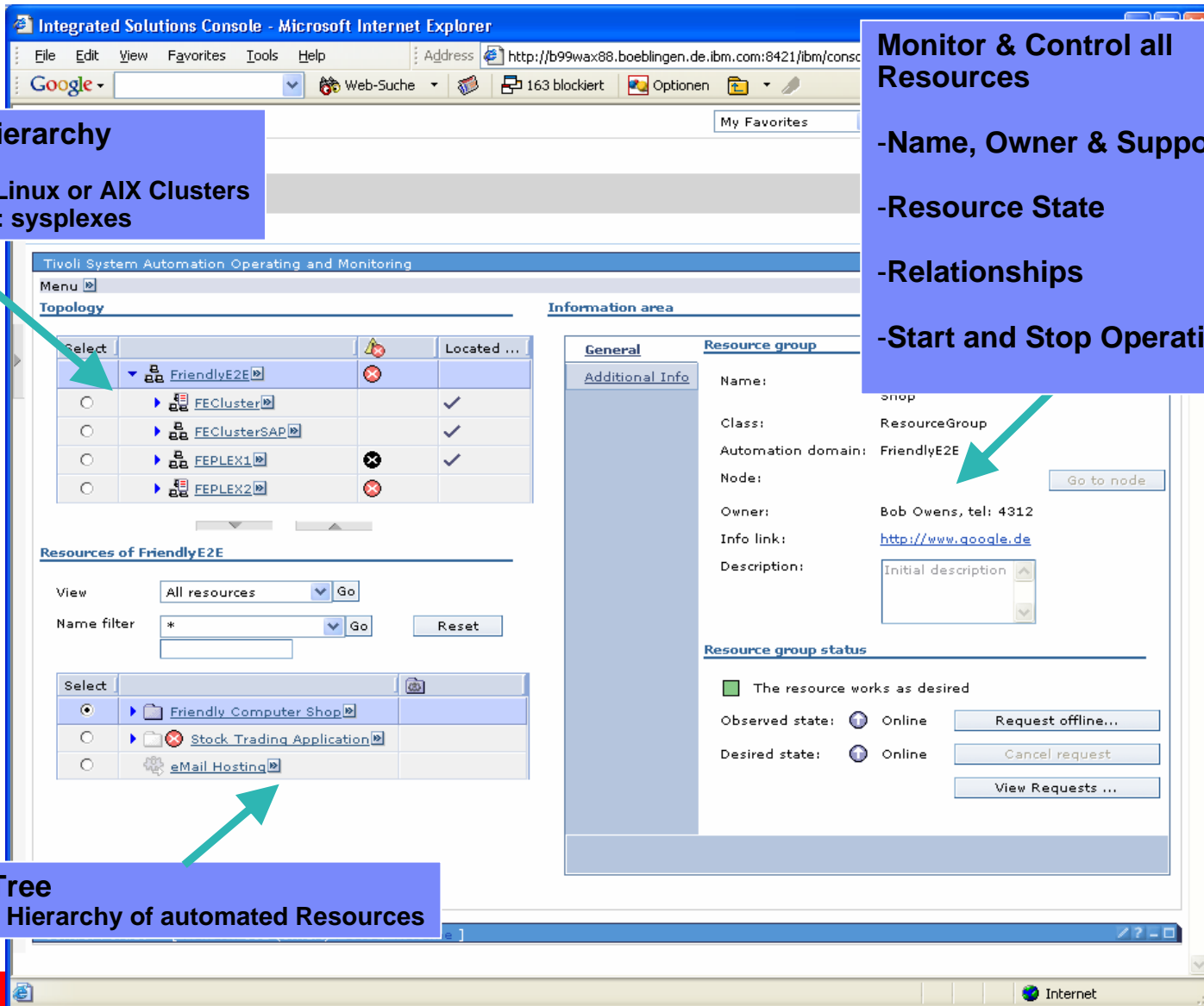


Domain Hierarchy

- SA MP: Linux or AIX Clusters
- SA z/OS: sysplexes

Monitor & Control all Resources

- Name, Owner & Support Info
- Resource State
- Relationships
- Start and Stop Operation

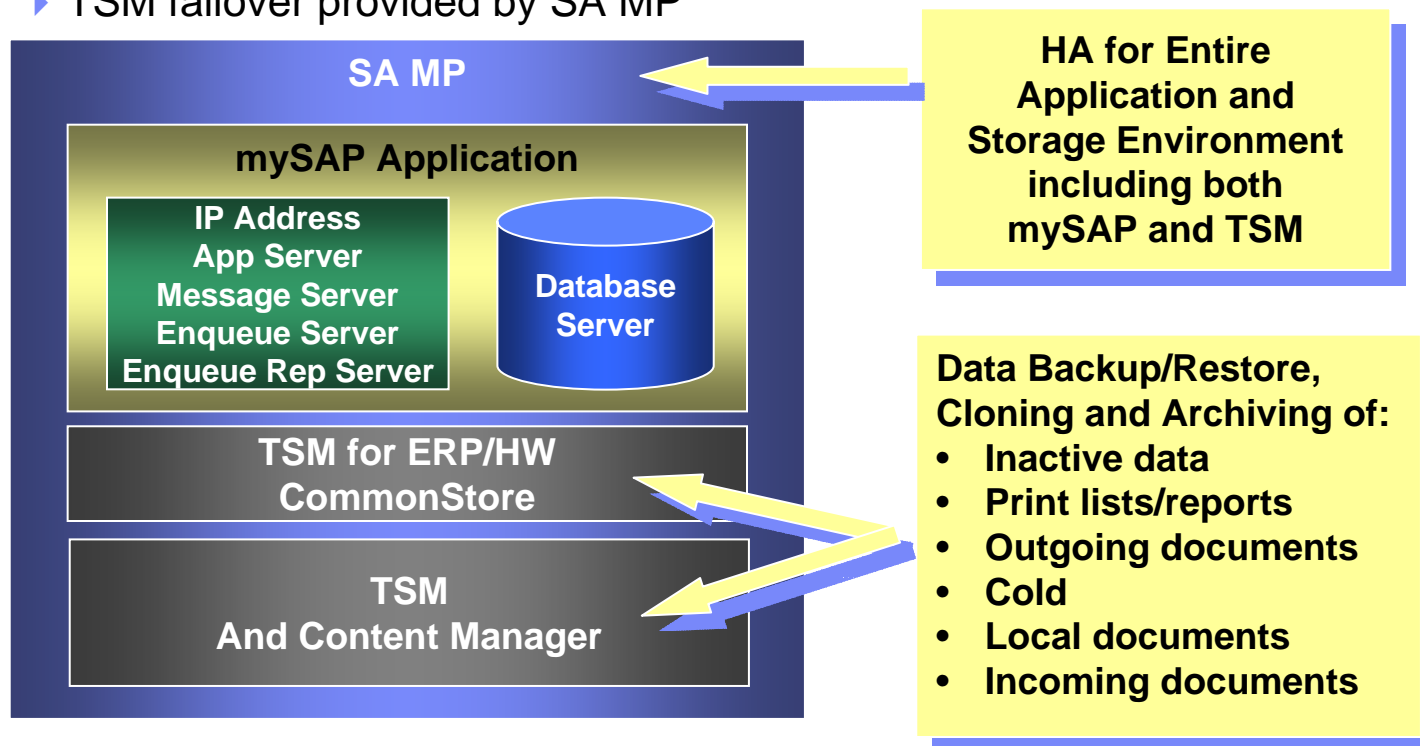


Resource Tree

- Grouping Hierarchy of automated Resources

SA MP and Tivoli Storage Manager (TSM) Deliver HA/DR Protection for Applications and Data

- Ensure service continuity with complete application and data protection
 - ▶ Application failover within and across sites provided by SA MP
 - ▶ Data backup/restore and cloning within and across sites provided by TSM
 - ▶ TSM failover provided by SA MP



System Automation for Integrated Operations Management



System Automation for Integrated Operations Management (SA IOM) Extends the SA Portfolio Capabilities

- SA IOM (formerly AF/REMOTE) provides
 - ▶ Secure, remote access to SA z/OS, SA MP and AF/OPERATOR automation solutions, the OMEGAMON monitoring suite and the Tivoli Enterprise Console (TEC)
 - ▶ Effective management of automated operations for multiple mainframe and distributed systems
 - ▶ Single point of control for monitoring system alerts and notifications
 - Alerts and notifications sent by pager, voice or email
 - Customizable escalation capability to base notification on expertise, shifts or other criteria
 - Respond to incidents and problems threatening business continuity from any location
 - ▶ Console consolidation for zSeries
 - ▶ Remote automated Initial Program Load (IPL) for zSeries



High Availability / Disaster Recovery Business Issues

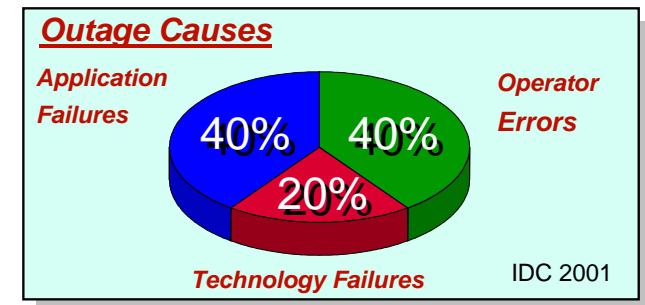


High Availability (HA) Refers to the Availability of an Entire Application System That Delivers a Service to End Users

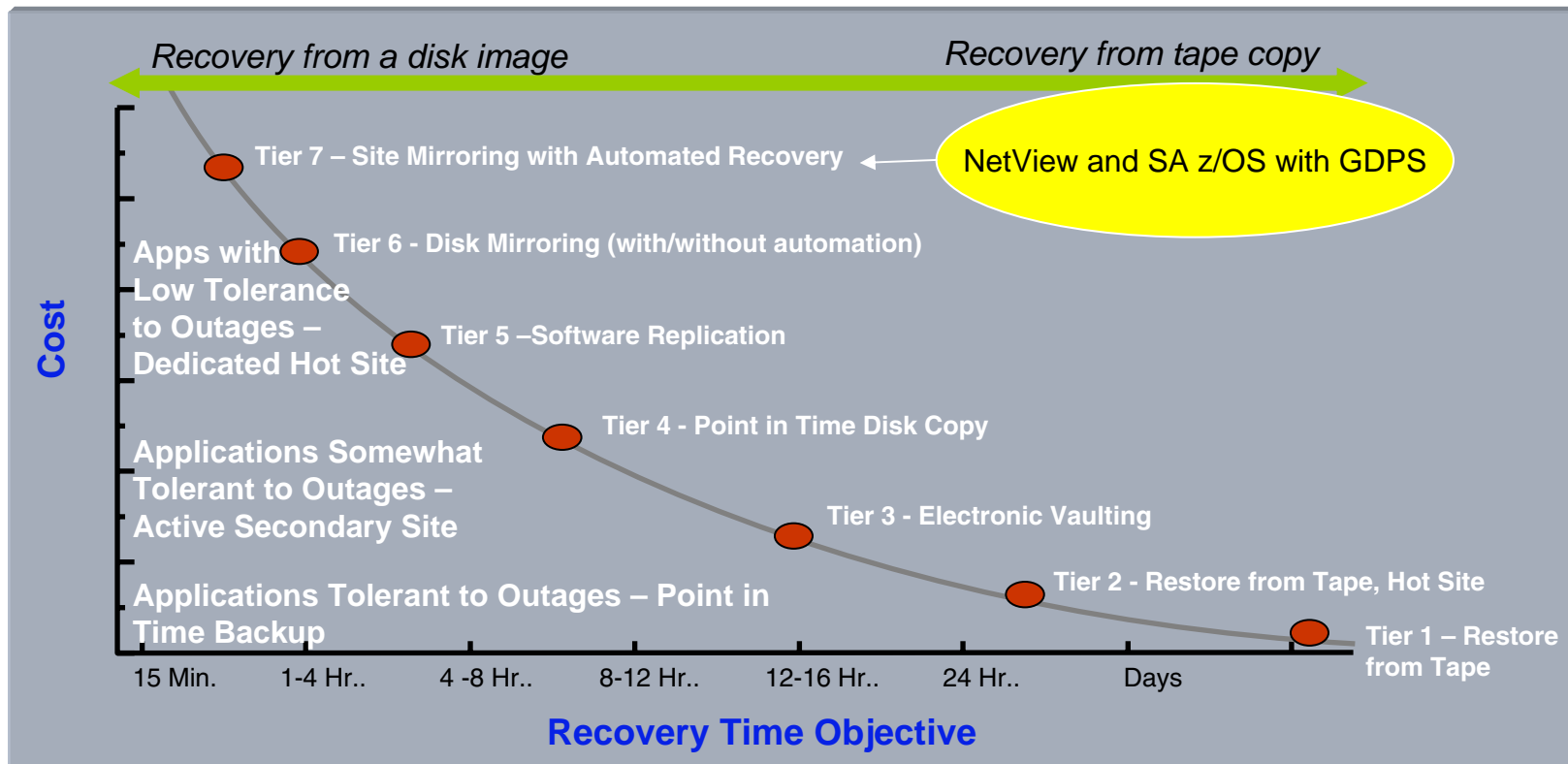
Number of 9s	Availability Level	Downtime per Year
6 nines	99.9999% Availability	32 Seconds
5 nines	99.9990% Availability	5.3 Minutes
4 nines	99.9900% Availability	53 Minutes
3 nines	99.9000% Availability	8.8 Hours
2 nines	99.0000% Availability	3.7 Days
1 nine	90.0000% Availability	37 Days



- The most common approach to achieve HA is running applications in virtualized server clusters
- Individual resources can be engineered for high availability themselves, but can still present single points of failure
 - ▶ 3 components each with 99.9% expected availability have an overall $99.9\% \times 99.9\% \times 99.9\% = 99.7\%$ expected availability
- The most common causes of outages however are application failures and human error, not hardware failures



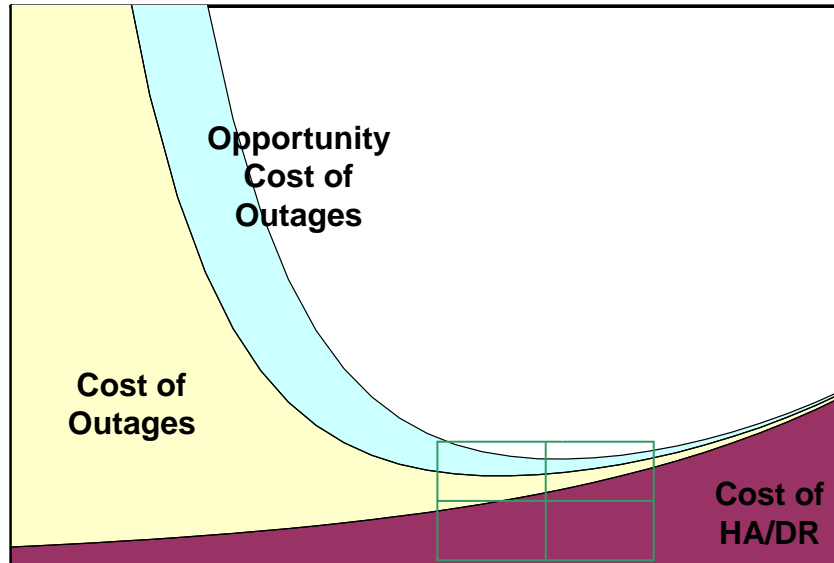
Disaster Recovery (DR) Refers to the Recoverability of Mission-Critical Business Workloads in the Event of a Major Catastrophe



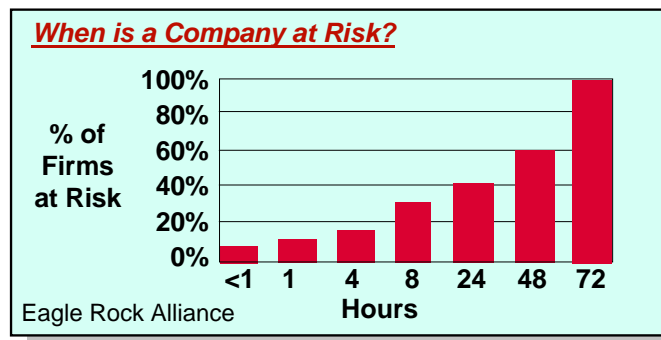
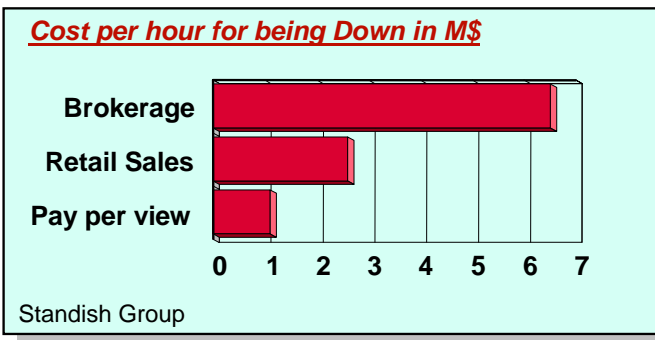
- IT disaster preparedness ranges from storing data on tape drives and hauling them off-site at the low end to automated failover of entire datacenter workloads to a hot backup site



The Optimum Level of Investment in HA/DR Depends on the Value of the Business Being Protected



- Cost of outages
- ▶ Lost customers
 - ▶ Lost revenue
 - ▶ Lost end user productivity
 - ▶ Lost IT staff productivity
 - ▶ Wasted goods
 - ▶ Regulatory compliance fines
 - ▶ Lost shareholder value
- Opportunity cost of outages
 - ▶ Reduced customer loyalty
 - ▶ Tarnished business reputation
 - ▶ Lowered employee morale
 - ▶ Reactive vs proactive IT organization



Best Practice is to Maximize Coverage at the Lowest Possible Cost by Blending HA/DR Levels

High Availability

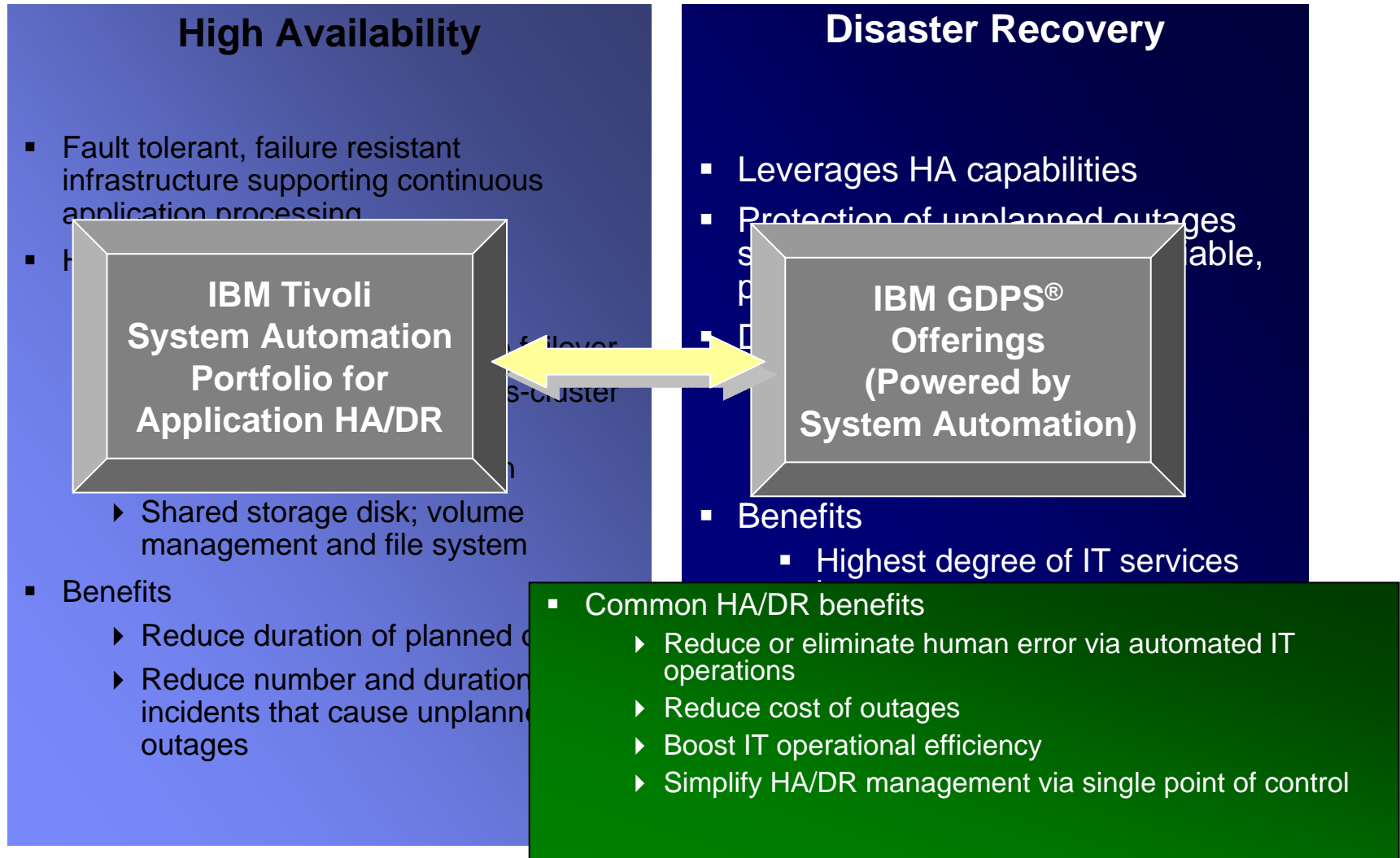
- Fault tolerant, failure resistant infrastructure supporting continuous application processing
- HA capabilities
 - ▶ HA server clusters
 - ▶ Application and middleware failover
 - ▶ Composite application cross-cluster automation
 - ▶ Data backup and replication
 - ▶ Shared storage disk; volume management and file system
- Benefits
 - ▶ Reduce duration of planned outages
 - ▶ Reduce number and duration of incidents that cause unplanned outages

Disaster Recovery

- Leverages HA capabilities
- Protection of unplanned outages such as disasters through reliable, predictable recovery
- DR capabilities
 - ▶ Point in time backup
 - ▶ Active secondary site
 - ▶ Dedicated hot site
- Benefits
 - ▶ Highest degree of IT services insurance
 - ▶ Quickly recover data and systems in the event of a major catastrophe



IBM Offers the Broadest Range of Capabilities to Automate Application HA/DR Across the Enterprise



Tivoli System Automation Portfolio Review

- **SA z/OS:** primary automation product providing automation & high availability for z/OS
- **SA Multiplatforms:** base component provides availability automation (stop, start, move/failover, restart in place) within a homogeneous cluster (on Linux and AIX)
- **SA Multiplatforms:** end-to-end component provides coordinated, cross-cluster/resource automation and high availability for multi-tiered applications
- **SA/IOM:** provides secure outboard automation and console consolidation for disparate operating systems and remote IPL for z/OS environments
- **AF/OPERATOR:** secondary, SMB-focused mainframe automation product for z/OS

Value proposition of SA portfolio:

- ▶ High Availability
- ▶ Identify incidents
- ▶ Resolve or work around incidents
- ▶ Recover software and hardware resources
- ▶ Message, I/O and Processor management
- ▶ Automate complex and repetitive tasks
- ▶ “Event Management”

