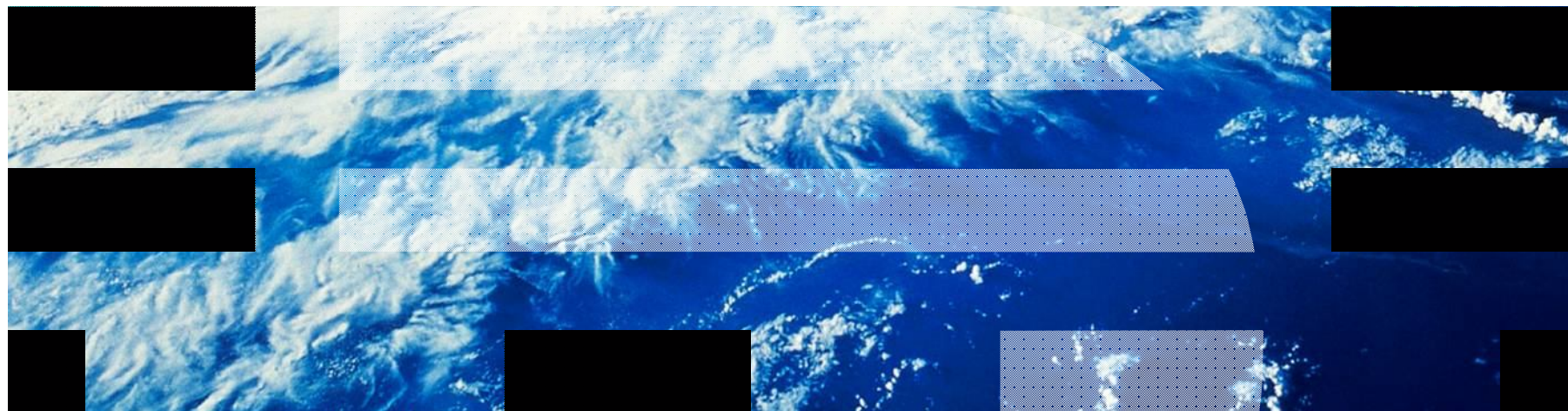


# Application High Availability in a Heterogeneous Environment

**Tivoli** software

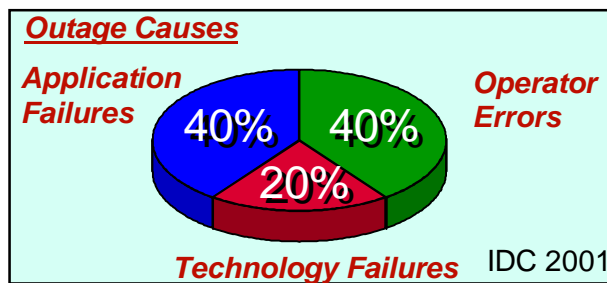
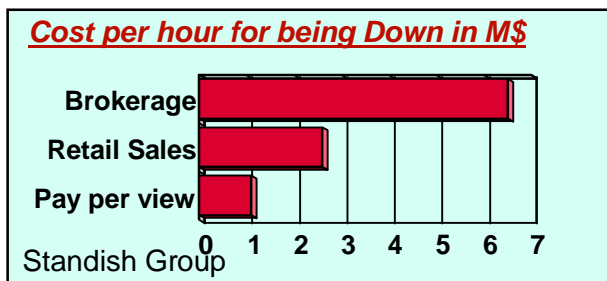


## Agenda

- High Availability Concepts
- Overview of Tivoli System Automation
  - System Automation for z/OS
  - System Automation for Multiplatforms
  - System Automation Application Manager
- Graphically Dispersed Parallel SYSPLEX
- Integration Scenarios



# Business Issue



## On demand challenges

- ▶ Downtime unaffordable
- ▶ Heterogeneous by nature
  - **Different HW/SW platforms**
  - **Cross-cluster application dependencies**
- ▶ Complexity

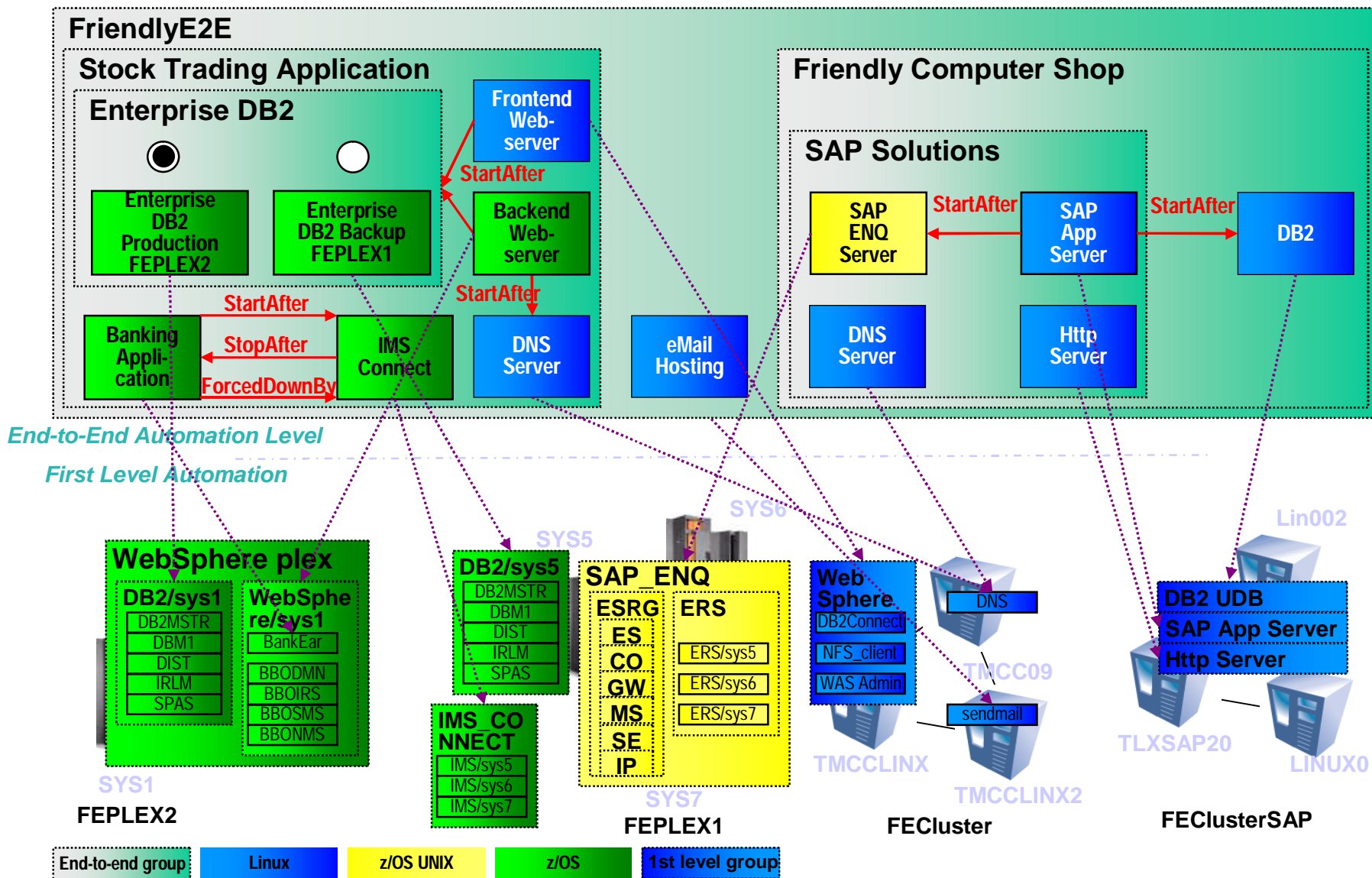
## Customer pressures

- ▶ No end-to-end automation
- ▶ Cost and availability issues due to multiple automation and operations teams
  - Education requirements
- ▶ Automation implementation and maintenance costs
- ▶ Rapid change of I/T infrastructure

- **Loss** of business
- **Loss** of customers – the competition is just a mouse click away
- **Loss** of credibility, brand image and stock value



# How do You Manage this?



## How to Improve Availability: Redundancy & Failover



- Highly Available Hardware
  - Processors, Memory, Power Supplies, Fans, Disks, Backplanes, IBM Director
  - Network, LAN, SAN connectivity (multiple links)
- Problem: Single Points Of Failure (SPOF)
  - Non Redundant Hardware
  - System Software
  - Application Software
- Solution: Failover application (components) to backup system(s)
  - Problem: Dependencies to HW/SW resources
  - Solution: Policy-based knowledge about application components and relationships
  - Problem: Data integrity (shared disks)
  - Solution: Heartbeats, quorum, STONITH (Shoot the other node in the head), Disk reserves

# System Automation Basic Principles

- Provide **Continuous Availability** of IT resources
  - Applications, processes, IP addresses, file systems, ...
- Capability to **automatically start and stop** resources with knowledge of...
  - Resource groups, relationships, backup resources, ...



IT Manager

Operator



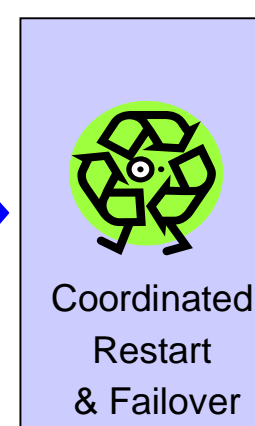
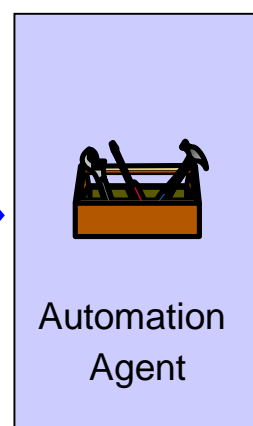
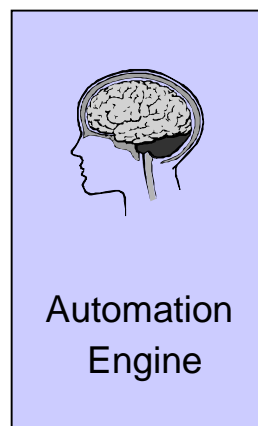
Event



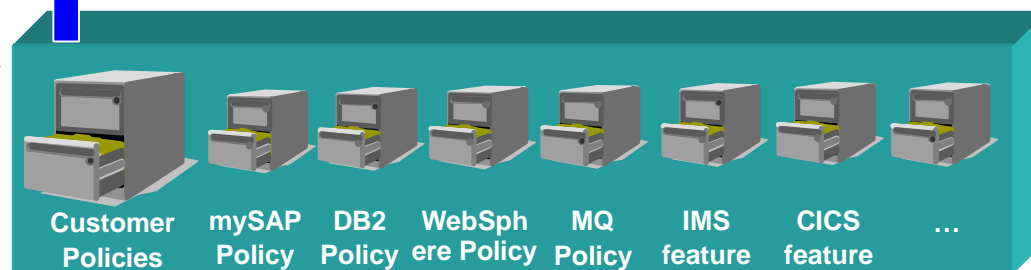
Scheduler



Orchestration



Operator



## Agenda

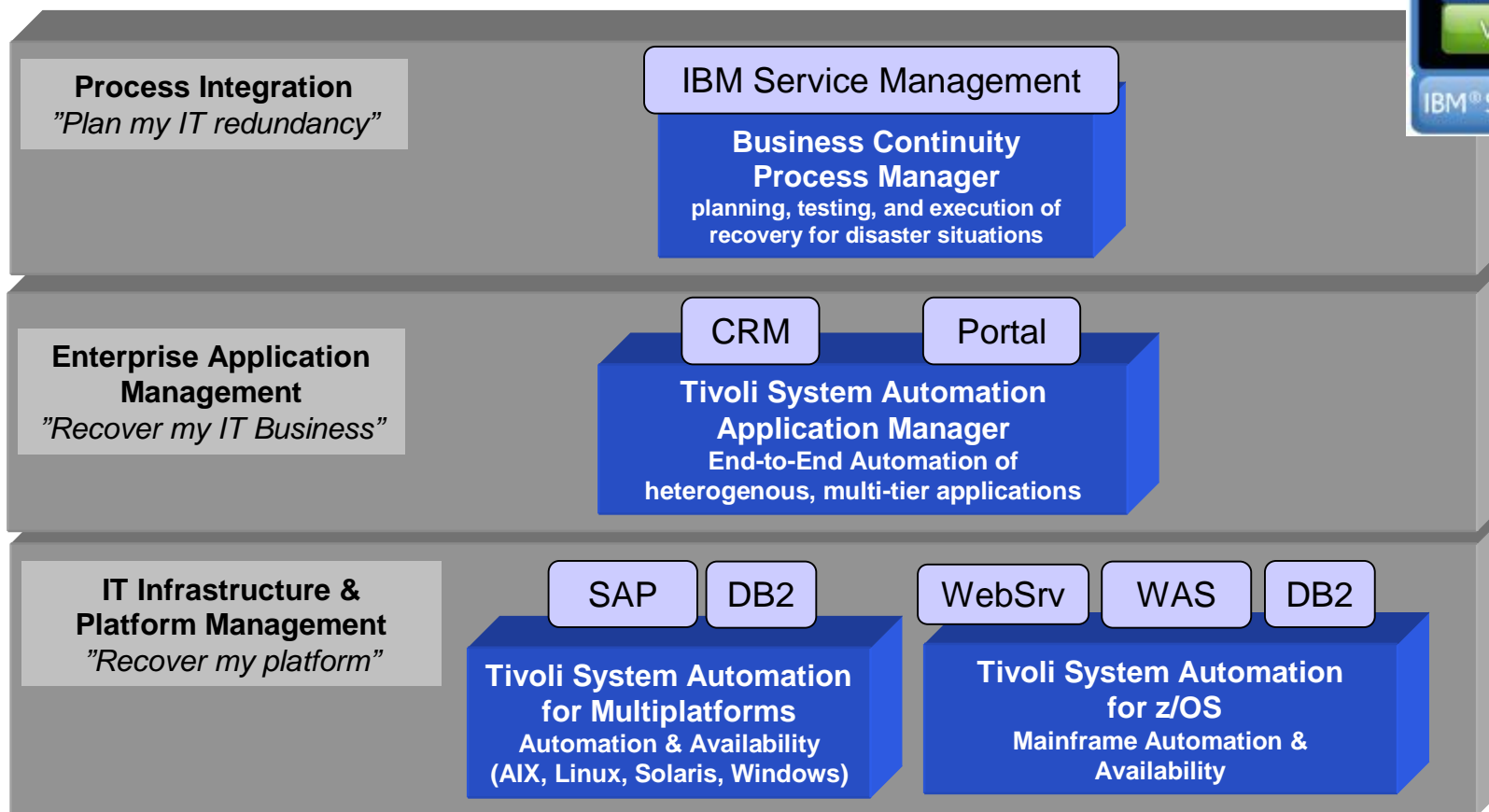
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## IBM Tivoli System Automation

*High availability and policy-based automation for applications and services across heterogeneous environments*

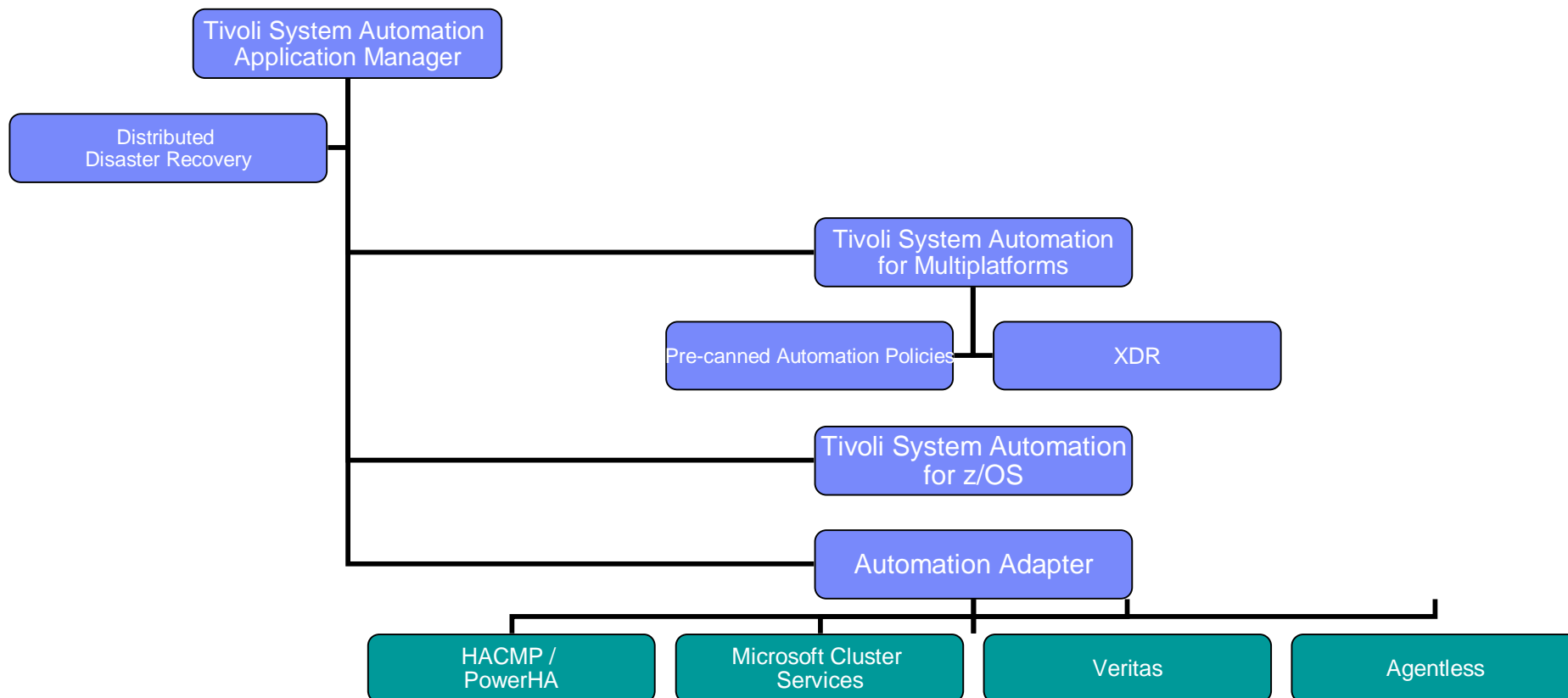
<http://www.ibm.com/software/tivoli/products/sys-auto-multi/>  
<http://www.ibm.com/software/tivoli/products/sys-auto-app-mgr/>





## Components of Tivoli System Automation Family

The System Automation Product Family shares same Automation and Availability Concepts across different platforms and management levels. It integrates other Automation and Cluster solutions to provide single point of operations and true management of composite applications.

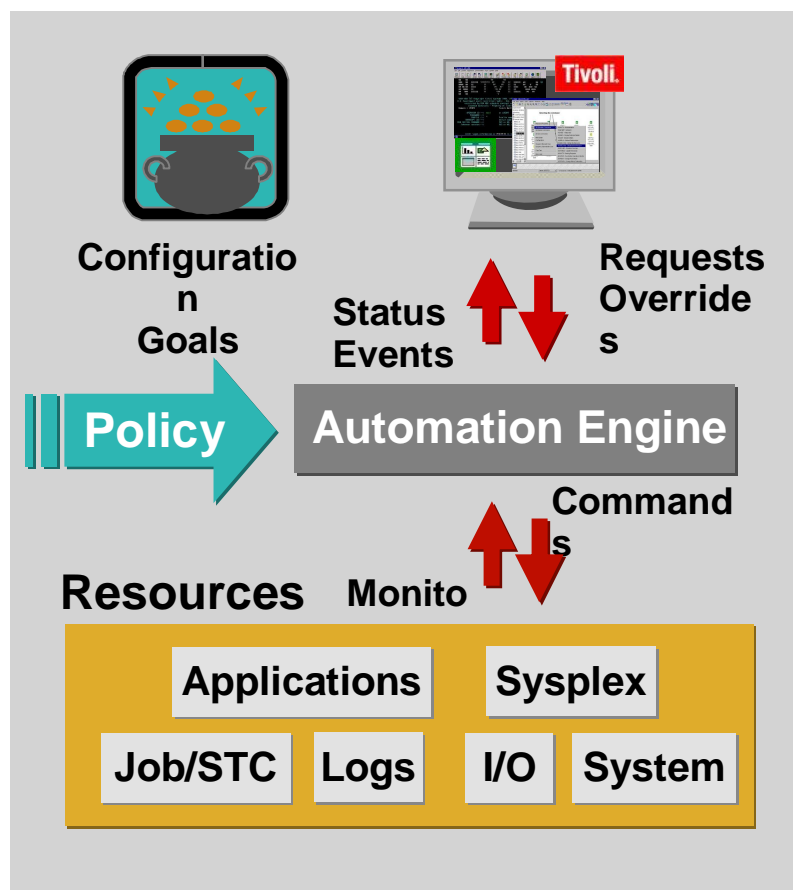


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## SA z/OS Component System Operations



### ■ Automation

- Start, recover and termination
- Manage applications
- Operator task automation
- Message monitoring & response
- Prevent outages of critical resources (WTO buffers, spool)
- Plug 'n play automation modules for CICS, IMS, DB2, mySAP, WebSphere, GDPS
- Integration: TWS, TBSM,
- Performance automation

### ■ Graphical interface

- Applications, systems, events, critical Sysplex resources
- Command interface

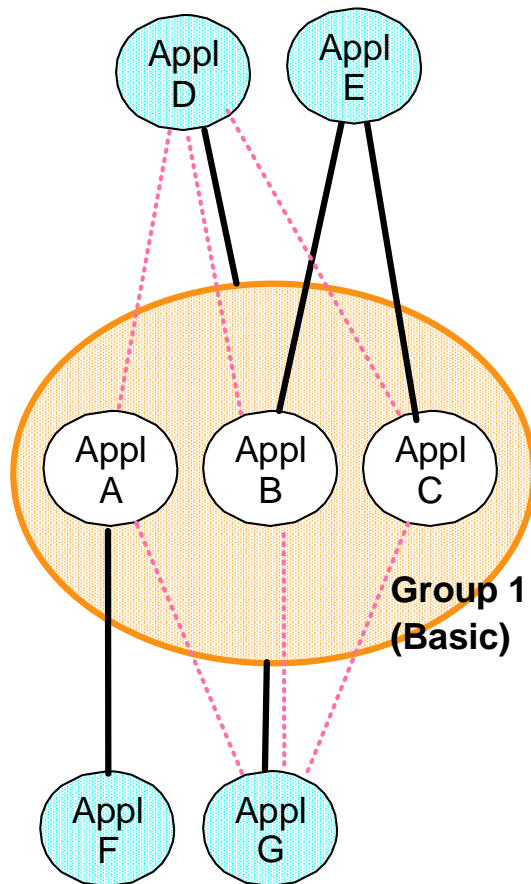
## SA z/OS Powerful Relationship Support

START and STOP relationships

- Relationships define how one resource relates to another resource
- ***HasParent***
- ***MakeAvailable, MakeUnavailable***
- ***PrepAvailable, PrepUnavailable***
- ***ForceDown***
- Condition associated with relationship
- ***WhenAvailable, WhenUnavailable***
- ***WhenAvailableOrStarting***
- ***WhenUnavailableOrStopping***
- ***WhenObservedDown***
- Automation option
- ***Active vs Passive***

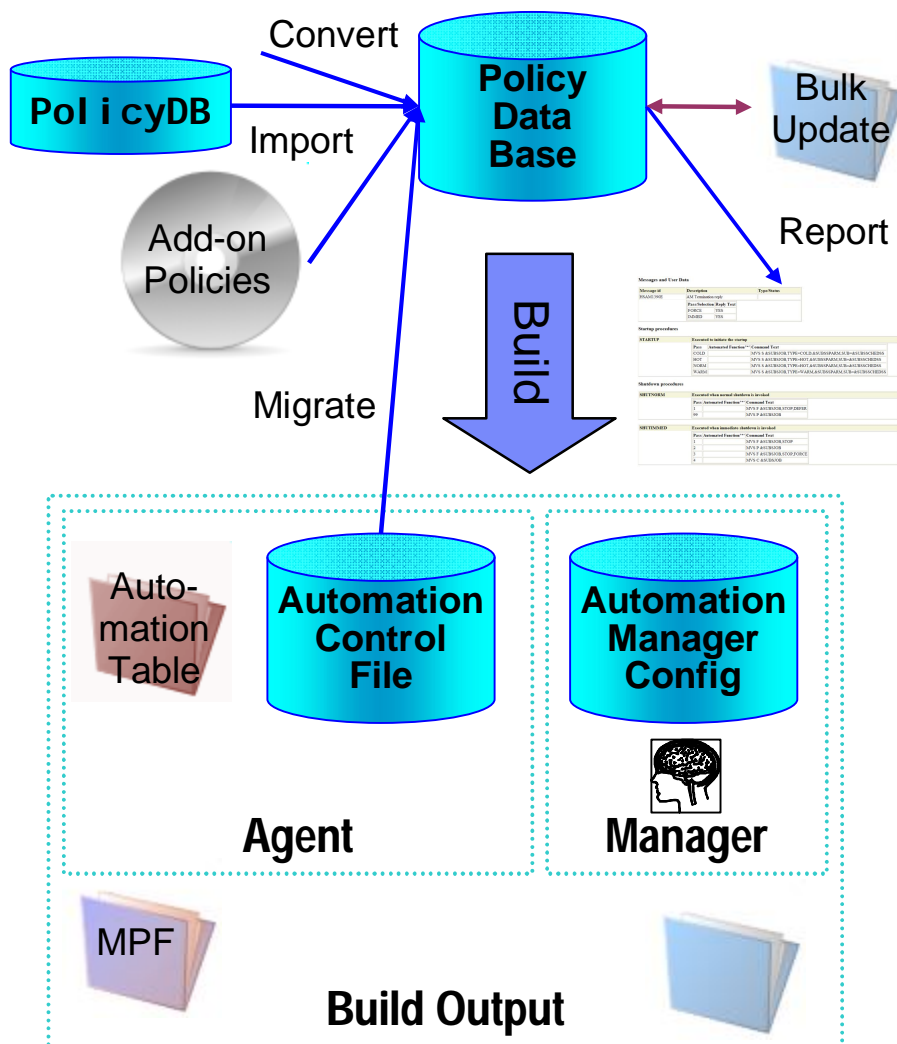
Unidirected, sysplex-wide

## Group and Conquer



- A group is a collection of multiple resources
- Status derived from the aggregated status of its members
- A group can be part of any dependency or other group
- Membership in multiple groups possible
- Groups are referenced by a sysplex or system-wide unique name
- Members can be distributed within a sysplex
- Enables automation and control for a complete (business) application
- **Frees operator from knowing the various pieces the application consists of**

# Policy Management



```

MENU  OPTIONS  HELP
-----
                SA z/OS 3.1 Customization Dialog Primary Menu
Option ==>

0 Settings          User parameters

1 Open             Work with the Policy Data Base
2 Build           Build functions for Policy Data Base
3 Report          Generate reports from Policy Data Base
4 Policies        Maintain Policy Data Base list
5 Data Management Import policies/Migrate files into a Policy Data Base
U User            User-defined selections

X Exit            Terminate Customization Dialog

To switch to another Policy Data Base, specify the Policy Data Base name
in the following field, or specify a ? to get a selection list.
Current Policy Data Base. . . _____

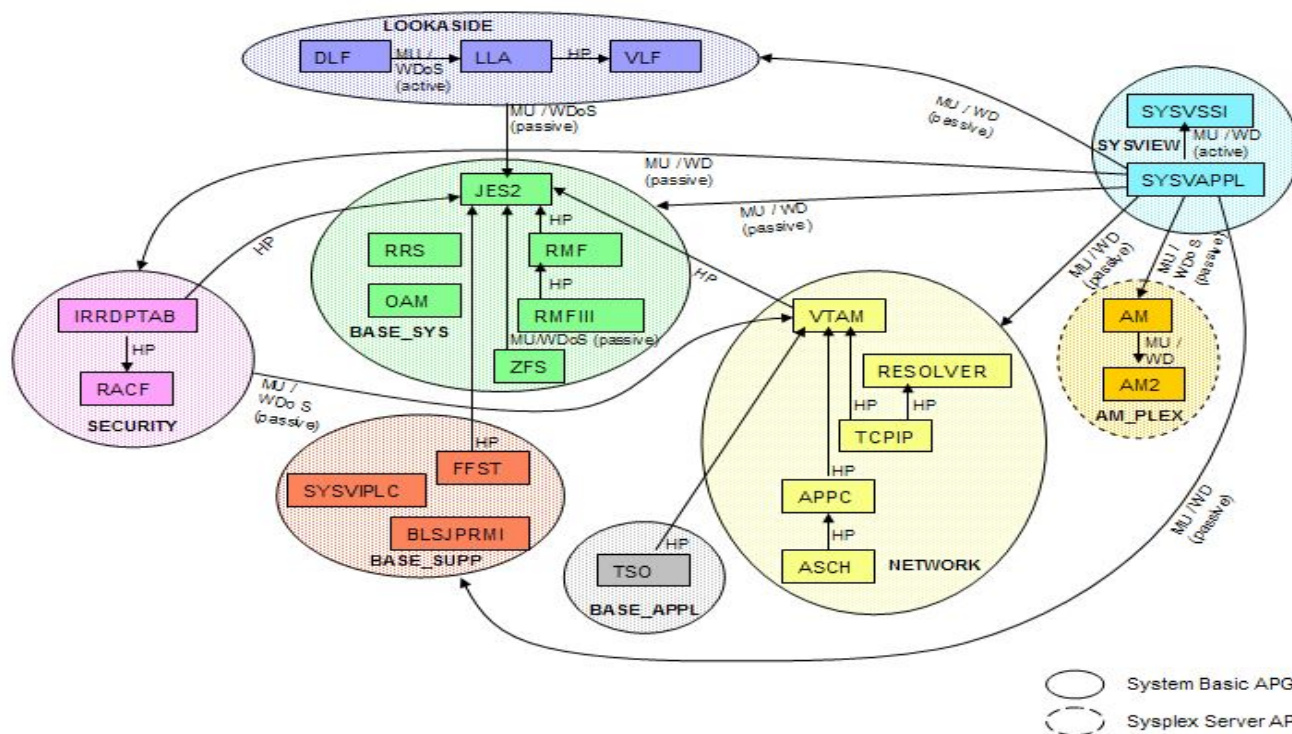
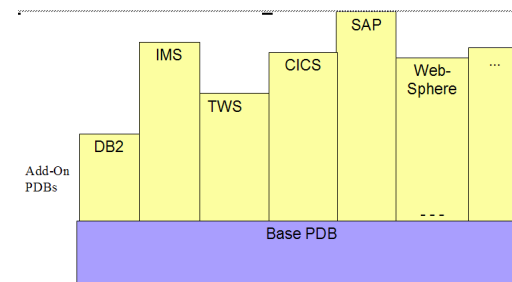
                Licensed Materials - Property of IBM
                5645-006 (C) Copyright IBM Corp. 1990, 2004 All Rights Reserved.
    
```

## Customization Dialog Reduces complexity and manual tasks

- 1 Policy Data Base for z/OS enterprise
- Define once, use multiple: share, clone, inherit

## Sample Policies based on “Best Practice”

- Base Policy + Multiple add-on policies
- Structured Collection of Policies
- Unique Definitions across all policies
- Solution Oriented



DB2  
TWS  
WebSphere  
IMS  
CICS  
NMC  
USS  
ProcOps  
OMEGAMON  
GDPS

## Agenda

- High Availability Concepts
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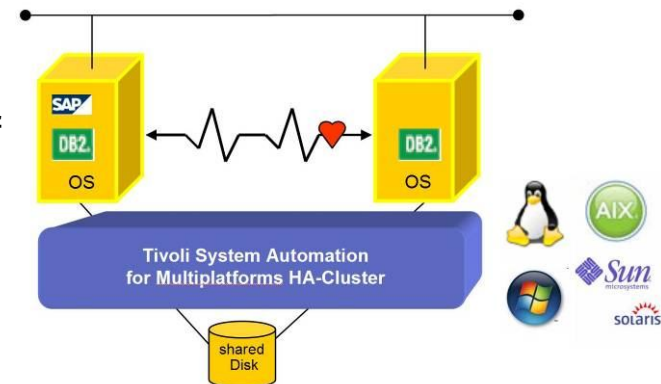
## System Automation for Multiplatforms

- **Tivoli System Automation for Multiplatforms**

- Provides a **High Availability Cluster**
- **Automates startup and shutdown** in correct sequence of complex, statefull applications
- **Actively monitors** all resources and **reacts on outages of SW and HW** components by automatic restart in correct context

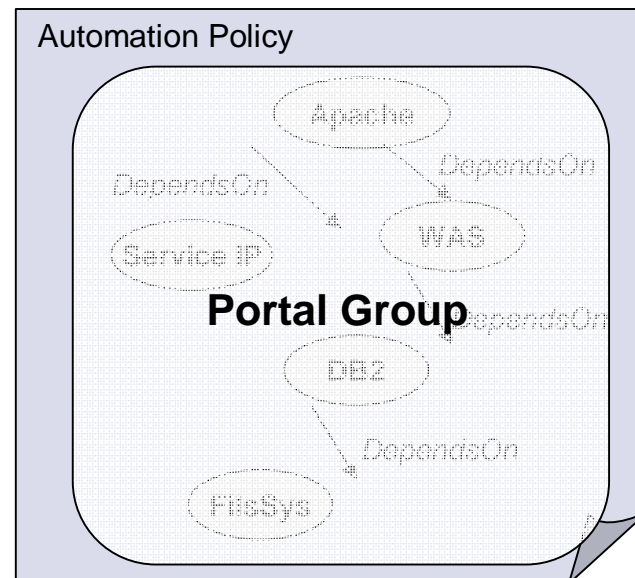
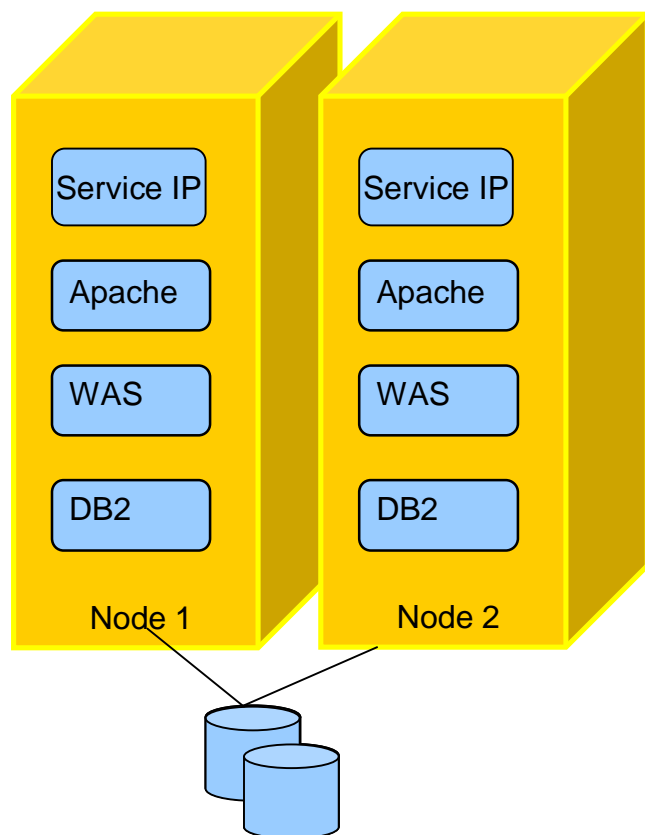
- **Automation Policies** define the **Automation Scope** of System Automation

- Describe **resources, groups and relationships**
- **Define the desired target availability situation**
- No need to develop automation workflow scripts.



## Automation example – Portal HA

*System Automation knows how to start/stop all required resources in correct sequence. One request against top level group is sufficient.*



### Scenario 1: „Operator starts Portal Group“

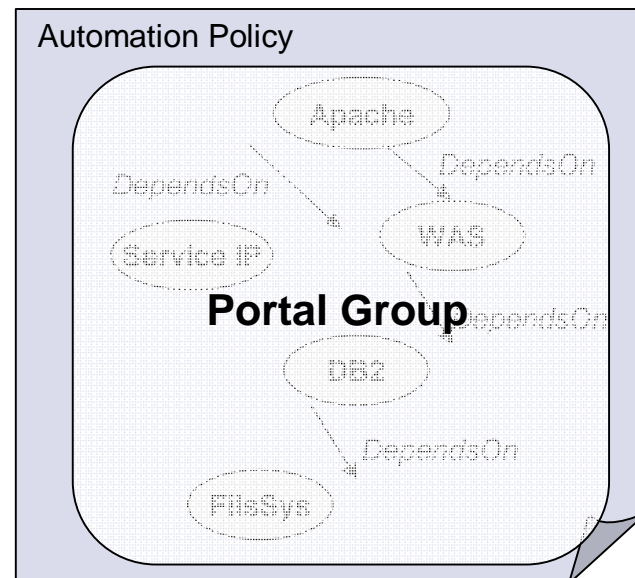
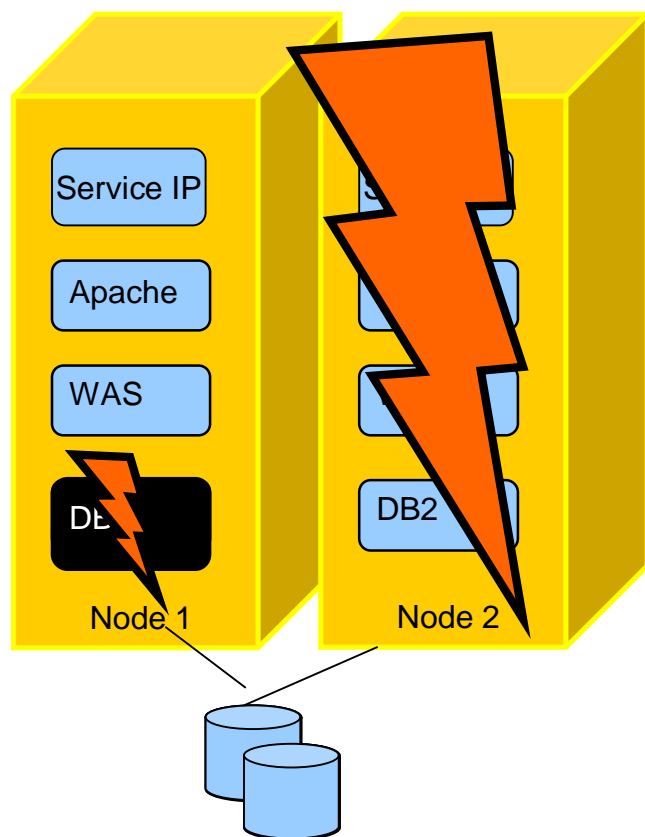
- Disk and Service IP will be mounted/created on Node 2
- DB2 start as first application
- WAS and Apache follow this start in correct sequence

### Scenario 2: „Maintenance on Node 2“

- Apache, WAS and DB2 are stopped in correct sequence
- Disk and Service IP are being mounted / moved to Node 1
- Applications start on Node 1 in correct sequence

## Availability example – Portal HA

*System Automation constantly monitors all resources and can react on SW / HW unplanned outages.*



### Scenario 1: „DB2 Failure“

- Applications dependent on DB2 will be stopped first
- DB2 will be „restarted in place“
- WAS and Apache are started in correct sequence again








### -Scenario 2: „DB2 cannot be started on Node 1“

- All resources on Node1 are stopped
- Disk will be mounted on Node 2
- Service IP will be moved to Node 2
- DB2, WAS and Apache start in correct sequence again

### Scenario 3: Failure of Node 2

- ...

## Pre-canned Automation Policy Templates (Linux / AIX)

- Data Management
  - ▶ DB2 8.x/9.x ESE 
  - ▶ DB2 8.x/9.x ESE DPF
  - ▶ DB2 8.x/9.x HADR
  - ▶ DB2 7.x WE, EE
  - ▶ Oracle 9i
  - ▶ Oracle 8i 
- WebSphere
  - ▶ WebSphere Application Server 6.0
  - ▶ WebSphere MQ
- Tivoli Products 
  - ▶ Tivoli Workload Scheduler
  - ▶ CCMDB / TADDM
  - ▶ Tivoli Storage Manager (TSM)
  - ▶ TSM Client
  - ▶ Tivoli Enterprise Console 3.8
- SAP 
  - ▶ SAP Replicated Enqueue Environment
  - ▶ SAP Application Server
- Shared File Systems
  - ▶ NFS Server
  - ▶ NFS Client
  - ▶ Samba 
- Groupware
  - ▶ Sendmail 8.11 
- Web Servers
  - ▶ Apache Web Server 
  - ▶ IBM HTTP Server
- Currently under development:
  - ▶ WebSphere Application Server 5.1
  - ▶ DP for mySAP
  - ▶ DRBD
  - ▶ SA MP End-to-End Component
  - ▶ Tivoli Provisioning Manager

<http://www.ibm.com/software/tivoli/products/sys-auto-linux/enablement.html>

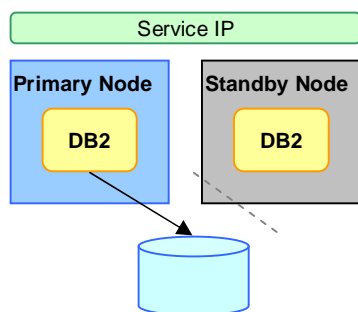
## DB2 HA Solutions based on Tivoli System Automation

Tivoli SA MP is the build-in HA provider for DB2 on distributed platforms

***Different HA concepts for different levels of availability – all based on Tivoli SA MP***

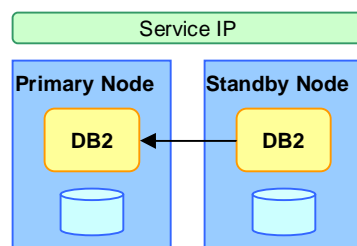
### Warm-standby

- DB2 LUW with shared disk
- DB2 instance data is stored on shared disk
- Standby node takes automatically over on failure
- Access to DB2 via Service bound to active node



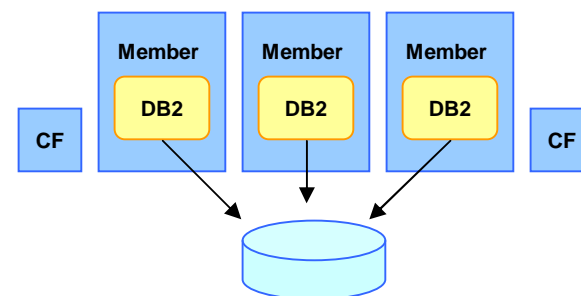
### Hot-Standby

- DB2 HADR
- DB2 built-in replication of transaction data from primary to standby node
- Server roles (primary / standby) will be automatically switched in case of failure
- Access to DB2 via Service IP or automatic client re-routing



### Active-Active

- DB2 pureScale
- Cluster of DB2 nodes with centralized lock and memory manager
- Maximize availability during failure recovery processing
- Clients are rerouted to healthy member at failure of member and healthy member are fully available all time



## High-level description: **SAP policy product support**

- Add product support for SA MP SAP policy within a defined scope of configuration variants → New customer orderable SAMP feature license for SAP policy.
- Enhance documentation
- Improve usability by replacing existing setup script “mksap” with template XML policy “sampolicy” and creating a wizard

### **Benefits:**

- Product support can be called for questions and problems
- Consolidated documentation to have a clear setup and operation guidance
- Ease of use wizard to help customer with initial SAMP cluster configuration

## Agenda

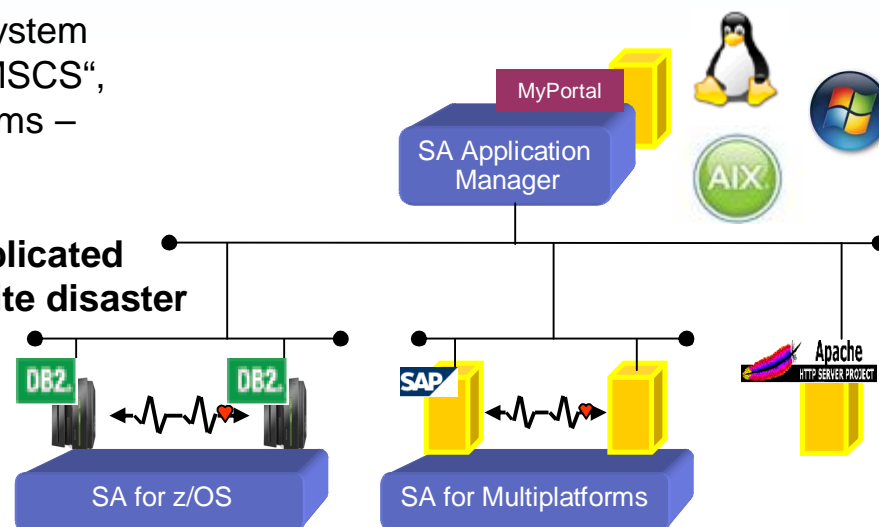
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# System Automation Application Manager

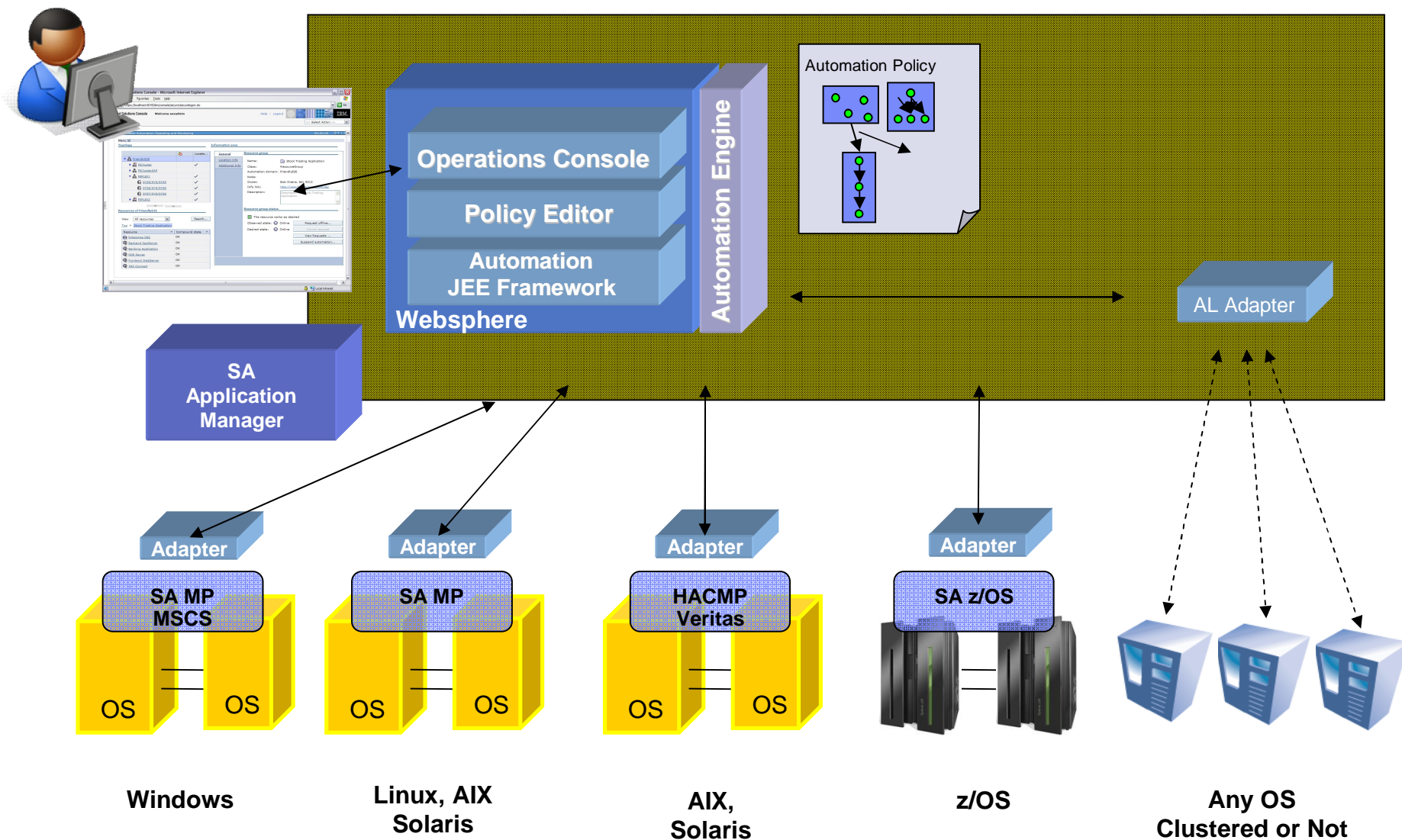
## ▪ Tivoli System Automation Application Manager

- Provides a **Cross-System** and **Cross-Cluster Operation** for **composite business applications**
- **Automates startup, shutdown and resynchronisation** of composite business applications running on different platforms.
- **Works on top of various High-Availability Clusters** such as „System Automation for Multiplatforms“, „System Automation on z/OS“, „HACMP/ PowerHA“, „MSCS“, „Veritas Cluster Server,“ - supporting all platforms – including workload running on Mainframe
- **Integrates application components with replicated storage devices** in order to provide a **multi-site disaster recovery solution**.





# Components of System Automation Application Manager



## Management with Integrated Solutions Console

Tivoli System Automation offers WEB-based user interfaces as single point of control

**Truly manage the availability of all resources hosted by different OS/Platforms managed by different Automation Products in one Interface**

### Clustered and Unclustered Systems

- SA MP Automation (Windows, AIX, Linux, Solaris)
- SA z/OS Automation Sysplexes (z/OS)
- HACMP / MSCS / Veritas Cluster on Solaris
- Agentless attached resources
- Virtual or Real Systems

OS Na...	OS Na...
Linux	Linux
Linux	Linux
Linux	Linux
Linux	Linux
Linux	Linux
Linux	Linux
Linux	Linux
Linux	Linux

### Business Applications

- Applications, Disks, FileSystems
- Replication Sessions

Compound State	Compound State
OK	OK
OK	OK

**Information Area**

**General**

**Resource Group**

Name: DR\_Portal

Class: ResourceGroup

Automation: portal

Node:

Owner:

Info link:

Description:

**Resource Group Status**

The resource works as desired

Observed state: Online Request Offline...

Desired state: Online Cancel Request

View Requests

Suspend Automation...

**Monitor & Control Systems Applications and Data Replication Sessions here.**

## Create Automation Policies

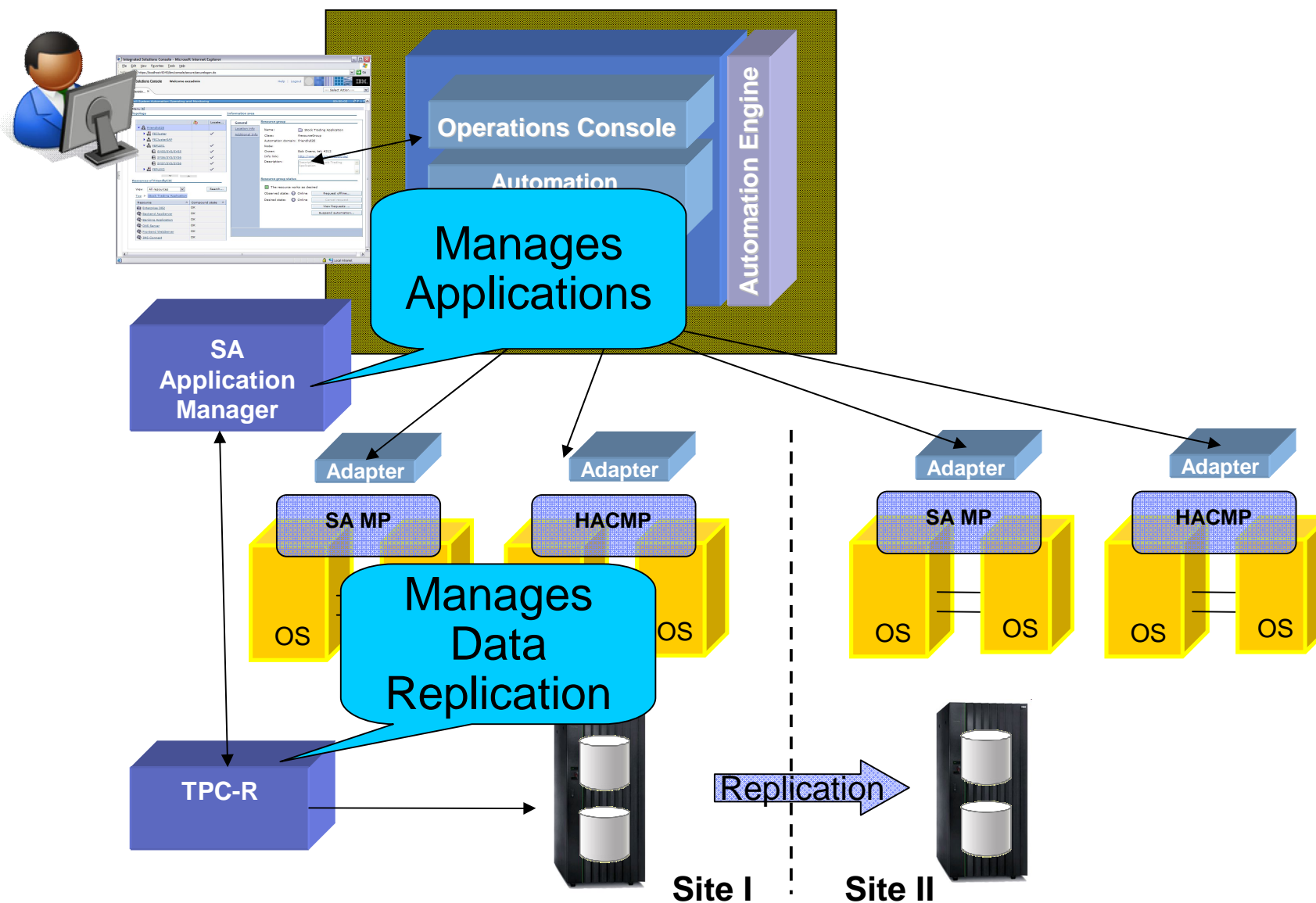
Tivoli System Automation also offers a WEB-based user interfaces to create automation policies

***Compose and Visualize Business Applications for SA MP and SA AppMan.***

**Create Resources, Groups and Relationships**

- Supports policies for:
  - SA MP
  - SA Application Manager
  - Agentless Adapter
- Provides Resource Harvesting
- Integrated Policy Checker

# SA Application Manager & Disaster Recovery Components View



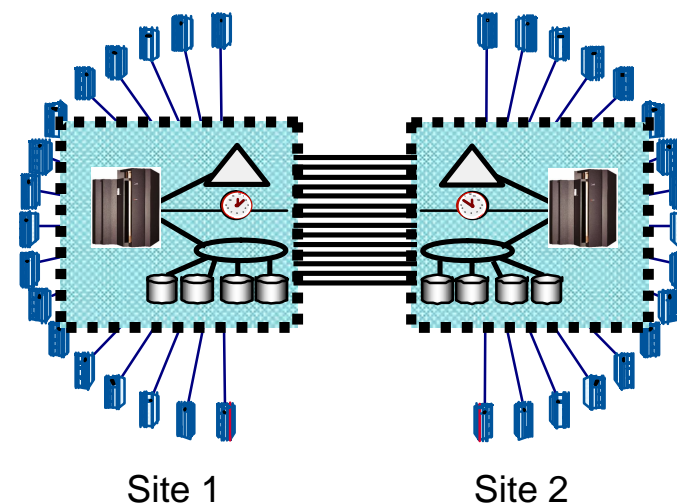
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## Disaster Recovery with GDPS (Geographically Dispersed Parallel Sysplex) & System Automation for z/OS

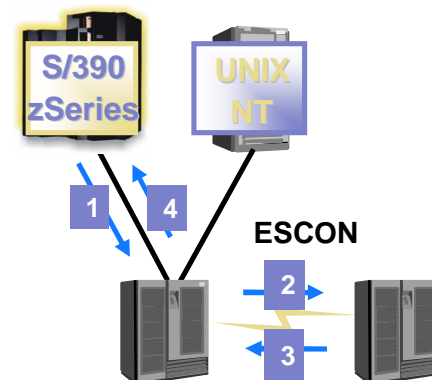
- Multi-site sysplex
- Remote data mirroring (disk & tape)
- **System Automation for z/OS** provides:
  - ▶ Automation infrastructure
  - ▶ Move of applications to site 2
  - ▶ Processor Operations
  - ▶ Sysplex automation like CF mgmt and removal of failed system



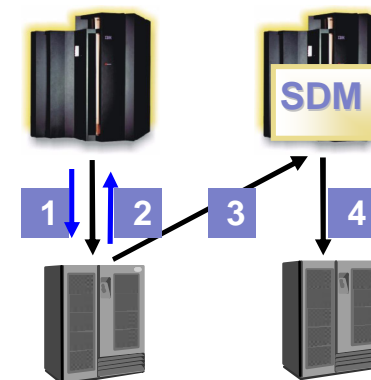
## GDPS Supports Two Data Mirroring Technologies



- Peer to Peer Remote Copy (PPRC)
  - Synchronous data mirroring
- GDPS manages secondary data consistency
  - No or limited data loss in failover - user policy
- Production site exception condition monitoring
  - GDPS initiates and executes failover
- Designed for Continuous Availability and Disaster Recovery solution



- eXtended Remote Copy (XRC)
  - Asynchronous data mirroring
  - Limited data loss to be expected in unplanned failover
- XRC manages secondary data consistency
- GDPS executes Parallel Sysplex restart
  - Limited user involvement
- Designed to support unlimited distance
- Disaster Recovery solution



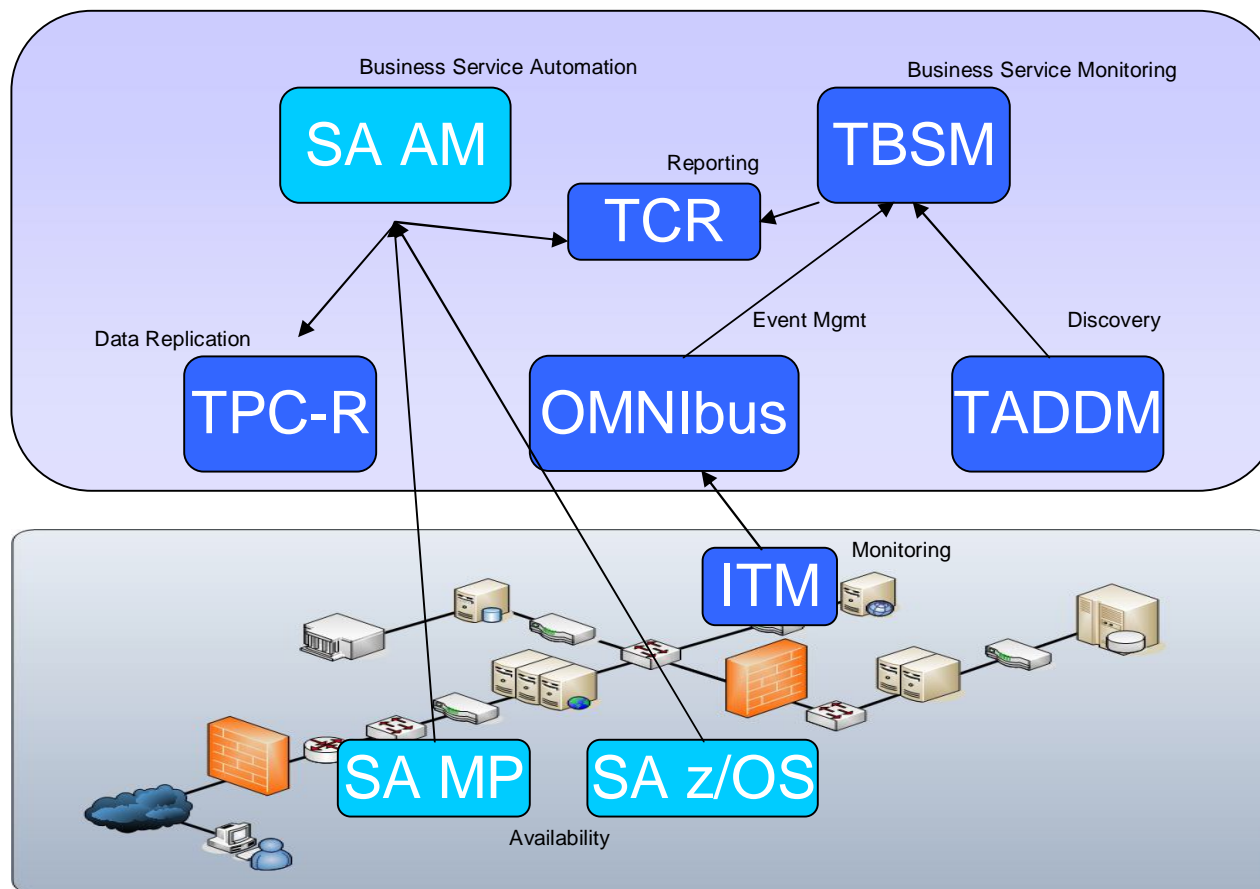
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# Integrated Service Management (ISM) and System Automation



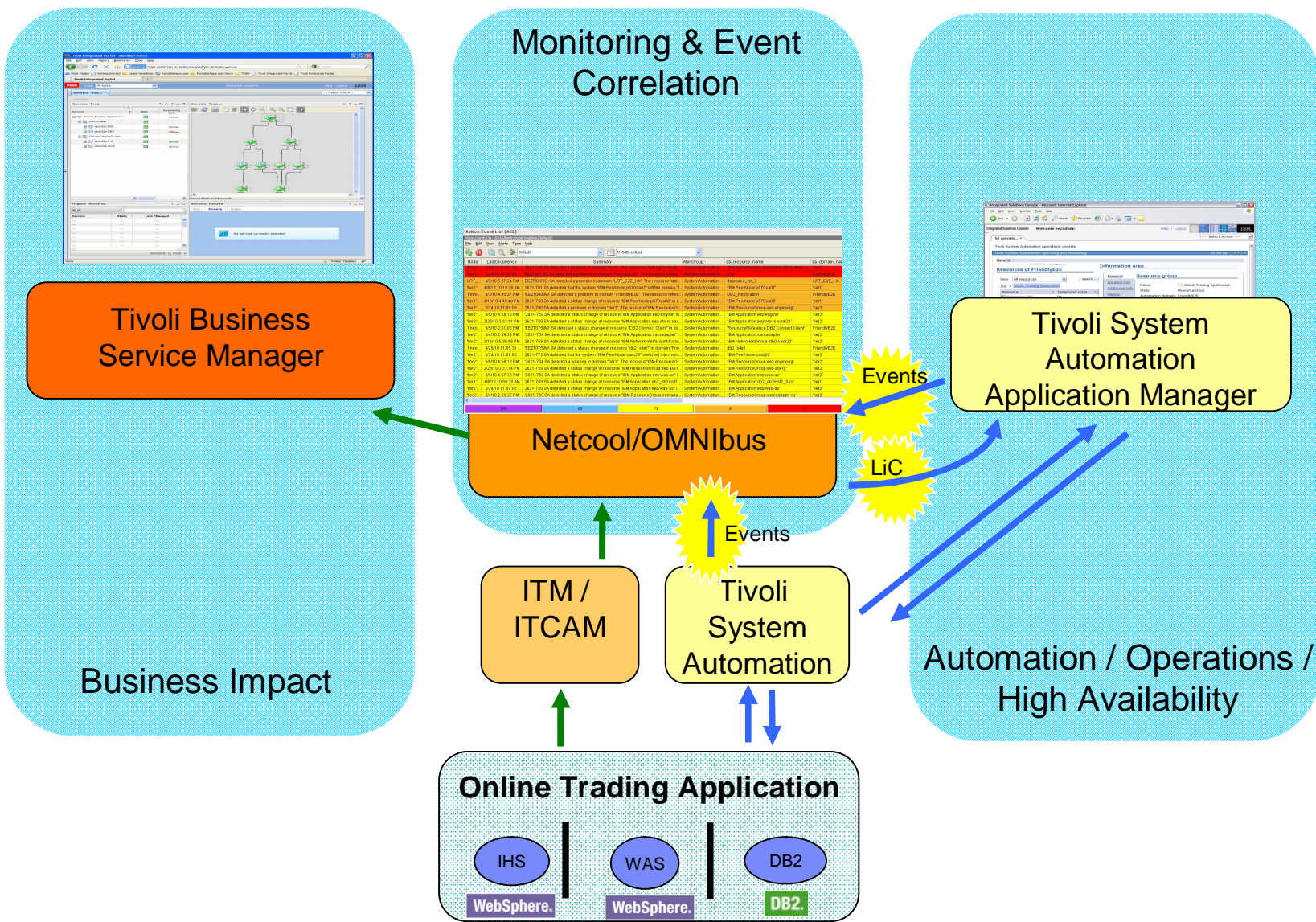
IT landscape

## TSA MP & TSA AppMan Integration with OMNIBus

Operators get a complete and consistent overview of situations. Automatically triggered corrective actions from TSA will appear as event together with other messages triggered by various monitors.

- Tivoli System Automation Multiplatforms and Application Manager now support to send availability state resource events to OMNIBus
- A set of SA specific OMNIBus rules for event correlation are provided
- An Operator can use the Launch-in-Context (LiC) feature from the selected SA event in OMNIBus to the SA Operations Console

# OMNibus Integration



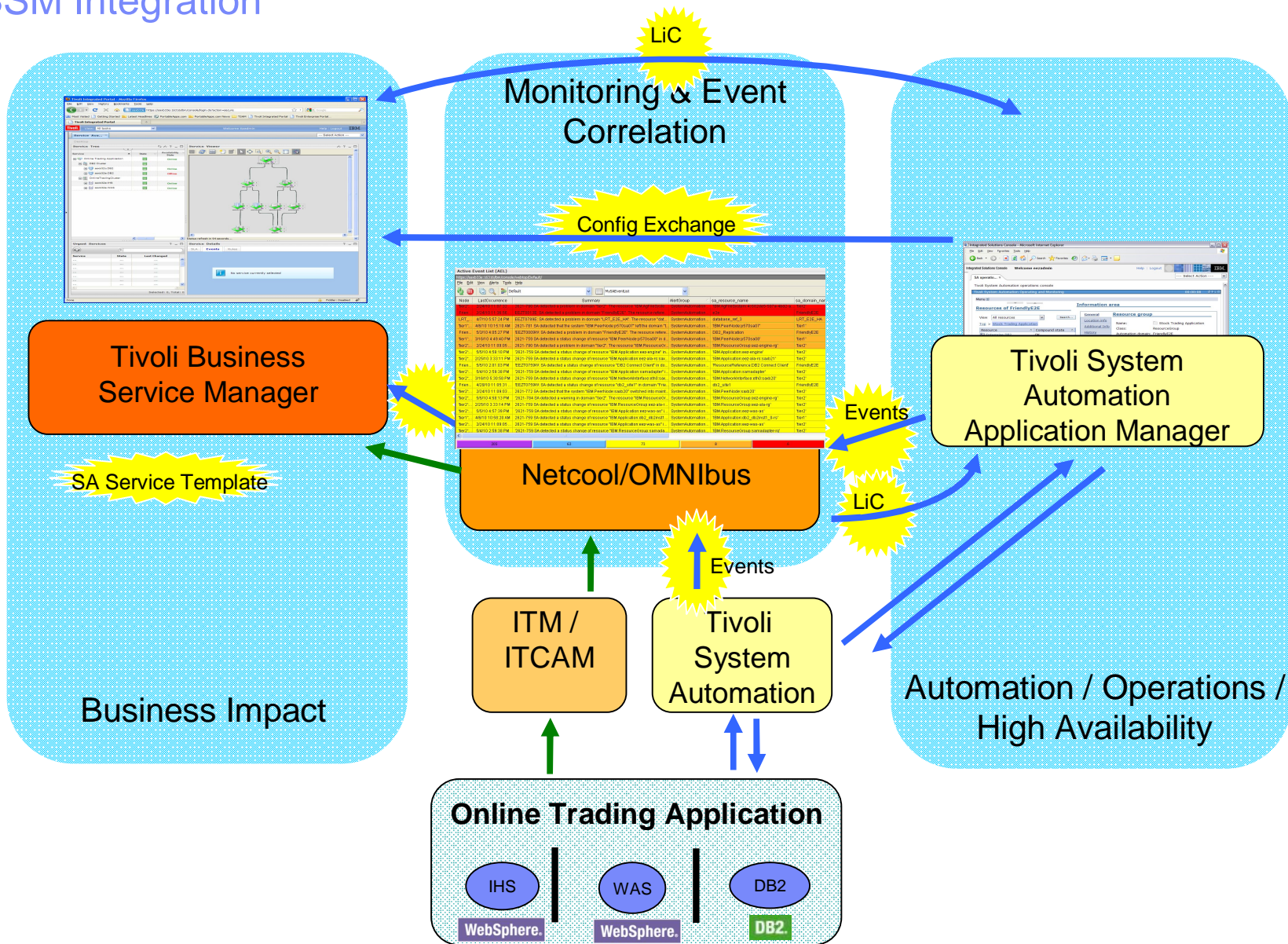
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## TSA AppMan Integration with TBSM

Provide a consistent overview of resource state. Operators are informed if manual interaction is required as response to some situation, or TSA already recovers from it.

- Tivoli System Automation Application Manager now provides documentation and service templates that can be used to enrich TBSM service views with TSA availability state information.
- TBSM Operators can now control (request online/offline) the automated resources.
- An Operator can use the Launch-in-Context (LiC) feature from the selected resource in TBSM to the SA Operations Console and back.

# TBSM Integration



## TBSM Integration – End-to-End Business Services Availability View

- **Enrich TBSM Service View with information from SA AppMan**
  - Map SA events to corresponding TBSM services
  - Show „Availability State“ from SA. Availability State shows if application is running or not
  - Events from SA AM, SA MP and SA z/OS are supported
- **SA Provide automatic recovery of services**
  - Observe in TBSM service view, how TSA recovers from failure situations

The screenshot displays the Tivoli Integrated Portal's Service Availability View. The browser address bar shows the URL: `https://saxb33e:16316/ibm/console/login.do?action=secure`. The page title is "Tivoli Integrated Portal" and the user is logged in as "tipadmin".

The main content area is divided into three sections:

- Service Tree:** A table listing services and their availability states.
 

Service	State	Availability State
Online Trading Application	Green	Online
DB2 Cluster	Green	Online
saxb32e:DB2	Green	Online
saxb32e:DB2	Green	Offline
OnlineTradingCluster	Green	Online
saxb32e:IHS	Green	Online
saxb32e:VIAS	Green	Online
- Service Viewer:** A hierarchical diagram showing the relationship between services. At the top is "Online Trading Appl", which branches into "DB2 Cluster" and "OnlineTradingCluster". "DB2 Cluster" further branches into "saxb32e:DB2" (two instances), and "OnlineTradingCluster" branches into "saxb32e:VIAS" and "saxb32e:IHS" (two instances). Each instance is represented by a server icon with a status indicator.
- Urgent Services:** A table with columns for Service, State, and Last Changed. The table is currently empty.

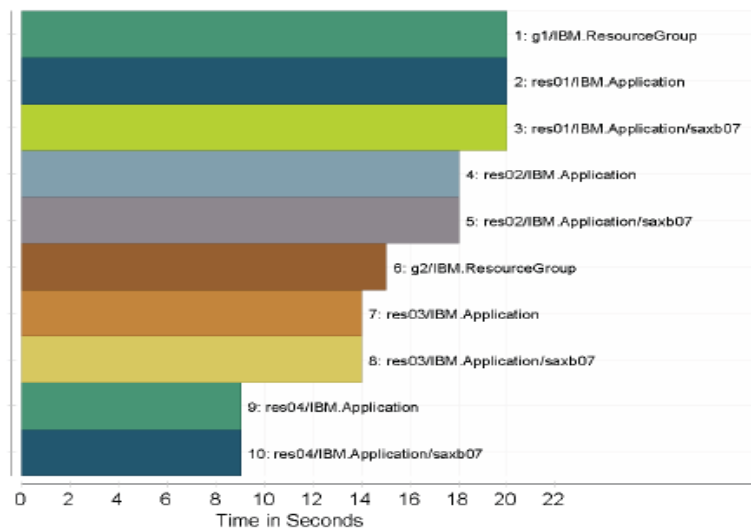
The Service Viewer diagram includes a status refresh indicator: "Status refresh in 94 seconds...".

## SA AppMan Integration with Tivoli Common Reporting

- SA Application Manager delivers **pre-defined reports** to **visualize key performance and availability data** for your automated business relevant applications.
- **Availability and Recovery Reports**
  - ***Resource Availability and Recovery***  
Report a resource's up- and downtimes, unexpected outages and corresponding recovery times.
  - ***Top Resources with the Highest number of Unexpected Outages***  
Report the top resources that had the highest number of unexpected outages in a selected domain.
- **Startup and Shutdown Reports**
  - ***Resource Startup and Shutdown***  
Report the cumulative startup and shutdown times for a resource including its dependencies.
  - ***Top Resources with the Longest Startup and Shutdown Times***  
Report the top resources with the longest startup and shutdown times in a selected domain.

# Resource Availability Reports

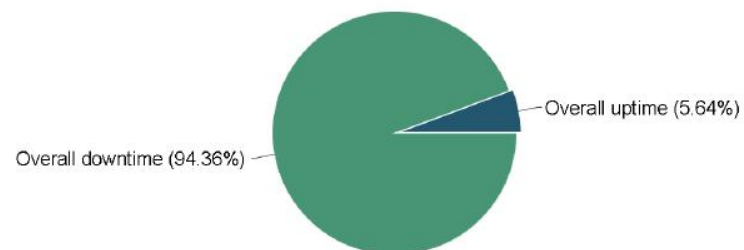
Tivoli



Resources with the longest startup times - overview

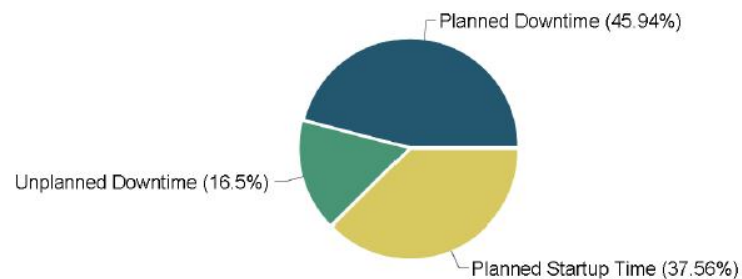
	Resources (Name/Class/Node)	Minimum	Maximum	Average	Number of startups
1	g1/IBM.ResourceGroup	5sec	25sec	20sec	7
2	res01/IBM.Application	5sec	25sec	20sec	9
3	res01/IBM.Application/saxb07	5sec	25sec	20sec	9
4	res02/IBM.Application	5sec	20sec	18sec	9
5	res02/IBM.Application/saxb07	5sec	20sec	18sec	9
6	g2/IBM.ResourceGroup	5sec	20sec	15sec	9
7	res03/IBM.Application	5sec	15sec	14sec	9

## Availability Overview



This chart provides an overview on the overall uptime and overall downtime of a resource. These time calculations are based on the observed state of a resource only. The desired state, e.g. whether an online or offline time was planned or not, is not taken into account.

## Downtime analysis



This chart gives a detailed insight in how the overall downtime value of the first chart is composed. "Planned downtime" includes "Planned Offline", "Planned Shutdown Time" and "Unplanned Startup Time". "Unplanned downtime" includes "Unplanned Offline" and "Unplanned Shutdown Time".



# Resource Startup and Shutdown Times Reports



## Startup and Shutdown Times for a selected resource Report

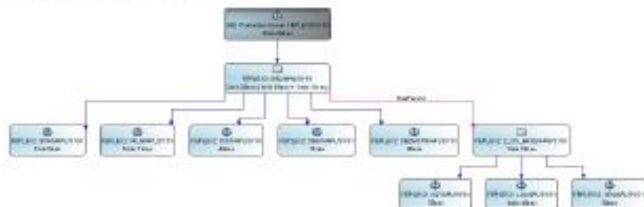
**Domain name:** P1andNCE  
**Resource Name:** DB2 Production Server FEPLX2/SYS1  
**Time Interval:** Mar 25, 2008 12:00 AM - Apr 27, 2008 12:00 PM  
**Active policy at report generation:** Policy 1      **Active since:** May 7, 2008 6:20 PM  
**Displayed graph depth:** All

### Summary

Cumulative startup time (including dependencies)		Own startup time		Observed startup time	
Minimum	2min 15sec	Minimum	2min 15sec	Minimum	22sec
Maximum	2min 47sec	Maximum	2min 47sec	Maximum	28sec
Average	2min 28sec	Average	2min 28sec	Average	26sec
Cumulative shutdown time (including dependencies)		Own shutdown time		Observed shutdown time	
Minimum	3min 47sec	Minimum	3min 47sec	Minimum	12sec
Maximum	4min 34sec	Maximum	4min 34sec	Maximum	28sec
Average	4min 11sec	Average	4min 11sec	Average	20sec

### Startup times

Chart shows average cumulative startup times

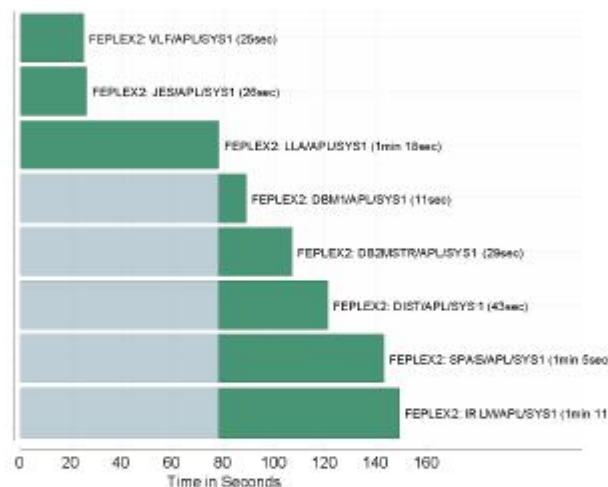


May 7, 2008 6:20:34 PM GMT+02:00

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Times shown in graph are the cumulative average startup times. If a resource has startup dependencies, the average cumulative startup time of this dependency chain and the resource own average startup time are displayed in parentheses. The times displayed are formatted like this: Cumulative Startup Time (Dependent Startup Time + Own Startup Time)



Resource Name	Cumulative startup time (including dependencies)			Startup time			Number of startups
	Minimum	Maximum	Average	Minimum	Maximum	Average	
DB2 Production Server FEPLX2/SYS1	2min 15sec	2min 47sec	2min 28sec	2min 15sec	2min 47sec	2min 28sec	Not applicable
FEPLX2: DB2/APG/SYS1	2min 15sec	2min 47sec	2min 28sec	1min 5sec	1min 20sec	1min 11sec	Not applicable
FEPLX2: Z_OS_BASE/JPG/SYS1	1min 10sec	1min 27sec	1min 18sec	1min 10sec	1min 27sec	1min 18sec	Not applicable
FEPLX2: DB2MSTR/APUSYS1	29sec	29sec	29sec	29sec	29sec	29sec	1

May 7, 2008 6:20:38 PM GMT+02:00

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