Linux on System z - How to Migrate Workloads, Monitor, Measure and Optimize Quality of Service

CMG Conference '08, Las Vegas
Louis Hanna, IBM Tivoli zSeries Software Specialist
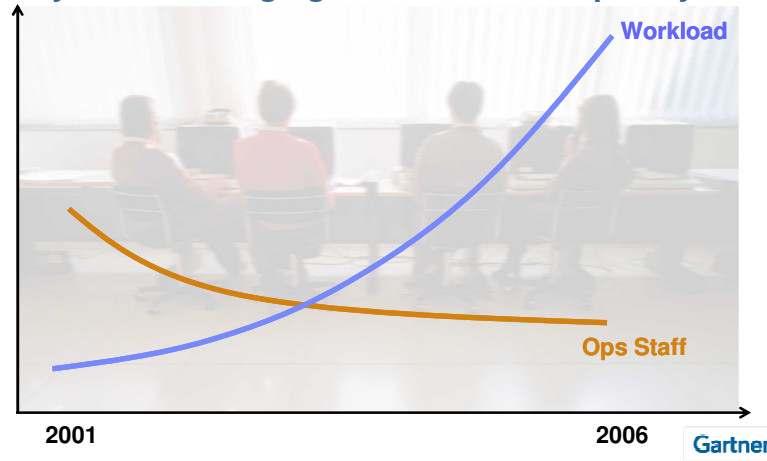12-11-08

System z Consolidation Helps Address IT Challenges

New HW / SW spending

15 years ago

Today

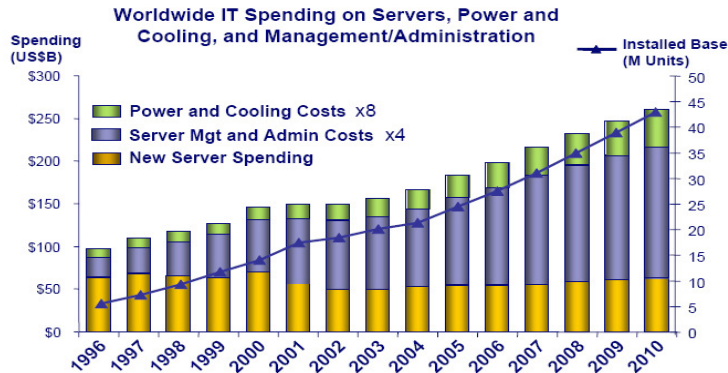**Cost of management & administration**

Source: Tony Picardi, IDC
Economist.com: Make it simple. October 28th, 2004
From The Economist print edition

System z Managing Growth and Complexity

Workload

Ops Staff

2001   2006

Gartner

Worldwide Server Market:
Cost of Management Ramps Dramatically

Worldwide IT Spending on Servers, Power and Cooling, and Management/Administration

Spending (US$B)

Installed Base (M Units)

- Power and Cooling Costs x8
- Server Mgt and Admin Costs x4
- New Server Spending

$300
$250
$200
$150
$100
$50
$0

50
45
40
35
30
25
20
15
10
5
0

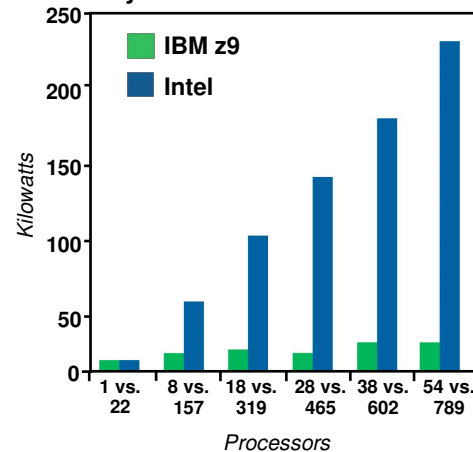1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

Many Servers, Much Capacity, Low Utilization = $140B unutilized server assets

Source: IDC, 2006

POWER:
System z vs. Linux on Intel

- ■ IBM z9
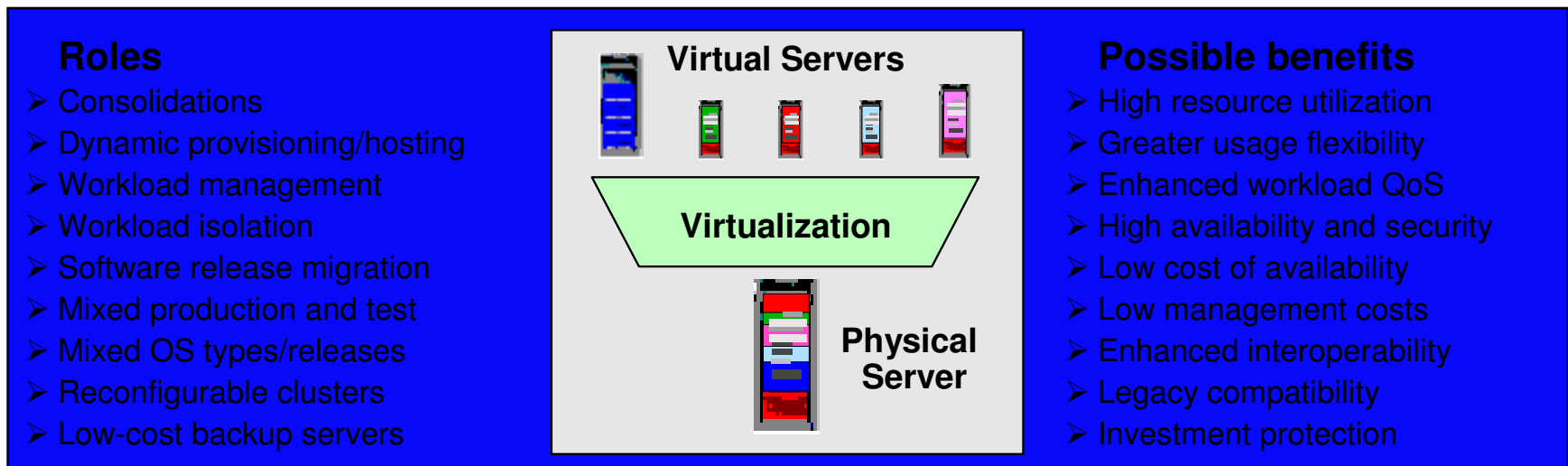- ■ Intel

Kilowatts

250
200
150
100
50
0

| 1 vs. 22 | 8 vs. 157 | 18 vs. 319 | 28 vs. 465 | 38 vs. 602 | 54 vs. 789 |

Processors

SPACE:
System z vs. Linux on Intel

- ■ IBM z9
- ■ Intel

Square Feet

120
100
80
60
40
20
0

| 1 vs. 22 | 8 vs. 157 | 18 vs. 319 | 28 vs. 465 | 38 vs. 602 | 54 vs. 789 |

Processors
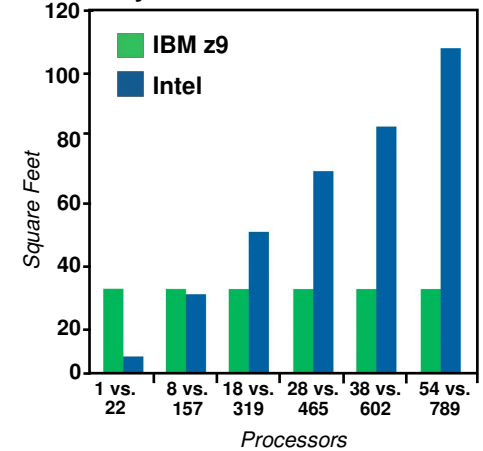
The Linux on Intel servers selected in this example are functionally eligible servers considered for consolidation to a System z running at low utilization such that the composite utilization is approximately 5%. The utilization rate assumed for System z EC is 90%. This is for illustration only actual power and space reductions, if any, will vary according to the actual servers selected for consolidation.

Server Virtualization Business Value

Roles		Possible benefits

Roles
- Consolidations
- Dynamic provisioning/hosting
- Workload management
- Workload isolation
- Software release migration
- Mixed production and test
- Mixed OS types/releases
- Reconfigurable clusters
- Low-cost backup servers

Virtual Servers

Virtualization

Physical Server

Possible benefits
- High resource utilization
- Greater usage flexibility
- Enhanced workload QoS
- High availability and security
- Low cost of availability
- Low management costs
- Enhanced interoperability
- Legacy compatibility
- Investment protection

- **In the final analysis, the potential virtualization benefits take three forms:**
  - Help reduce hardware and energy costs
    - Help increase physical resource utilization
    - Small footprints
    - Reduced power and cooling
- **Can improve flexibility and responsiveness**
  - Virtual resources can be adjusted dynamically to meet new or changing needs and to optimize service level achievement
  - Virtualization is a key enabler of on demand operating environments
- **Can reduce management costs**
  - Fewer physical servers to manage
  - Many common management tasks become much easier

Leverage the strengths of the Ultimate Virtualization Platform

X86 Virtualization
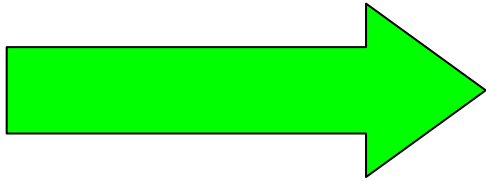
z/VM Virtualization
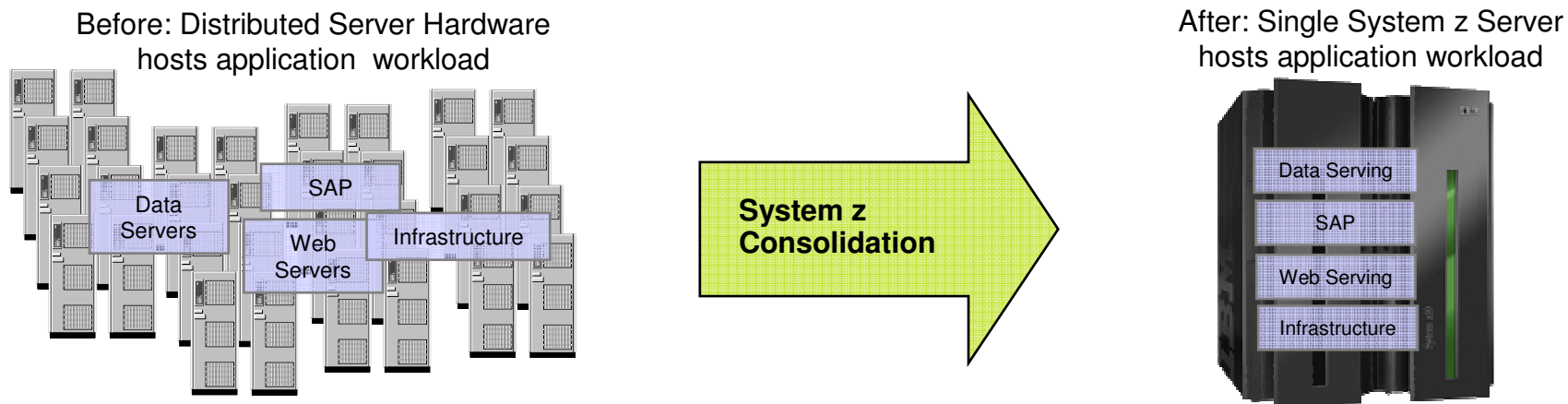
Grow here (add more boxes!)

x86 blade servers with 304 cores using virtualization product
Example: x86 SUN X2100 1U dual-core Opteron
8 racks of 19 dual-core servers per rack running many
copies of x86 virtualization product

One IBM System z10 EC with
**26 cores (IFLs) and z/VM**
– with room to add 38 more cores –

"Mean Time Between Failure"	measured in decades versus months
¼ network equipment costs	virtual and physical connectivity
1/25th floor space	400 sq. ft. versus 10,000 sq. ft
1/20 energy requirement	$24.6K/year versus $133K/year
1/5 the administration	< 5 people versus > 25 people
Highest average resource utilization	Up to 100% versus < 15%
Capacity Management & upgrades	On demand; in minutes, not weeks/months
Security intrusion points	Reduced by z architecture and # of access pts.
SW license fees for OTC	26 engines of Oracle vs 304 engines yields 91% savings

System z Workload Consolidations Basics

- **What is a server consolidation?**
  - Application workload running on many distributed server is moved to run on a single System z server

- **What is typically being consolidated?**
  - Examples of applications are being consolidated today include data servers, application hosting servers, ERP CRM applications and "Infrastructure" used to support applications
  - *Analysis is required to determine appropriate workload for consolidation*

- **Why use a System z to consolidate?**
  - Control distributed server growth and lower total cost of ownership (TCO)
  - Leverage existing skills and IT investments
  - Use best of breed virtualization technology and highest level Quality of Service (QOS) level
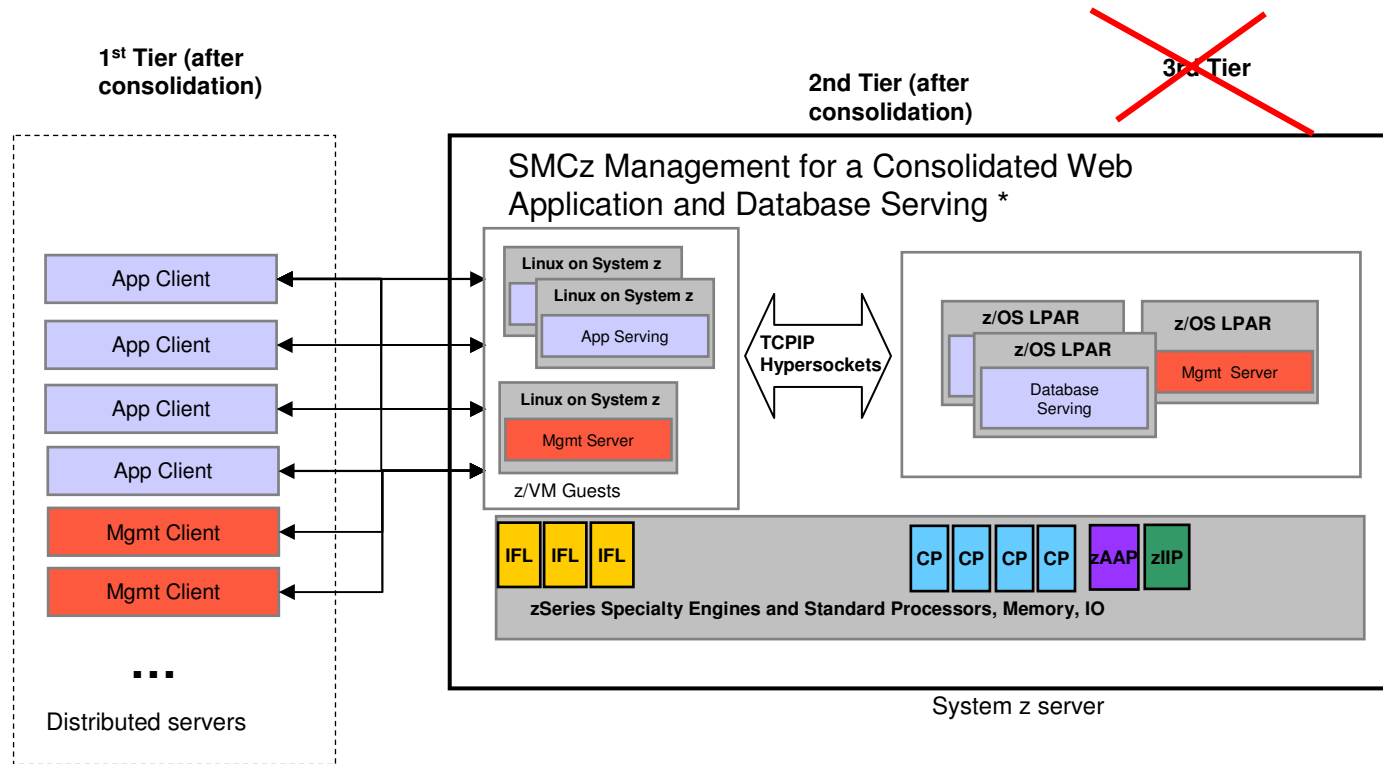
Before: Distributed Server Hardware hosts application workload

Data Servers

SAP

Web Servers

Infrastructure

System z Consolidation

After: Single System z Server hosts application workload

Data Serving

SAP

Web Serving

Infrastructure

Example Scenario: Application Workload – Before Consolidation

1st Tier (before consolidation)

2nd Tier (before consolidation)

3rd Tier (before consolidation)

Distributed servers

System z server
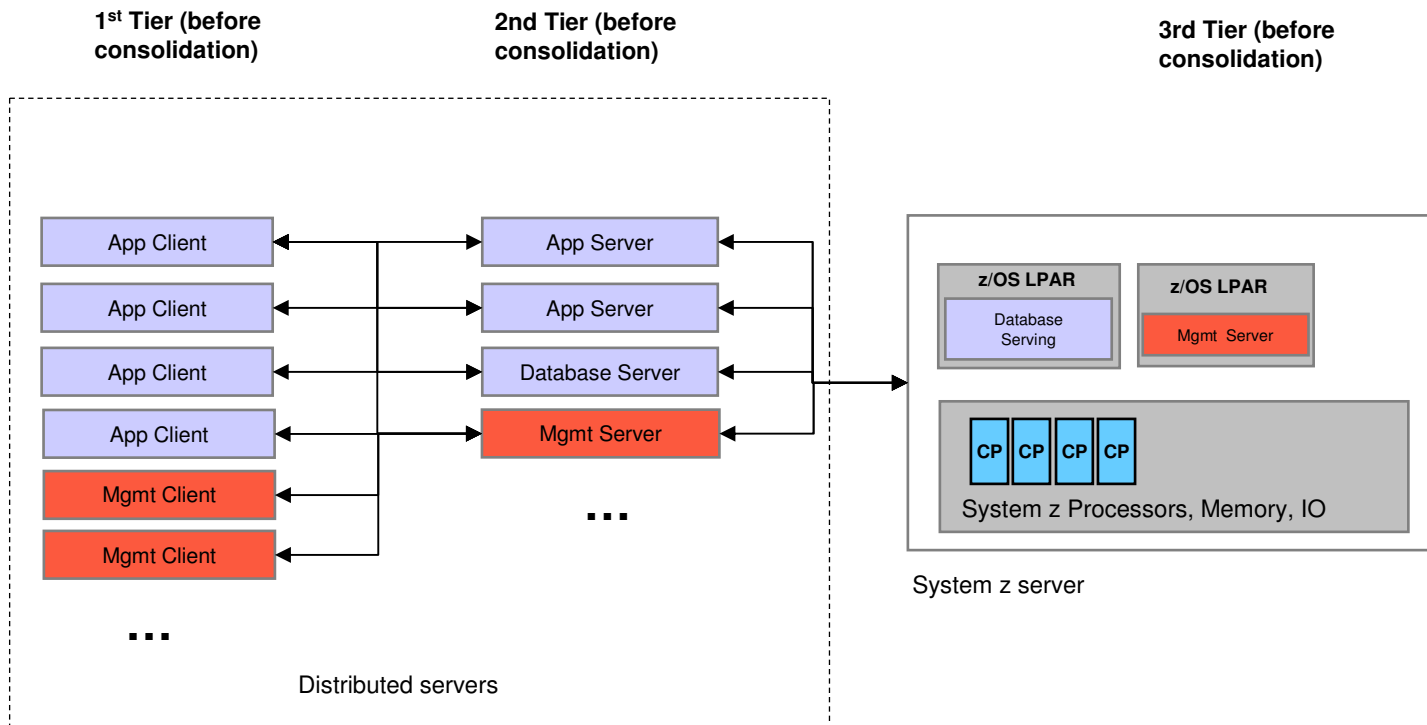
Example of a networked web application and database serving

Example Scenario: Application Workload – After Consolidation

1st Tier (after consolidation)

2nd Tier (after consolidation)

3rd Tier ~~(crossed out)~~

SMCz Management for a Consolidated Web Application and Database Serving *

Linux on System z

Linux on System z

App Serving

Linux on System z

Mgmt Server

z/VM Guests

App Client

App Client

App Client

App Client

Mgmt Client

Mgmt Client

TCPIP Hypersockets

z/OS LPAR

z/OS LPAR

z/OS LPAR

Mgmt Server

Database Serving

IFL IFL IFL

CP CP CP CP zAAP zIIP

zSeries Specialty Engines and Standard Processors, Memory, IO

System z server

. . .

Distributed servers

* Note consolidation is workload dependent. All distributed workload is not appropriate for consolidation.

IFL = Integrated Facility for Linux (IFL)

zAPP = System z Application Assist Processor

zIIP = IBM System z Integrated Information Processor

✓Operational advantages with less hardware and fewer parts with integrated and centralized service management

✓More secure than networked application and data serving with higher reliability due to fewer points of failure

Management Considerations during a System z Consolidation Project

During analysis phase to determine what workload is appropriate to consolidate, also consider

I. <u>What</u> is needed to manage consolidated environment

II. <u>Where</u> the management solution runs

III. <u>Incremental</u> approach leverages existing investments

IV. <u>Common</u> service management process automation infrastructure
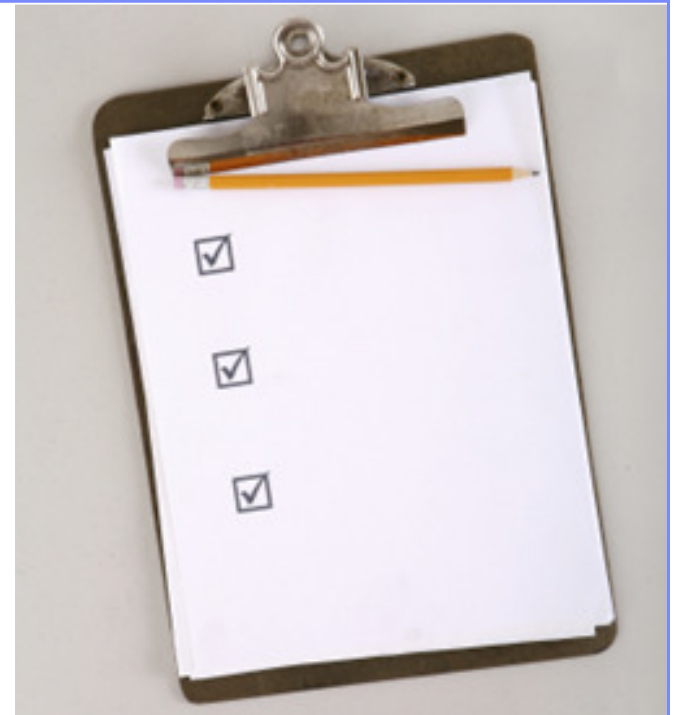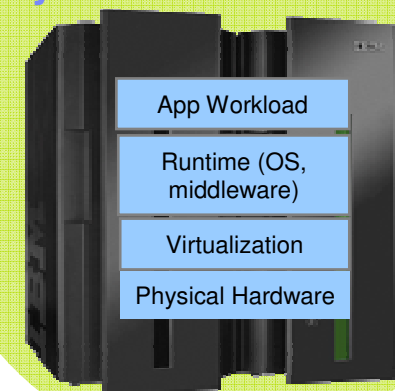
Consider the new System z Consolidated Environment

- **Visualize, control and automate the consolidated operating environment**

- **Improve availability with performance monitoring and automation**

- **Realize the total cost of ownership (TCO) advantages of consolidating**

- **Design for operational advantages up-front**

- **Leverage existing skills and centralized management**

- **Optimize the use of physical hardware with correlation to virtual resources**

New consolidated System z environment
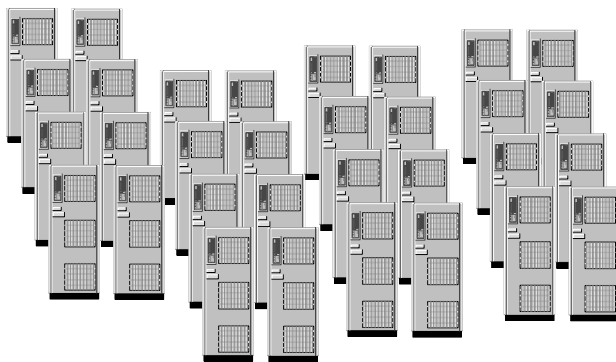
System z
Consolidation
(10:1 - 20:1 reduction
in physical servers) *

✓ Simplifier
✓ Faster
✓ Cheaper

| App Workload |
| Runtime (OS, middleware) |
| Virtualization |
| Physical Hardware |

* Analysis required to determine workload appropriate for consolidation.

- Choice of appropriate workload

- Run virtual quests on z/VM or native LPAR?

- Single z/VM vs. Multiple? At minimum a separation of production and test z/VM is recommended for security and change management

- Which Linux distribution ?

- How big do I make my Linux system?
  - Generally speaking no more than what is required, without impacting the application. Generally application owners will expect performance at least as good as before consolidation.
  - Virtual CPUs usually are not = or > than physical CPUs
  - Don't over commit guest memory or it will result in large % being used for Linux IO buffers and cache
  - Conserve disk by using shared binaries

- Centralized authentication vs unique repository for each virtual system.

- Aim for migrating many distributed server/application to one consolidated server/application (as opposed to 1 : 1)

- Monitoring, Automation , and Capacity Planning is Required

Linux on System z Provides an Ideal Platform for Key New Workloads – Data, Web / WebApp Servings
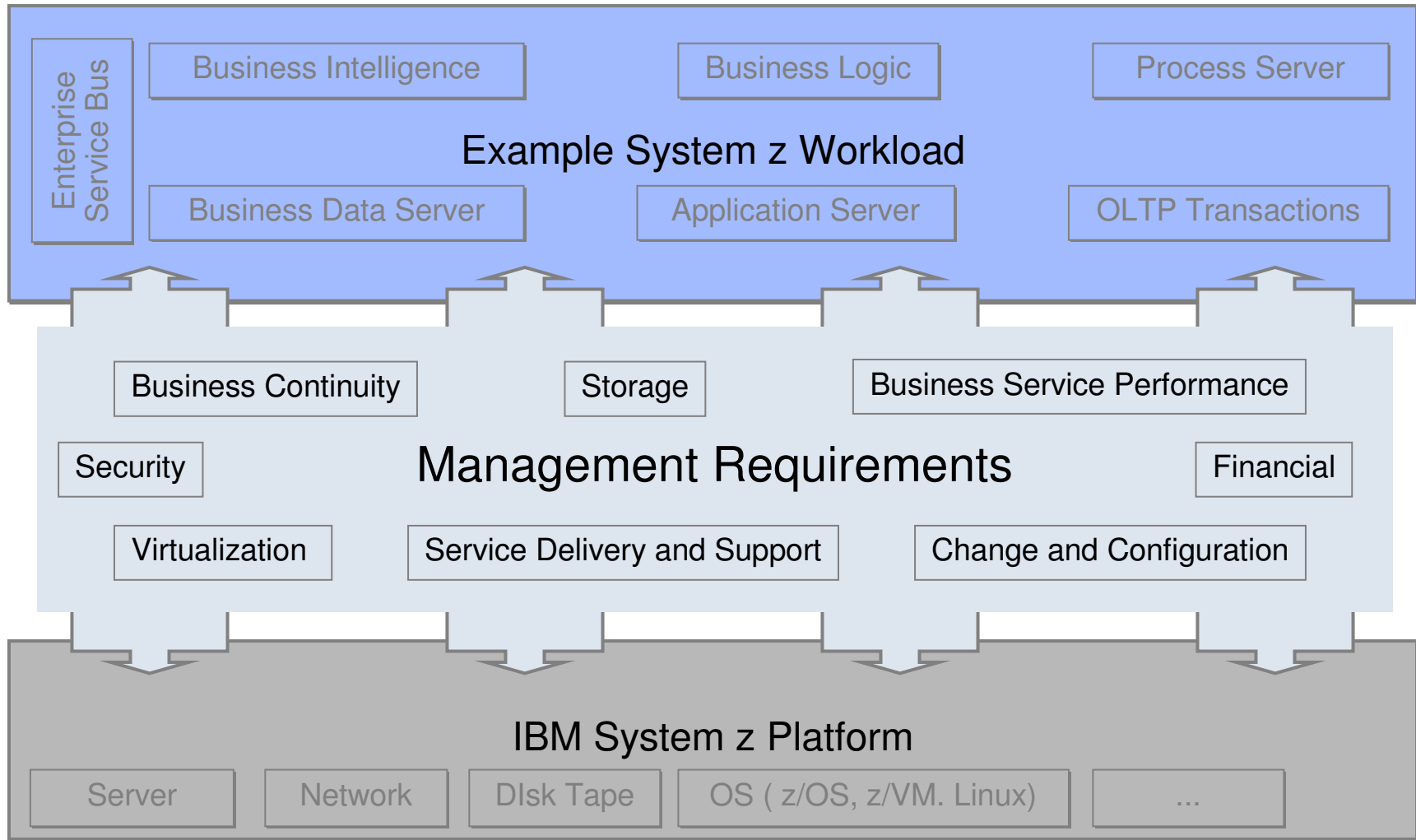
- **Data Serving challenge**: Manage massive processing requirements and meet them quickly

    - System z scalability supports consolidation of diverse workloads onto zSeries servers

    - "Vertical" scaling consolidates workloads of less powerful processors onto a more powerful processor

- **Web Serving/Web App challenge**: Requires many server instances, resulting in complex   server environments

    - z/VM running on a zSeries processor enables "horizontal" server consolidation

    - Capacity is added by obtaining additional servers and integrating them into the network

"With z/VM, the mainframe can support hundreds to thousands of Linux virtual systems on a single mainframe, which can provide excellent total cost of ownership, especially based on software pricing per core."
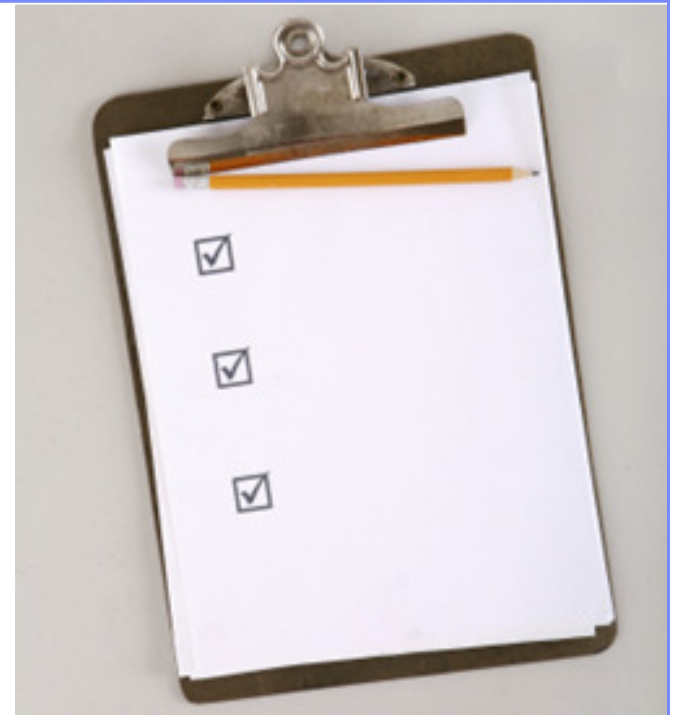
-- Gartner "Open Source in IBM Mainframe"

Management Required for New System z Workload

Example System z Workload

Enterprise Service Bus	Business Intelligence	Business Logic	Process Server
	Business Data Server	Application Server	OLTP Transactions

Management Requirements

- Business Continuity
- Storage
- Business Service Performance
- Security
- Financial
- Virtualization
- Service Delivery and Support
- Change and Configuration

IBM System z Platform

Server	Network	DIsk Tape	OS (z/OS, z/VM. Linux)	...

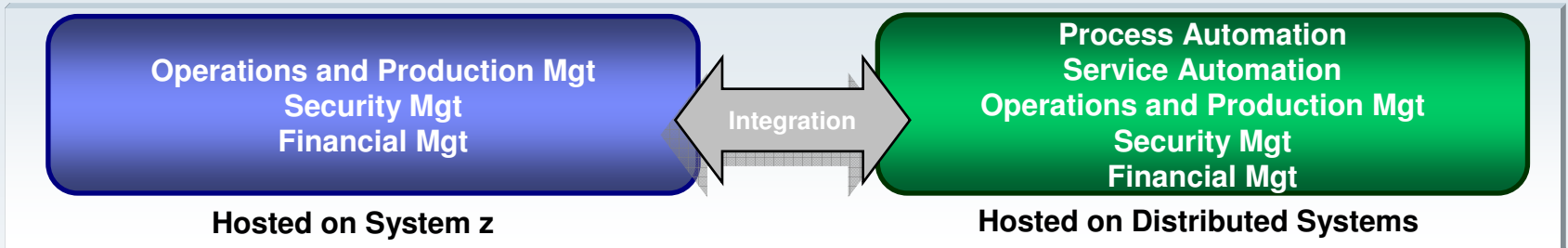# Management Considerations during a System z Consolidation Project

During analysis phase to determine what workload is appropriate to consolidate, also consider

I. <u>What</u> is needed to manage consolidated environment

II. <u>Where</u> the management solution runs

III. <u>Incremental</u> approach leverages existing investments

IV. <u>Common</u> service management process automation infrastructure

Consider flexibility in where management runs

- Traditional service management implementation:

Operations and Production Mgt Security Mgt Financial Mgt	← Integration →	Process Automation Service Automation Operations and Production Mgt Security Mgt Financial Mgt
Hosted on System z		**Hosted on Distributed Systems**

- Consolidated IBM Service Management for System z implementation:

Process Automation
Service Automation
Operations and Production Mgt
Security Mgt
Financial Mgt

System z   **Distributed Systems**

✓ **Management solution can be consolidated to run on System z ***

- Flexibility allows for same TCO benefits of consolidating applications
- Management for Enterprise can be "managed from" System z

✓ **Legacy z/OS management provide basis for centralized management and common infrastructure**

* Analysis required to determine workload appropriate for consolidation.

IBM Tivoli's Service Management Center for System z:
Providing organizations with the Visibility, Control and Automation to use System z as the hub for managing their entire enterprise

- **Implements service management with System z as the core platform for managing services that often span diverse operating systems and platforms**

  - Not a single product, but a portfolio of integrated solutions, organized into management domains

- **Provides unified means for z practitioners to have enhanced visibility, control and automation of the services delivered to their customers**

- **Manages a System z virtualized environment and the high utilizations of consolidated workloads to reduce your environment complexity and overall energy consumption**

- **Exploits the operational advantages of System z to deliver and expand enterprise services managed as a utility**
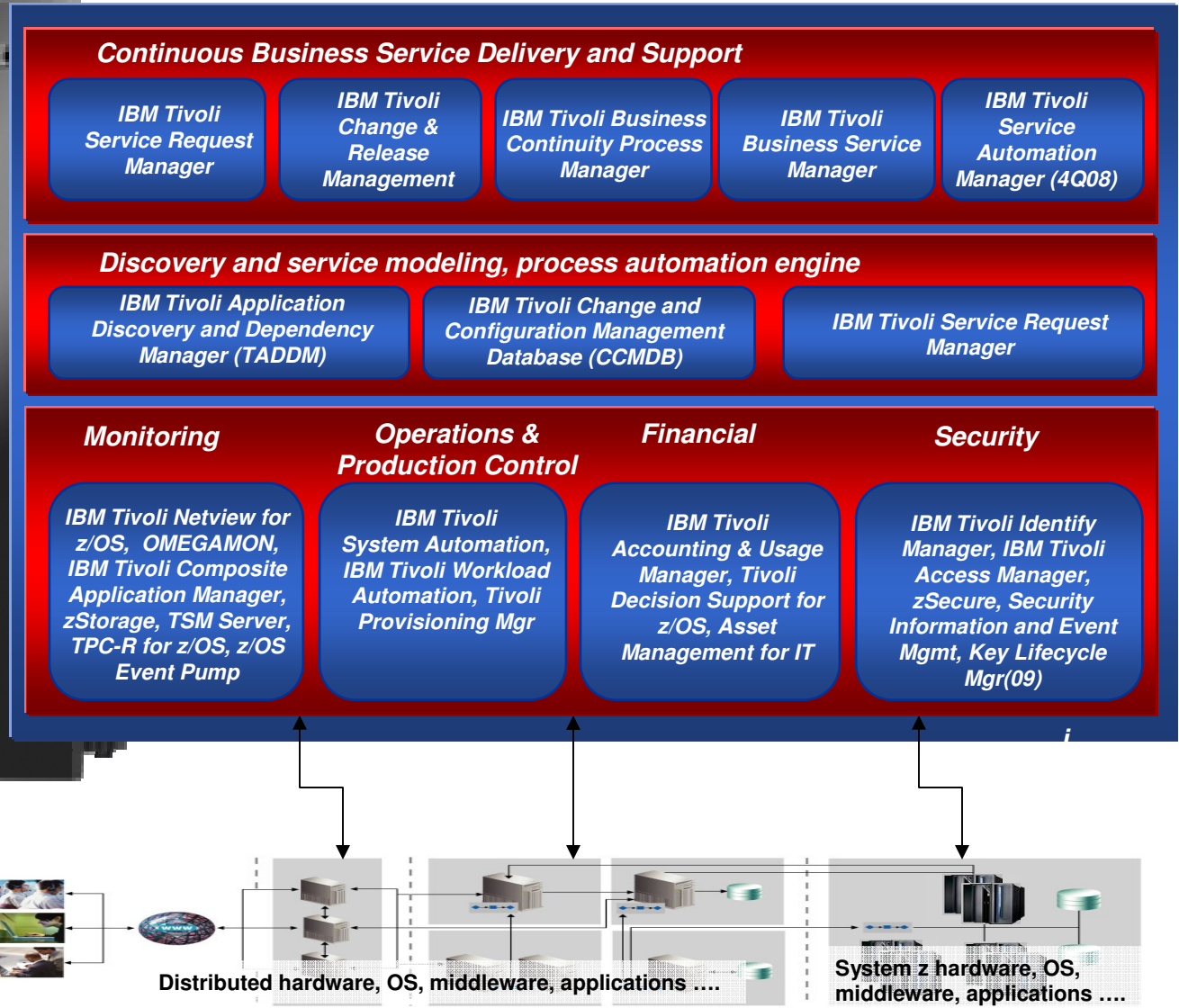
IBM Tivoli Service Management Center for System z (SMCz) Solution Strategy Includes Where the Management Runs
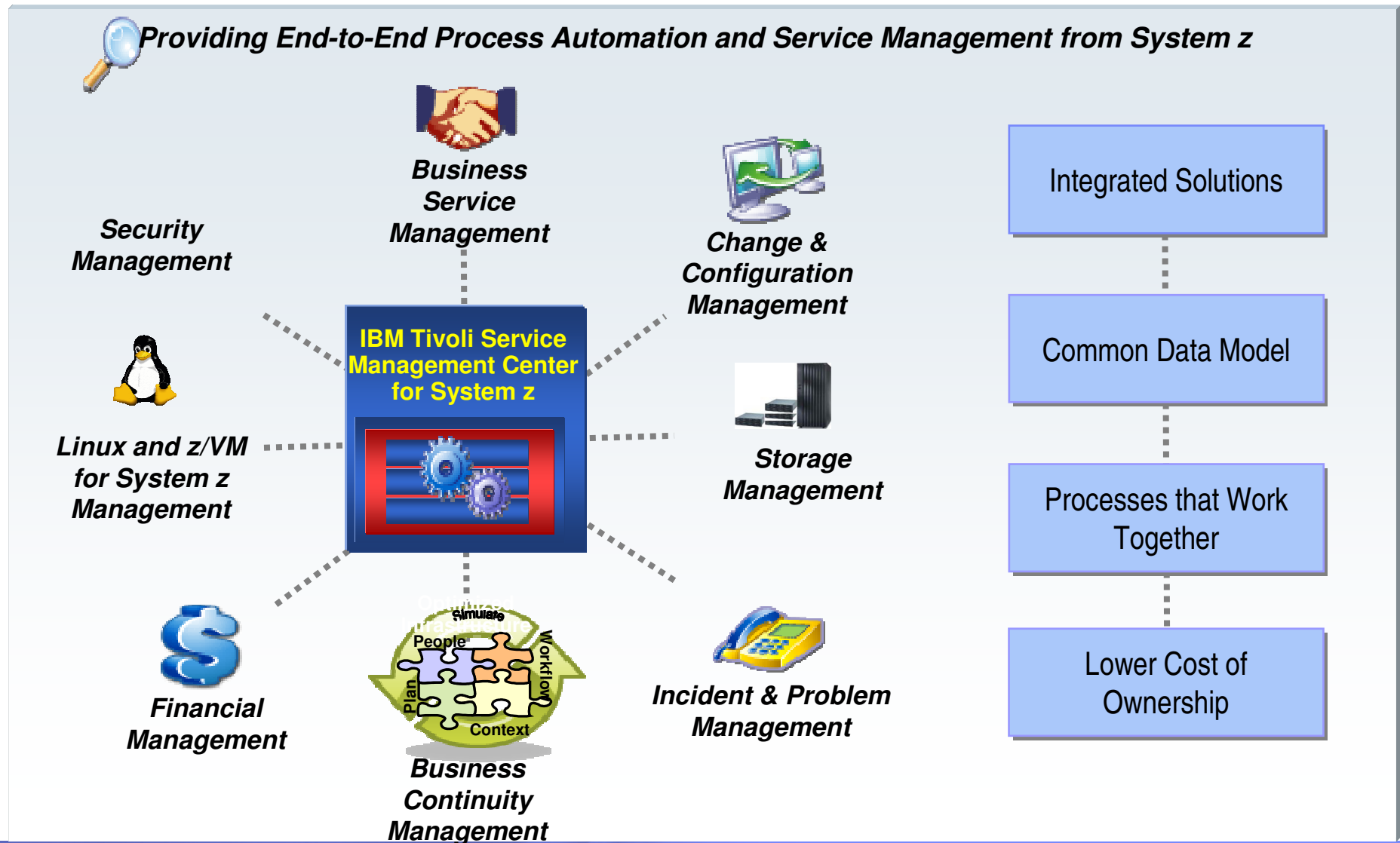
IBM Tivoli

Service Management Center for System z

Solution Strategy

- ✓ Integrate with existing management

- ✓ System z Inclusive Management from end to end

- ✓ Automate ITIL best practice processes

- ✓ Centralized service management from System z

Continuous Business Service Delivery and Support

IBM Tivoli Service Request Manager	IBM Tivoli Change & Release Management	IBM Tivoli Business Continuity Process Manager	IBM Tivoli Business Service Manager	IBM Tivoli Service Automation Manager (4Q08)

Discovery and service modeling, process automation engine

IBM Tivoli Application Discovery and Dependency Manager (TADDM)	IBM Tivoli Change and Configuration Management Database (CCMDB)	IBM Tivoli Service Request Manager

Monitoring	Operations & Production Control	Financial	Security
IBM Tivoli Netview for z/OS, OMEGAMON, IBM Tivoli Composite Application Manager, zStorage, TSM Server, TPC-R for z/OS, z/OS Event Pump	IBM Tivoli System Automation, IBM Tivoli Workload Automation, Tivoli Provisioning Mgr	IBM Tivoli Accounting & Usage Manager, Tivoli Decision Support for z/OS, Asset Management for IT	IBM Tivoli Identify Manager, IBM Tivoli Access Manager, zSecure, Security Information and Event Mgmt, Key Lifecycle Mgr(09)

Distributed hardware, OS, middleware, applications ....

System z hardware, OS, middleware, applications ....

Service Management Center for System z Technical Strategy Solution Areas

Providing End-to-End Process Automation and Service Management from System z

Security Management

Business Service Management

Change & Configuration Management

Linux and z/VM for System z Management

IBM Tivoli Service Management Center for System z

Storage Management

Financial Management

People
Workflow
Plan
Context

Business Continuity Management

Incident & Problem Management

Integrated Solutions

Common Data Model

Processes that Work Together

Lower Cost of Ownership

SMCz Management Hub Run-time Technical Strategy

•IBM Tivoli Service Management Center for System z solutions will support System z run-time environment by:

✓Using IBM middleware and exploiting zSeries specialty engines

✓Continuing to enhance solutions that run on z/OS (eg. currency, new features) managing the enterprise from end to end.

✓Also using Linux on System z to create a consolidated mgmt hub differentiated by the platform's advantages (e.g. secure, simplified operations, power, floor space, cabling, "always-on" high availablity, standard imaging and dynamic workload balancing)

•Reduce points of failure in management hub by removing dependencies on distributed servers and integration with high availablity technology.
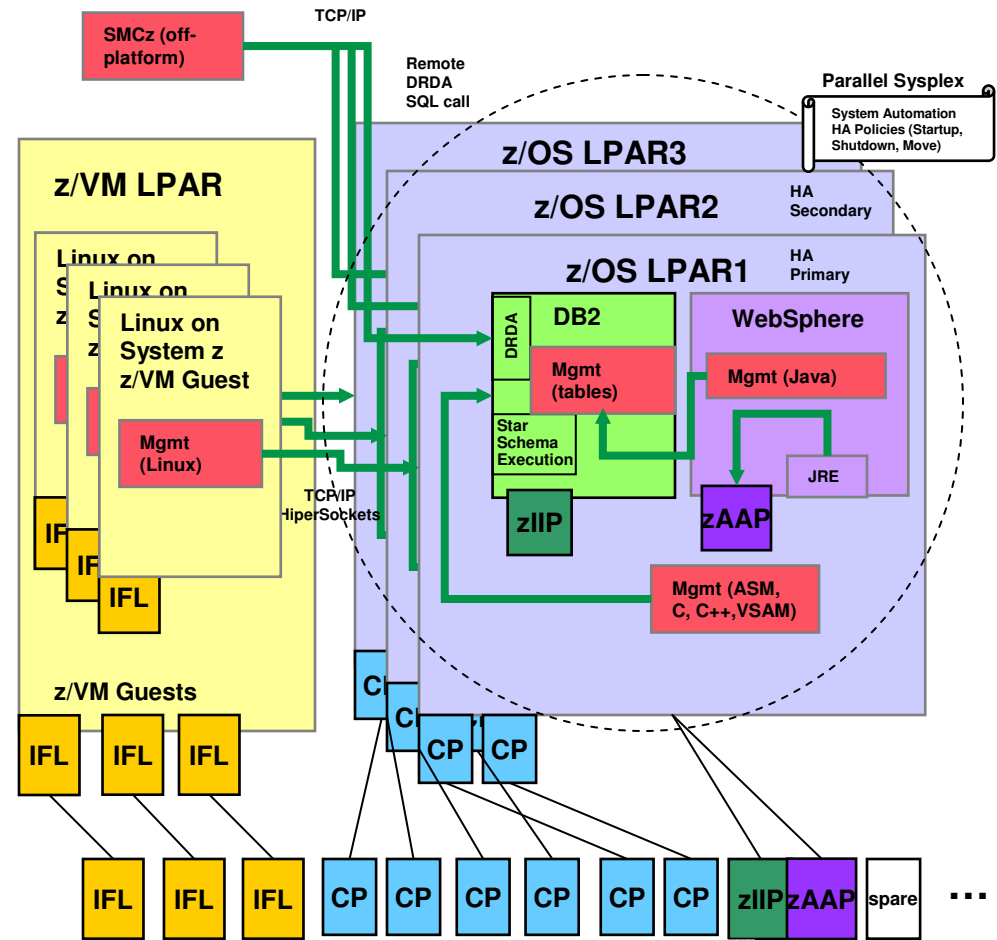
Diagram labels

SMCz (off-platform)

TCP/IP

Remote DRDA SQL call

Parallel Sysplex
System Automation HA Policies (Startup, Shutdown, Move)

z/OS LPAR3

z/OS LPAR2

HA Secondary

z/VM LPAR

z/OS LPAR1

HA Primary

Linux on System z

Linux on System z

Linux on System z z/VM Guest

Mgmt (Linux)

DRDA

DB2

Mgmt (tables)

WebSphere

Mgmt (Java)

Star Schema Execution

JRE

zIIP

zAAP

Mgmt (ASM, C, C++,VSAM)

TCP/IP HiperSockets

IFL

IFL

IFL

z/VM Guests

IFL IFL IFL

CP

CP

CP CP

IFL IFL IFL   CP CP CP CP CP CP zIIP zAAP spare   •••

System z Virtualization

IFL = Integrated Facility for Linux (IFL)
zAPP = System z Application Assist Processor
zIIP = IBM System z Integrated Information Processor

Management Considerations during a System z Consolidation Project

During analysis phase to determine what workload is appropriate to consolidate, also consider

I.   <u>What</u> is needed to manage consolidated environment

II. <u>Where</u> the management solution runs

III. <u>Incremental</u> approach leverages existing investments

IV. <u>Common</u> service management process automation infrastructure

Common infrastructure enables service management process automation

Service Management Process Automation

Enterprise Operations Management

Configuration Management Database

④ **Optionally add process automation service management**

③ **Leverage existing and optionally add new managers**

Operational data *

Operational data *

Operational data *

① **Leverage existing sources**

② **Add new sources**

① **Leverage existing sources**

Software hosted on distributed servers

. . . **physical servers**

Workload

Management

Software hosted on System z server

Linux workload*

Linux Mgmt

z/VM Mgmt

. . . **virtualized resources**

Legacy z/OS Workload

Legacy z/OS Mgmt

Virtualization, Operating Systems, Hardware: Specialty Processors, Memory, Hipersocket Network IO

* Operational data includes events, discovery, key performance indicators, availability, compliance, usage accounting, etc.

** Centralized Operations Enterprise Managers perform remote analysis across many resources for reporting, event viewing, topology, inventory, dashboards etc.

Management capabilities need to be considered as part of consolidation analysis

- **Existing IT tools and their infrastructure should be considered**

- **Management of both physical and virtual resources is required**

- **Many management tools exist for z/VM and Linux on System z**

IBM Management Capabilities for System z Consolidations (1 of 4)

Management Capability	Pre-Consolidation IT Tools	IT tools for Linux on System z	IT Tools for z/VM	Use of Existing z/OS Infrastructure
Monitoring and Performance Management	<existing mgmt environ>			
Scheduling Workload Automation	<existing mgmt tools i environment>			
Security management	<existing mgmt tools i environment>			

IBM Management Capabilities for System z Consolidations (2 of 4)

Management Capability	Pre-Consolidation IT Tools	IT tools for Linux on System z	IT Tools for z/VM	Use of Existing z/OS Infrastructure
Data Protection Storage Management		•IBM Tivoli OMEGAMON XE on z/VM and Linux (TEPS/TEMS on Linux or z/OS		•Tivoli Storage Manager (Server on z/OS) •OMEGAMON XE for Storage (TEMS Remote, feeds into TDW) •TDW feeds from OMEGAMON TEP (OM XE for Storage, ACM, AAH, ARH, AO)
Systems Automation and Disaster Recovery				

IBM Management Capabilities for System z Consolidations (3 of 4)

Management Capability	Pre-Consolidation IT Tools	Linux on System z	z/VM	Use of Existing z/OS Infrastructure
Business Service Management	<existing mgmt tools in environment>	•Tivoli Business Service Management* •IBM Tivoli Application Dependency Discovery Manager (TADDM) •Tivoli Service Level Advisor •TADDM DLAs (TDWB, TPC, TPM, TBSM)	z/OS DLA for TADDM	DLA for TADDM (z/OS, NetView for z/OS, TDSz, GDPS, SA for z/OS, OMEGAMON TEMS) TDW feeds from OMEGAMON TEMS on z/OS zEvent and TDW feeds Status Feeds to OMEGAMON TEP (OMEGAMON with OTEA, ITCAM, TDSz, TWS, SA, zStorage, NetView for z/OS TEP workspaces) zEvent Status Feeds into TBSM from NetView on z/OS and z/OS Data
Capacity planning				
Event and Network Management				

IBM Management Capabilities for System z Consolidations (4 of 4)

Management Capability	Pre-Consolidation IT Tools	Linux on System z	z/VM	Use of Existing z/OS Infrastructure
Process Automation Service Management	<existing mgmt tools in environment>	•IBM Tivoli Application Dependency Discovery Manager (TADDM) •IBM Change and Configuration Management Database •Tivoli Service Request Manager •TADDM DLAs provide CIs (TDWB, TPC, TPM, TBSM, AMIT?)	z/OS DLA for TADDM zTrouble tickets from EIF event feeds using data from IBM Tivoli OMEGAMON XE on z/VM and Linux	zTrouble tickets from EIF event feeds using data from OMEGAMON TEMS on z/OS (OMEGAMON, ITCAM, TDSz, TWS, SA, zStorage, NetView for z/OS TEP workspaces) zSecure policies DLAs for TADDM provide CIs (z/OS, NetView for z/OS, TDSz, GDPS, SA for z/OS, OMEGAMON TEMS)
Financial Management	<existing mgmt tools in environment>	•IBM Tivoli Usage & Accounting Manager •IBM Tivoli License Compliance Manager •Tivoli License Compliance Manager (TLCM) •Asset Management for IT •Enterprise Asset Management	•TUAM collectors for z/VM	•Tivoli License Compliance Manager for z/OS (TLCMz) •IBM Tivoli Decision Support for z/OS •IBM Tivoli Usage & Accounting Manager for z/OS
Provisioning	<existing mgmt tools in environment>	•IBM Tivoli Provisioning Manager Family (for OS, for Apps, for Software) •Tivoli Configuration Manager •Tivoli Intelligent Orchestrator	•IBM Tivoli Provisioning Manager z/VM support •IBM z/VM DirMaint feature (2) •z/VM Center task of IBM Director	•SMP/E

Incremental Addition of Management Tools to Existing IT Environment

Legend:
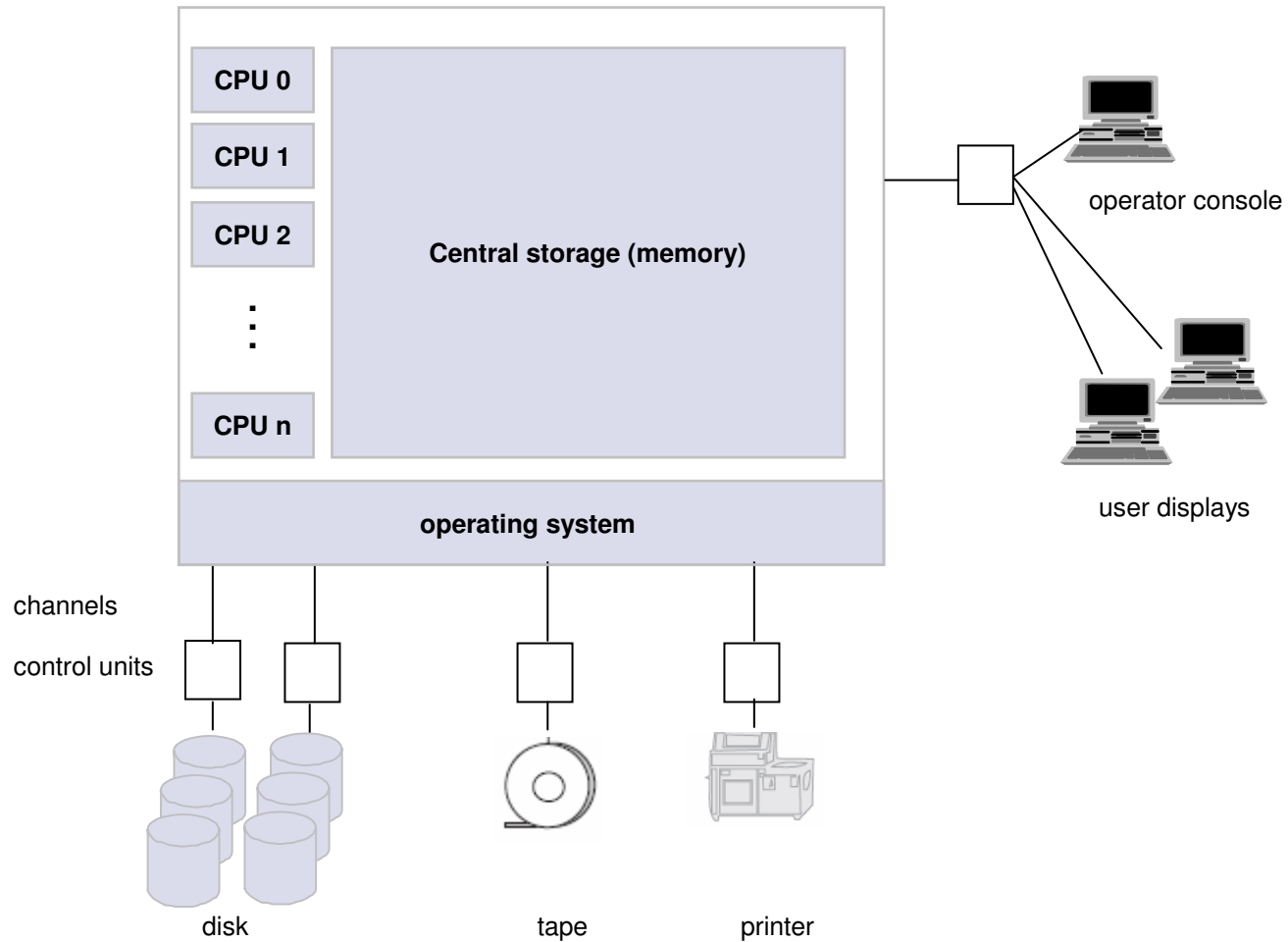
NEW mgmt tools

Existing mgmt tools

Release and Change Incident Management

....

Problem and Incident Management

ITIL transformation

Centralized Business Service Management

Process Automation Engine

Federated ITIL Process Discovery and Archive

Centralized Business Service Management

Federated Configuration Discovery and Archive

Manage goals of business and IT together

Centralized End to End Operational Management

Network   Storage   Storage   System Automation   Monitoring   Workload Automation

Scheduling for Linux on System z Workload

System Automation for Linux on System z Workload

z/OS Scheduling

z/OS System Automation

Build out operational mgmt from end to end using common technology

Scheduling

System Automation

Performance Monitoring

z/OS Performance Monitoring

Distributed servers

Existing Mgmt

Monitoring

System z server

Discovery

IT Discovery & Events

z/OS Discovery

Events

z/OS Events

PeopleSoft

App Client

Linux on System z

Linux on System z

WebSphere software

SAP

App Client

App Serving

TCPIP Hipersockets

z/OS LPAR

z/OS LPAR

samba

App Client

z/OS LPAR

Mgmt

App Client

Linux on System z

Database Serving

Mgmt

Mgmt

Mgmt

DB2 Information Management Software

z/VM Guests

...

IFL   IFL   IFL

CP   CP   CP   CP

zSeries Specialty Engines and Standard Processors, Memory, IO

Consolidated Web Application and Database Serving

Recap: Management Considerations during a System z Consolidation Project

During analysis phase to determine what workload is appropriate to consolidate, also consider

I. <u>What</u> is needed to manage consolidated environment

II. <u>Where</u> the management solution runs

III. <u>Incremental</u> approach leverages existing investments

IV. <u>Common</u> service management process automation infrastructure

Physical System z Computing System Resources

CPU 0	
CPU 1	**Central storage (memory)**
CPU 2	
⋮	
CPU n	

operating system

channels

control units

disk   tape   printer

operator console

user displays

z/VM Virtual Machine Running Linux Guests

CPU 0

CPU 1

CPU 2

:

CPU n

Linux Virtual Server

Linux Virtual Server

Linux Virtual Server

Linux Virtual Server

Linux Virtual Server

Linux Virtual Server

z/VM

operator console

user displays

channels

control units

disk

tape

printer

Performance management required for virtual resources associated with z/VM Linux guests

Performance management required for System z physical (aka real) resources

Example: Gain Visibility into System Health and Resolve Issues Quickly with IBM Tivoli OMEGAMON XE on z/VM and Linux

- **Combined product offering that monitors z/VM and Linux for System z**

- **Provides work spaces that display:**
  - Overall system health
  - Workload metrics for logged-in users
  - Individual device metrics
  - LPAR Data

- **Provides composite views of Linux running on z/VM**
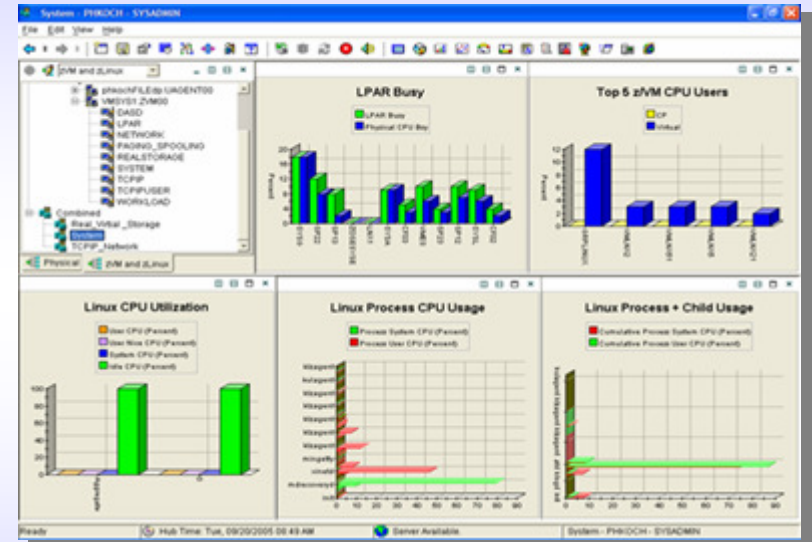
Sampling of Performance Metrics

z/VM

- z/VM Linux Default Workspace
- PAGING and SPOOLING Utilization
- DASD
- LPAR Utilization
- NETWORK Utilization (Hiper Socket and Virtual Switch)
- REAL STORAGE Utilization
- TCPIP Utilization – Server
- TCPIP Utilization – Users
- SYSTEM Utilization
- System Terminal Workspace
- Workload (z/VM User ID) Activity
- Linux Workload Workspace
- ApplData Workspace

Linux

- Linux OS
- Capacity Usage
- Disk Usage
- File Information
- Network
- Process
- System Information
- Users

Performance Management z/VM and Linux Scenario

Problem

- **Uneven Linux Guest CPU consumption**

Solution

- **Use Linux Guest Workload workspace to identify problem Linux guest**

- **Link to Linux workload/process workspace to identify problem app/process**

- **Notify app owner of app performance problem**

Potential Benefits

- **Quicker identification of base problem**

- **Can manage z/VM and Linux from a single point of control**

Identify problem Linux Guest

Look at additional data for Linux Guest

Link to Linux process workspace

Identify problem app/process on Linux

Scenario Realized with Tivoli Enterprise Portal (TEP) Technology – More than Visualization

ODBC

RDMS

Command Line Interface
SOAP API

TMS

Out of the box Monitors
Task Execution

Agent-less
Adapter

File
Socket
API
SNMP
HTTP

Post
ODBC
Script Data Provider

SQL : Attribute
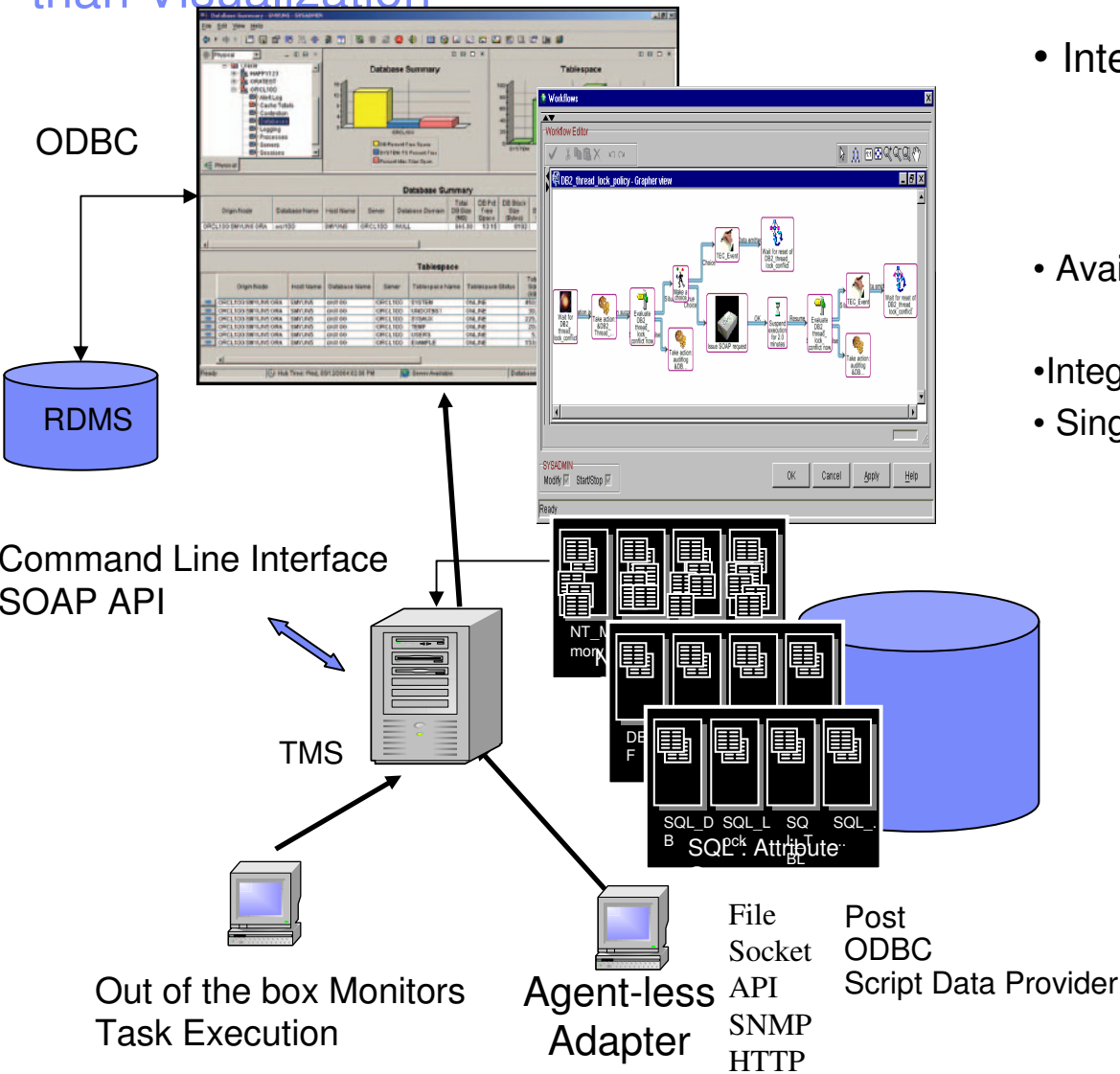
- Integrated Warehouse
  - Full Operational Data
  - Aggregation and Pruning
  - Quick Setup
- Available Data Management:
  - Situations, Workflows, Policies
- Integrated Run-book with Expert Advise
- Single Operations Console with Workflow
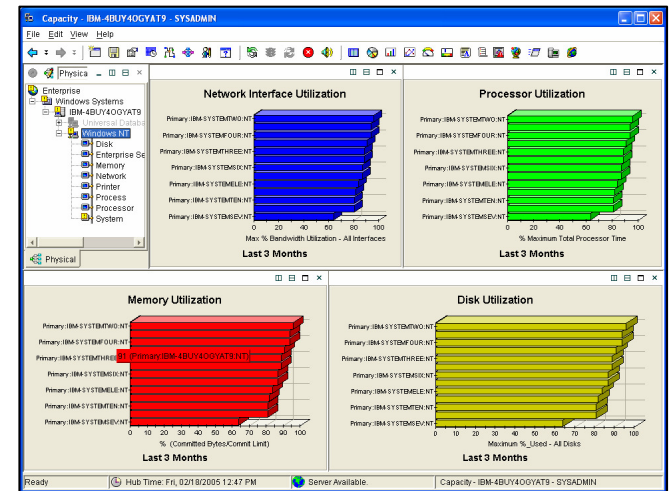
Intelligent Monitoring with Situations and Automation

CPU Utilization

Threshold

Managed System

CPU threshold exceeded 3 times in interval *N*

N
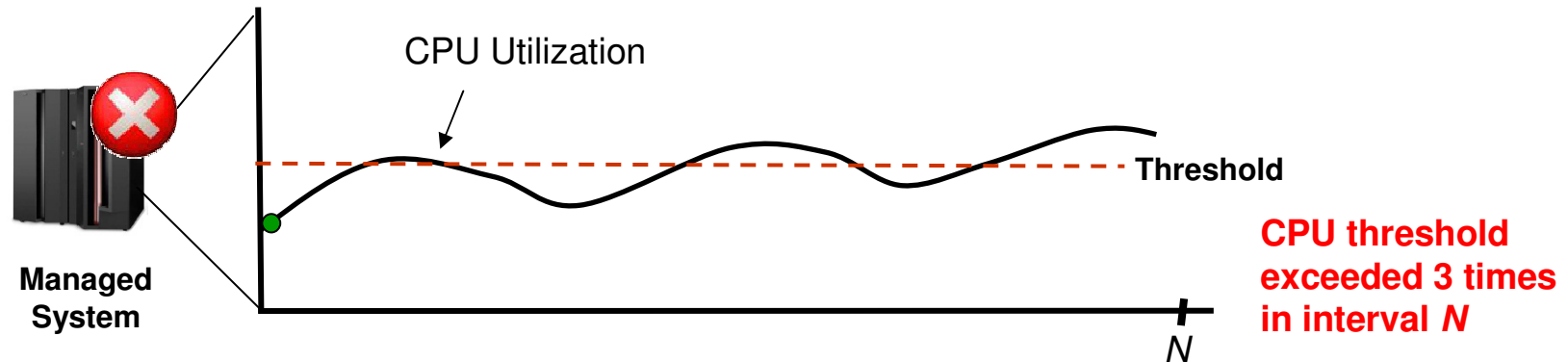
- **Detect and repair incidents as they occur with both supplied and customizable *situations***
  - Out-of-the-box supplied *situations* include combination of metrics and thresholds to trigger, identify, notify and solve problems
  - Built-in situation editor allows to customize to create granular notification and eliminate false alarms

- ***Expert advice* can help obtain detailed explanation of problems and recommendation for resolution**

- ***Take action* to automatically resolve recurring problems by running existing or customized scripts**

Automation using TEP Situations

- **A situation describes one or more conditions that you want to test**

- **Each condition compares a user-specified value against attribute data collected from managed systems**

- **If all conditions are met, the situation evaluates to true and an alert indicator icon appears on the TEP to let you know that a problem exists**

- **When you create a situation, you can also specify recommended actions (Expert Advice) and/or automated responses to take place when the situation becomes true (Take Action)**

- **Each management agent comes with a set of pre-defined sample situations that can be used as templates**

- **Each situation may examine the values of one or more attributes, or imbed other situations. DE also offers policies.**

Situation Editor
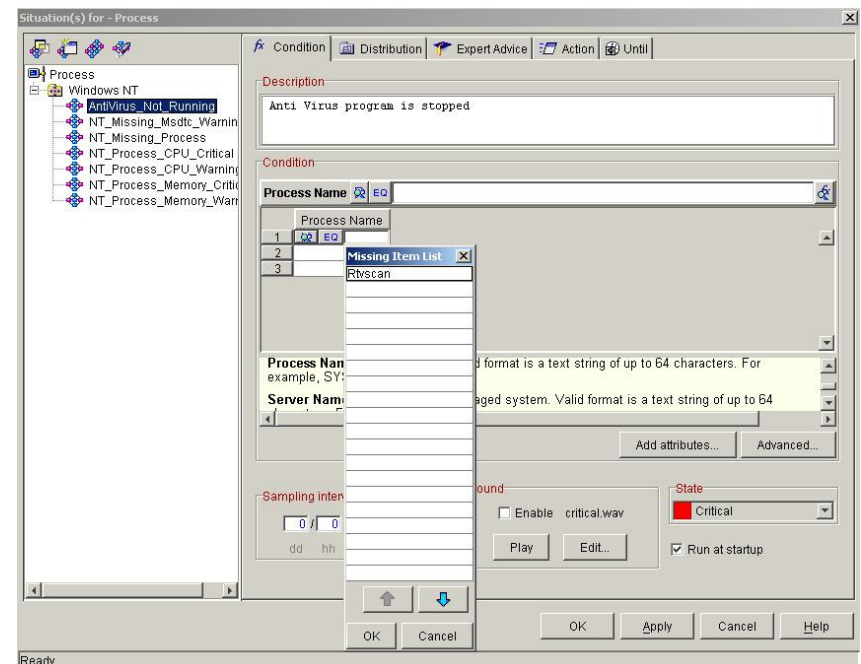
Examples of Provided Sample Situations

Workspace	Situation Name	Warning	Critical
LPAR	**ZVM_LPAR_Busy_Critical ****		**> 90 %**
	ZVM_Physical_CPU_Critical **		**> 90 %**
	ZVM_LPAR_OVHD_Critical **		**> 40 %**
System	**ZVM_CP_CPU_Critical ****		**> 30 %**
	ZVM_Total_CPU_Critical **		**> 90 %**
	ZVM_Total_to_Virtual_High	**> 40 %**	
Workload	**ZVM_User_CPU_Critical ****		**> 90 %**
	ZVM_Virtual_CPU_Critical **		**> 90 %**
Real Storage	**ZVM_Avail_Mean_Low**	**<= Avail Mean Low Thresh**	
	ZVM_Avail_Mean2G_Low	**<= Avail Mean Low Thresh 2G**	
	ZVM_Page_Used_Critical **		**> 95 %**
	ZVM_Spool_Used_Critical **		**> 95 %**
DASD	**ZVM_DASD_Queue_Critical ****		**> 25 %**
z/VM Linux	**ZVM_PerfKit_Collector_Inactive PerfKitCollector/INACTIVE**		**INACTIVE**

** Warning Situation shipped, but not run at startup

Example LPAR Workspace with situation flyover...

Example: DASD Device Utilization (z/VM system devices)

© 2008 IBM Corporation
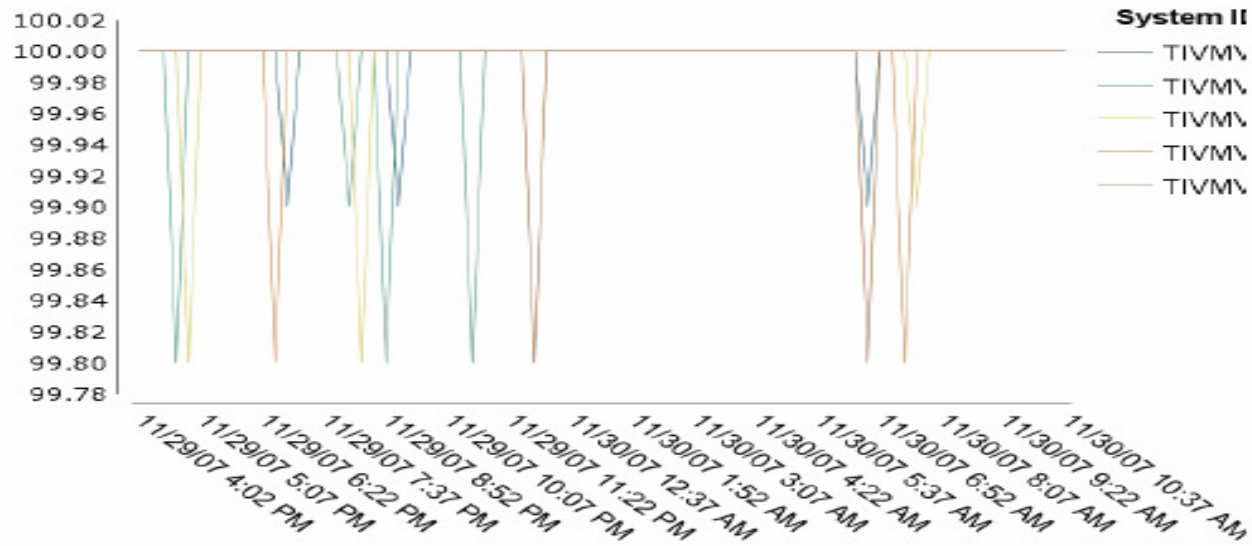
Example: Virtual z/VM Linux Guest System Information
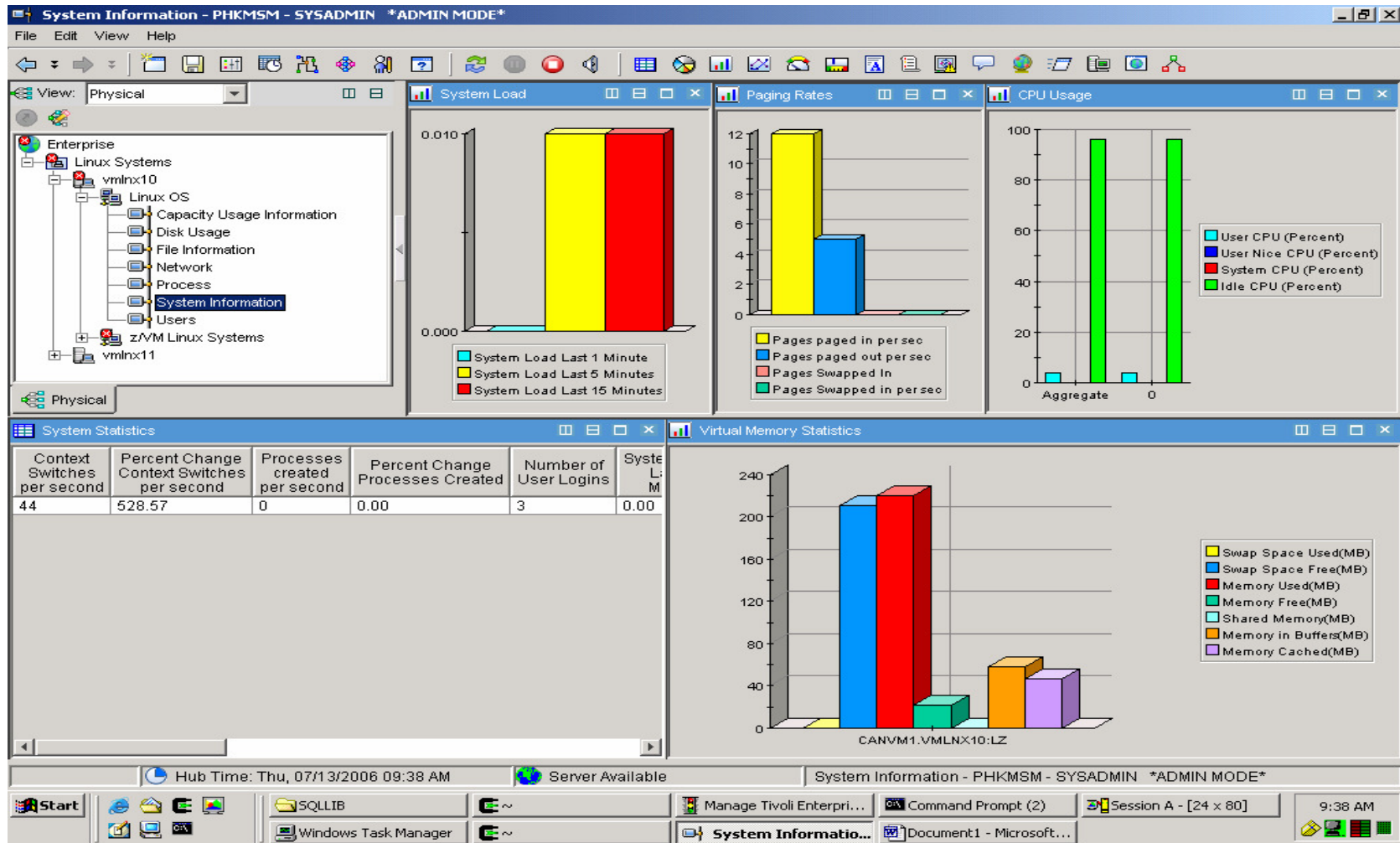
z/VM Automation Scenario Improves Availability and Increases productivity

Increase productivity

- Authorized users view and interact with monitored virtual machines without logging onto them
- Multiple users view/interact with a virtual machine simultaneously

Improve system availability

- Monitor virtual machines and processes
- Take automated actions based on console messages
- Reduce problems due to operator error
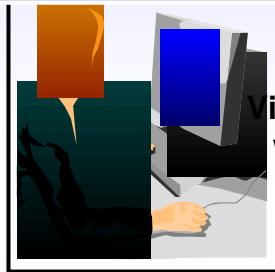
View & interact with consoles

Console monitoring

Service Virtual Machine being monitored

Operations Manager for z/VM

Take action

Service Virtual Machine being monitored

Console monitoring

Automation

Perform routine activities more effectively with minimal operations staff

Integration

Fulfill take-action requests from OMEGAMON XE on z/VM and Linux

Operations Manager for z/VM and OMEGAMON XE on z/VM and Linux

➢ **OMEGAMON XE on z/VM and Linux**
  ➢ Performance monitoring for z/VM and Linux guests
  ➢ Part of Tivoli Management Services (TMS) infrastructure
➢ **Operations Manager for z/VM**
  ➢ Monitor consoles of z/VM service machines and guest user IDs
  ➢ Take actions based on console messages
    ➢ Respond to "take action" requests from OMEGAMON
  ➢ Schedule routine tasks

Web browser

System z

Extensions

Operations Manager

Perf Toolkit

OMEGAMON XE (including TMS)

Linux Guest

Application

Agent

Linux Guest

...

Application

Agent

Linux Guest

z/VM
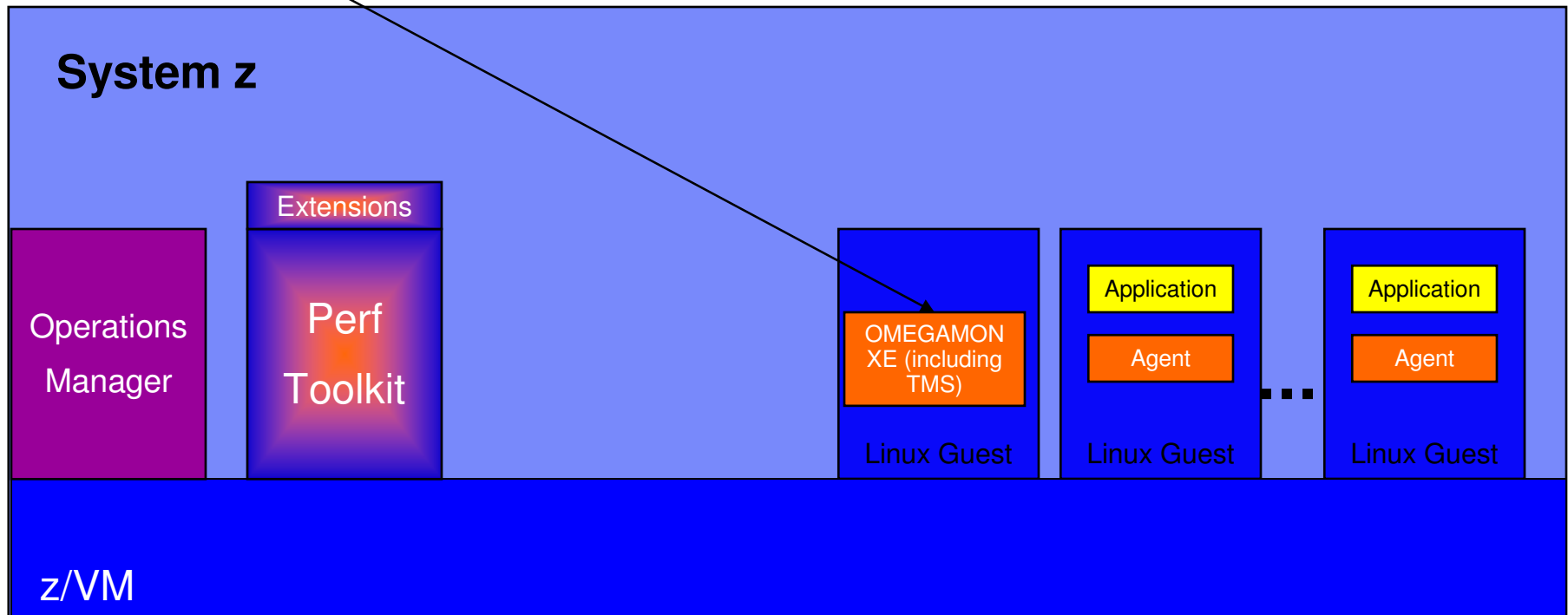
Tivoli OMEGAMON XE on z/VM and Linux a Scenario

Problem

- **Uneven Linux guest CPU consumption**

Solution

- **Use situation to recognize high swapping with high CPU and working set size**

- **Send message to Operations Manager**

- **Operations Manager invokes a rule to execute a CP tuning command to allocate more resource to the Linux Guest**

Potential Benefits

- **Automated problem resolution**

- **Integrated solution**

Create a Situation

Situation is triggered and causes a Take Action

Response to problem is automatic

Message is sent and triggers z/VM automation

Main Server (GOMMAIN)

Action Processing Server (GOMSVMnn)

Automation Product (Operations Manager)
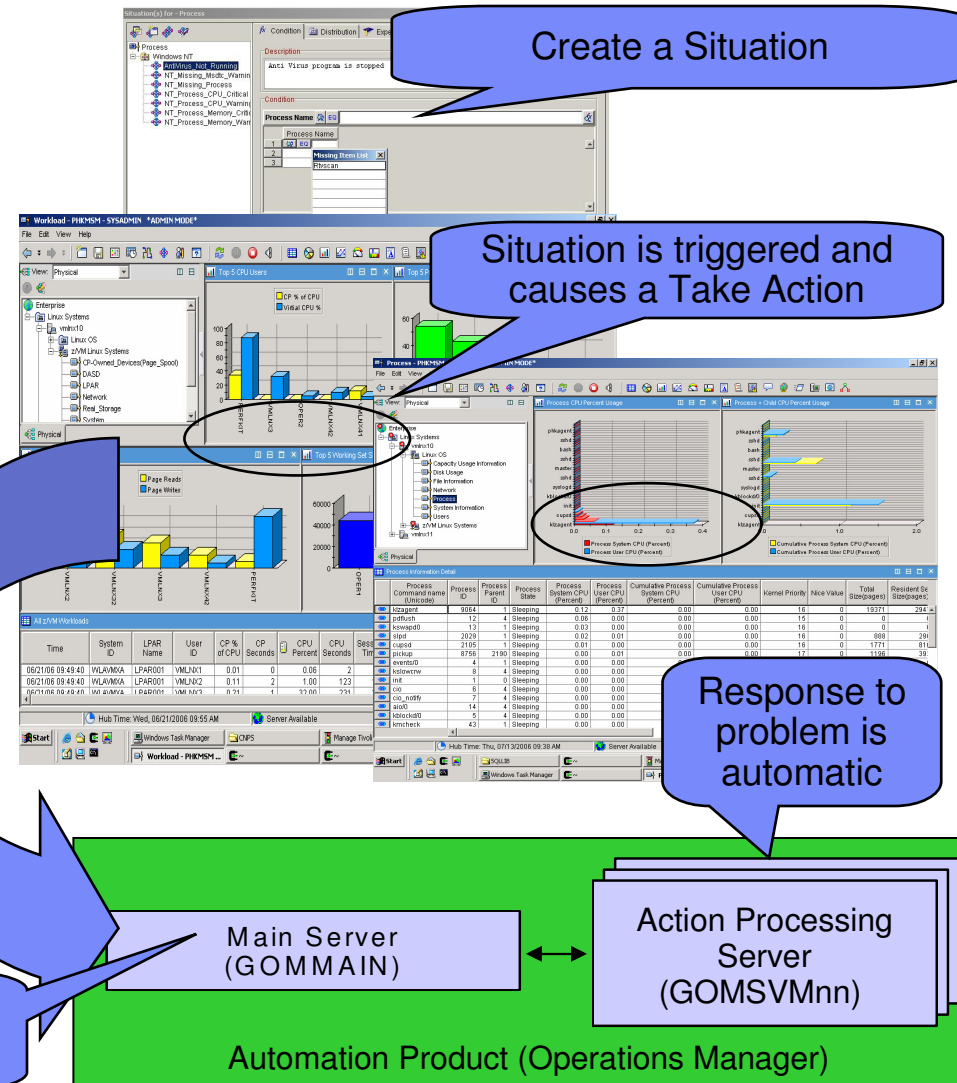
OMEGMON XE on z/VM – Architecture
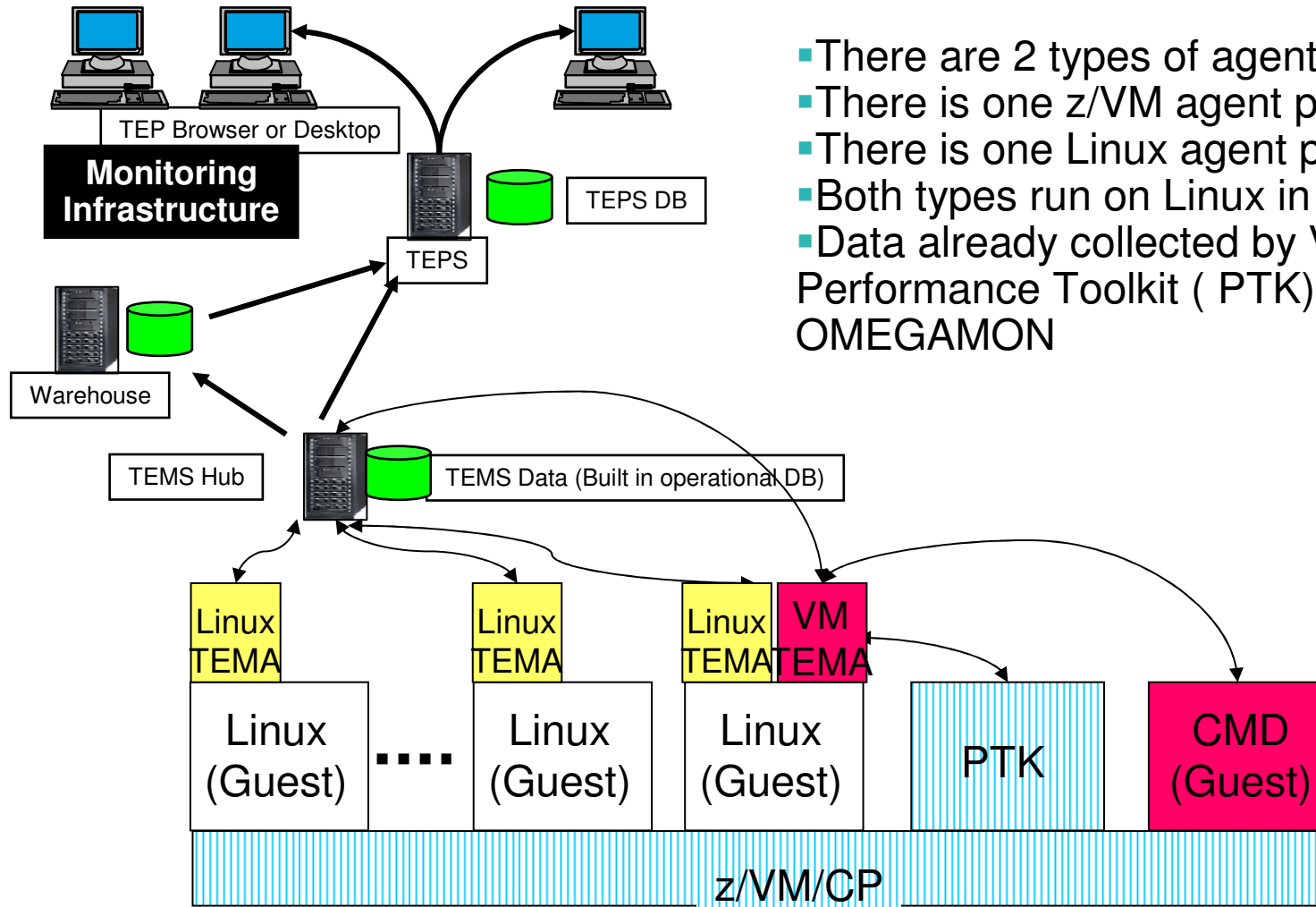
- There are 2 types of agents
- There is one z/VM agent per z/VM LPAR
- There is one Linux agent per Linux Guest
- Both types run on Linux in this release
- Data already collected by VM Performance Toolkit (PTK) is leveraged by OMEGAMON

TEP Browser or Desktop

Monitoring Infrastructure

TEPS DB

TEPS

Warehouse

TEMS Hub

TEMS Data (Built in operational DB)

Linux TEMA	Linux TEMA	Linux TEMA	VM TEMA		
Linux (Guest)	.... Linux (Guest)	Linux (Guest)		PTK	CMD (Guest)

z/VM/CP

Linux Agent CPU Utilization on z/VM vs. Control (RHEL 5)

z/VM & Linux 4.1.0.3 CPU usage by RHEL5 guest ids.
(2094 Processor w/8 GB storage)
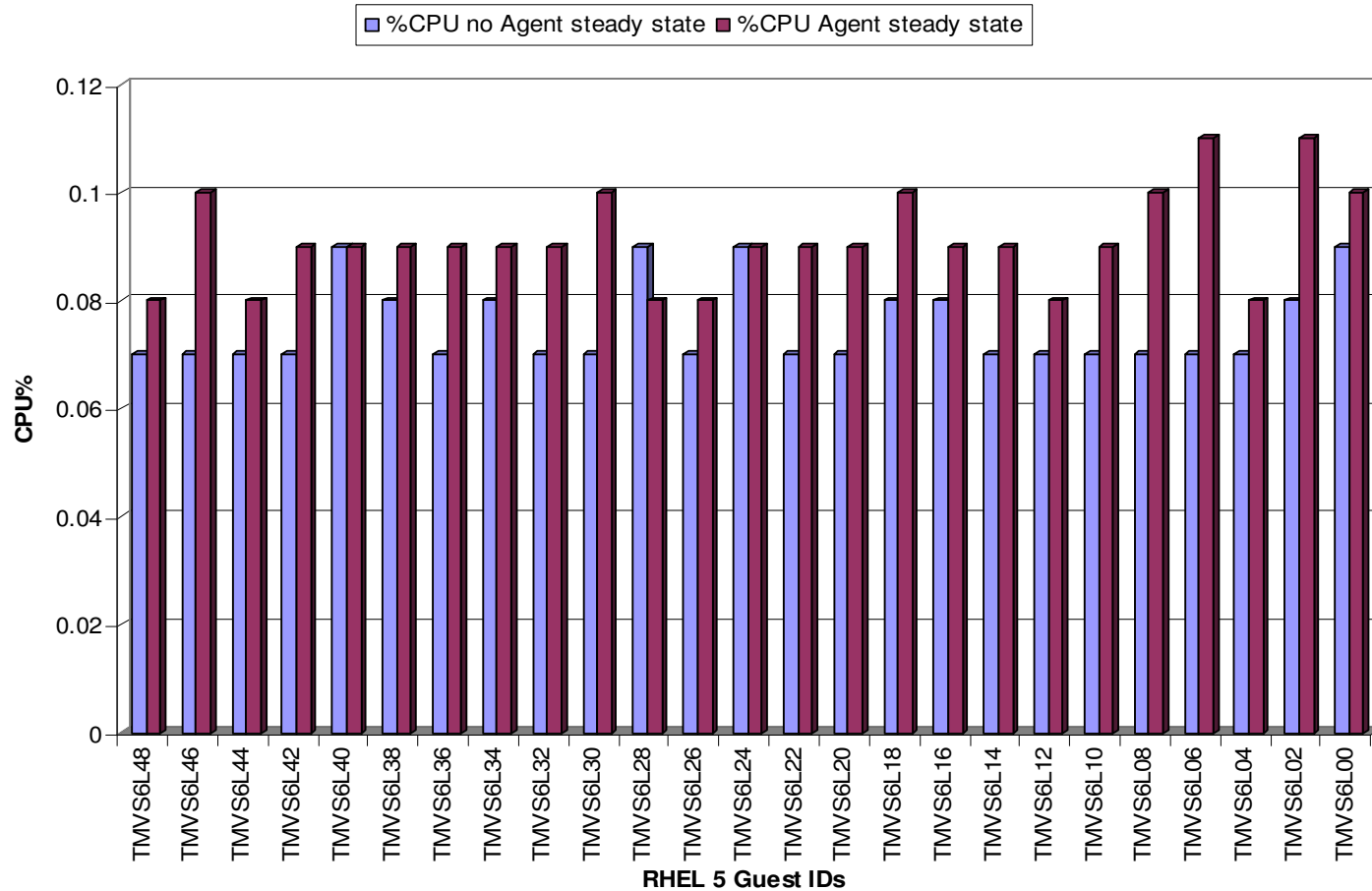
Backup Reference Material

Management Hub Example: Centralized IT Operations Management

Mainframe

- zIIP & zAAP processors
- RMF III integration
- CICS TS 3.1
- CICS JVM statistics
- CICS PA integration
- Enterprise JAVA reporting
- IMS TRF & HALDB reporting
- IMS Connect
- DB2 Connect
- DB2 v9
- SQL PA integration
- Comm Server Network Management Interface data
- EE & HPR network reporting
- DFHMS & DFDSS storage admin
- System Automation
- Workload Scheduling
- z/VM & Linux reporting
- z/VM PTK integration

Native z/OS OTEA

Tivoli Enterprise Portal

Linux on z
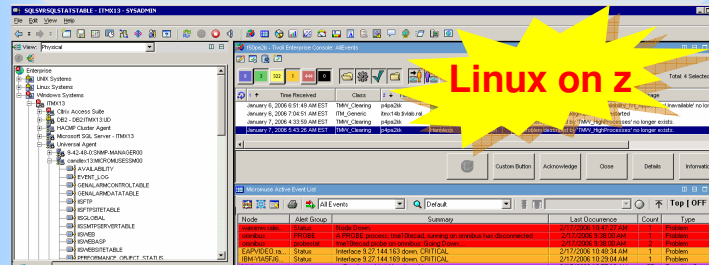
Tivoli Enterprise Portal
Everything at your Fingertips

Composite Application Management

- Application topology & transaction info to CCMDB
- Web Services and Configurable Mediation Primitives
- DataPower
- Lotus Workplace, ESB, and Process Server
- Custom MBean Monitoring, Web Session data,
- J2EE apps on WebSphere, BEA, JBoss and Tomcat

End To End Management

Distributed

- UNIX
- Windows
- Linux
- OS/400
- DB2, Oracle, Microsoft SQL, Sybase
- mySAP, Siebel
- HACMP
- Microsoft Exchange
- Microsoft .NET
- Virtual Servers - Citrix, VMWARE ESX

Dynamically Manage Workloads across Virtualized Resources with Tivoli Workload Automation Portfolio

- Single solution to integrate workloads from multiple applications across multiple platforms

- Improve availability and integrity of production systems with built-in high availability and fault tolerance

- Dynamic real-time workload and resource utilization optimization to maximize workload velocity into existing resources

- Integrate with systems management solutions to:
  - Manage critical workloads by exception in broader systems management context
  - Start/stop resources on demand
  - Provision additional resources on demand

Scheduling Web UI

Linux on z

Job Scheduling Console

Tivoli Enterprise Portal

TWS Servers

z/OS

Linux on z

z/OS based   Distributed

End to End Job Scheduling

Tivoli Dynamic Workload Broker

Linux on z

Linux on z

TWS Agents

AIX, HP, Solaris, Windows, Linux, OS/400, z/OS…

TWS Business Agents

SAP   PeopleSoft   Oracle

TWS LoadLeveler

HPC   HPC   Grid
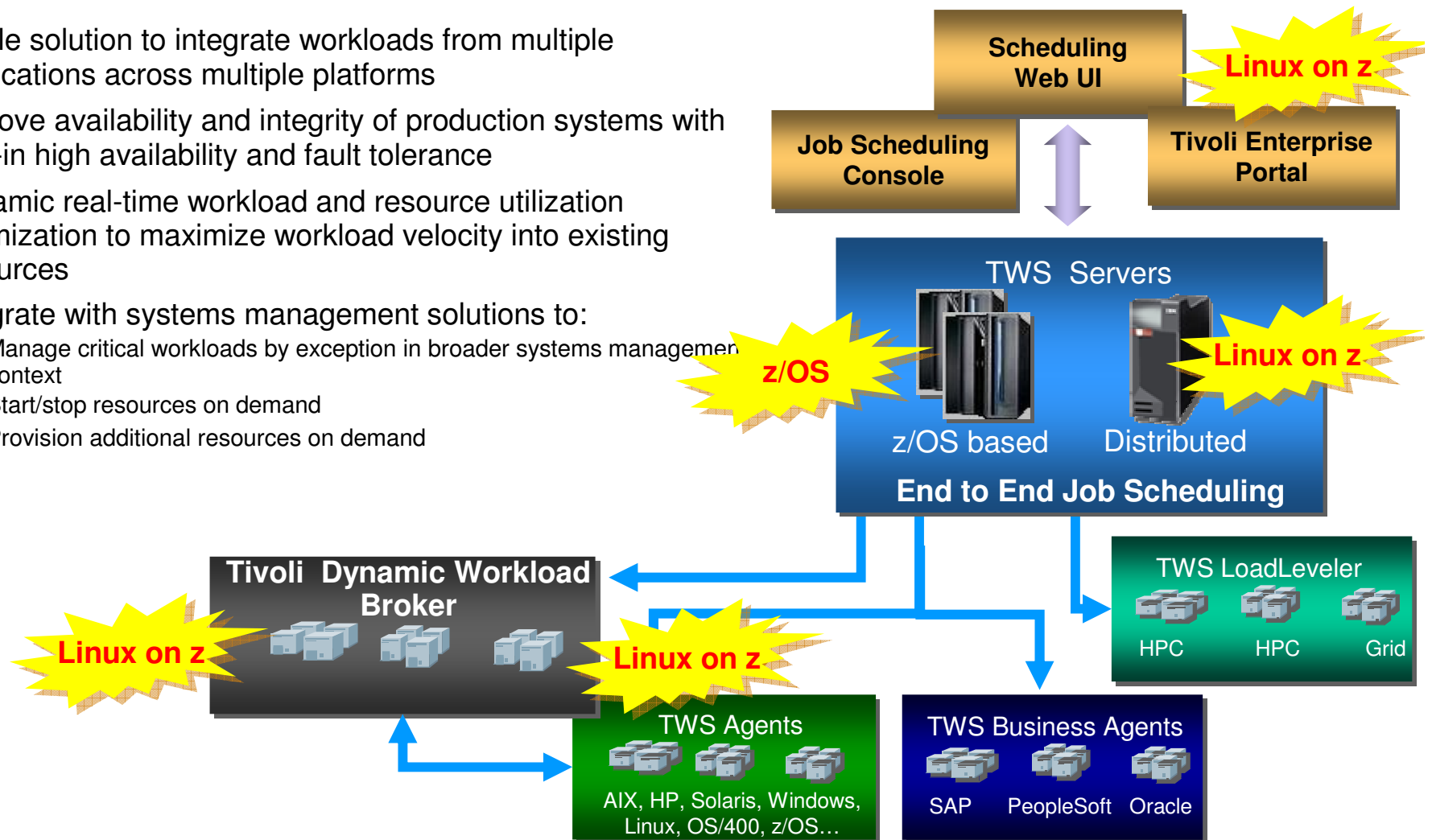
Tivoli Business Service Manager provides QOS Visibility

TBSM is Tivoli's Service Dashboard

- **TBSM takes a <u>service-centric approach</u> to aligning Operations with the Business**

<u>Capabilities include</u>:

- **Model any service**

- **Track real-time Service Level Agreements**

- **Custom business views & dashboards**

- **Service status/health from external sources**

- **Advanced numeric rules for calculations**

- **Dynamic key performance indicators (KPIs)**

- **Service definition from CMDB/inventory**

- **Tight BSM product integration:**
  - ITCAM for ISM & ITM
  - TADDM, TSLA
  - OMNIbus & TEC

Linux on z

TBSM Solution – High Level Architecture

Customer Resource Data (Inventory, CMDB, Provisioning Data)

Expand to 500+ Data Feeds

status

visualization

permissions

TBSM

rules

structure

TADDM

Resource, Application, Network Discovery

Events

Dependencies

z/OS

Mainframe resources, (OMEGAMON, 3rd Party applications)

Event Engine drives component status/health (OMNIBus – TEC, ITM, Probe feeds)

Business Data

CMDB

Customer Resource Data (Inventory, CMDB, Provisioning Data)

Leverage Customer Data: (used to define services, drive health & compliance, & align IT resources to business service context)

MYSQL **MSSQL** **DB2**

ORACLE **Postgres**

structure status

Any RDBMS

Incidents, Transactions, Billing, Performance, Process, Compliance

Relationships & Health

Event Pump on z/OS Architecture

CICS

DB2

IMS

z/OS Event Pump

1 Subsystems write messages on z/OS

System Messages

3 EIF events are sent to EIF Probe

Event Pump

2

Registration Data

Registration Data determines messages to forward for some feeds

Probe Rules

Probe rules format messages for OMNIbus

Assign identifiers
• BSM_Identity
• BSM_SubIdentity
• zOS_EventID
• zOS_Format
• zOS_Action

EIF Probe

Resources are populated into TBSM from z/OS DLA or TADDM

TBSM v4.2x UI

Class Relationship Mapping

Auto-Population Rules

Composites

Identity Rules

5

Event-based discovery

TBSM v4.2x Server

Linux on z

Schema Changes

Severity Mapping

Resolution Process

Omnibus v7.x Server

4

Message Severity is set & msg/exception resolution processing is done

z/OS

TBSM + OMNIbus

Discover Application Dependencies and Topology with Tivoli Application Dependency Discovery Manager 7.1 for Linux on System z

- Topology – Enhanced Visualization

  - Sysplex perspective graph - topology of components that make up a Sysplex, including multiple ZSeries computer systems.

  - HW perspective - topology of components that run on a ZSeries computer system, including multiple Sysplexes.

- Configuration Data - Greater depth of discovery and handling of large amounts of configuration data

  - System z report files

- Discovery - Improved dependency mapping across the distributed and z worlds

  - IMS Connect and CICS Transaction Gateway discovery

  - Added: distributed apps that access IMS and CICS via the IMS and CICS Gateways
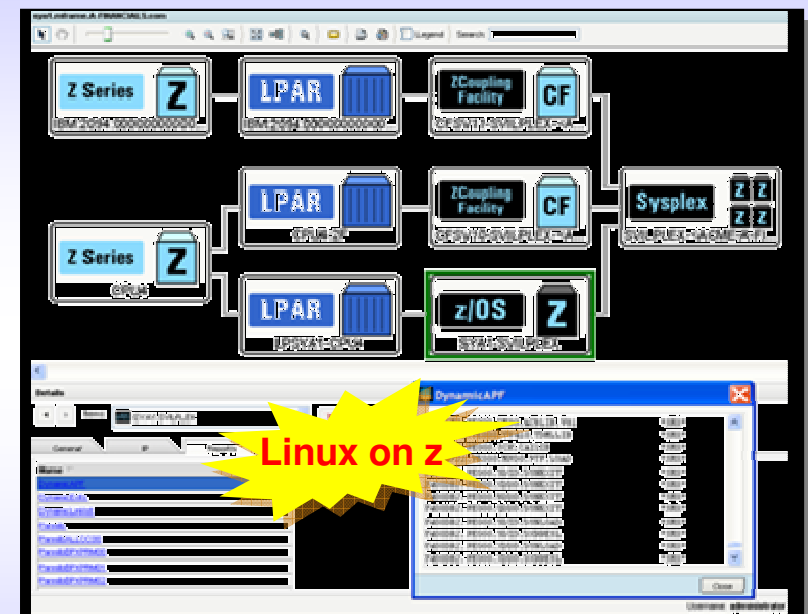
TADDM identify configuration changes to assist problem resolution
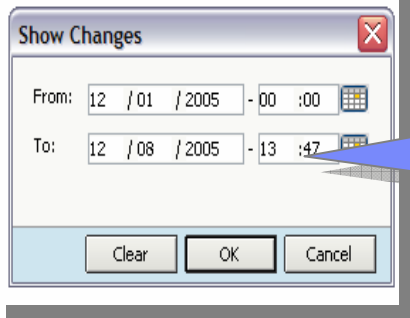
1) Select change history window to identify changed components in any application

2) Changed CIs are easily identified
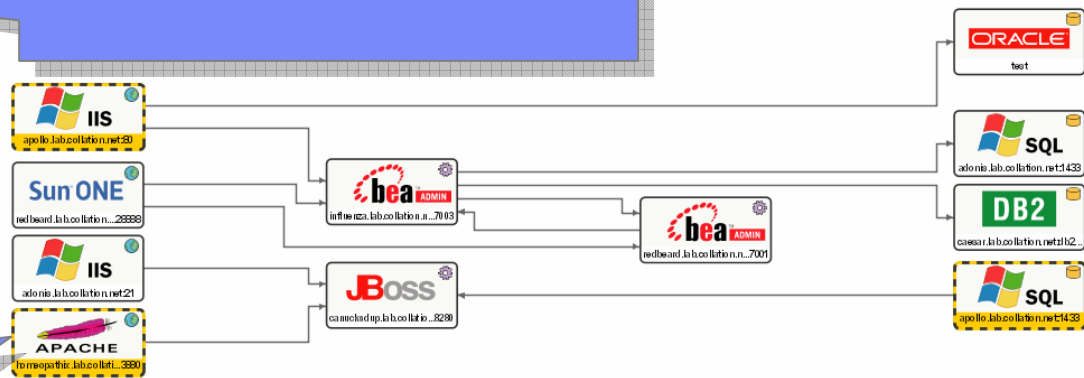
3) View detailed history of the changes by attribute

Show Changes

From: 12 / 01 / 2005 - 00 : 00

To: 12 / 08 / 2005 - 13 : 47

[Clear] [OK] [Cancel]

ORACLE
test

IIS
apollo.lab.collation.net:80

Sun ONE
redbeard.lab.collation...:28998

IIS
adonis.lab.collation.net:21

APACHE
homeopathix.lab.collati...:3980

bea ADMIN
influenza.lab.collation.n...:7003

bea ADMIN
redbeard.lab.collation.n...:7001

JBoss
canuckadup.lab.collatio...:8280

SQL
adonis.lab.collation.net:1433

DB2
caesar.lab.collation.net:db2...

SQL
apollo.lab.collation.net:1433

Collation Confignia - Version: Current

File   Edit   Display   Discovery   Topology   Analytics   Status Management   Windows   Help

Discovered Components

Business Applications

- Business Application Overview
  - Billing
  - Inventory Management
  - Logistics Management
  - Order Management

Change History: Results

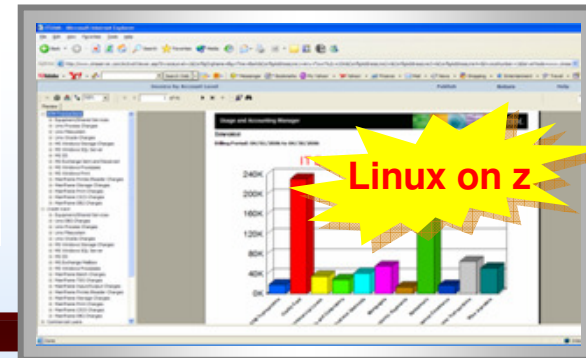| Type	Component	Change	Date	Attribute	Old Value	New Value	Id
Apache	homeopathix.lab.collati	Updated	12/04/2004 15:01 PST	appDescriptors		/usr/local/apache/app	13342
Apache	homeopathix.lab.collati	Updated	12/04/2004 15:01 PST	appDescriptors		/usr/local/apache//app	13342
ApacheWebContainer	homeopathix.lab.collati	Updated	12/04/2004 15:01 PST	ApacheWebContainer	/usr/local/apache/	/usr/local/apache	13342
ApacheWebContainer	homeopathix.lab.collati	Updated	12/04/2004 15:01 PST	ApacheWebContainer	15	20	13342
ApacheWebContainer	homeopathix.lab.collati	Updated	12/04/2004 15:01 PST	ApacheWebContainer	88	100	13342
ProcessPool	homeopathix.lab.collati	Updated	12/04/2004 15:01 PST	homeopathix.lab.collati	/usr/local/apache//bin/	./httpd -d /usr/local/ap	13420

Solutions for the Green Data Center

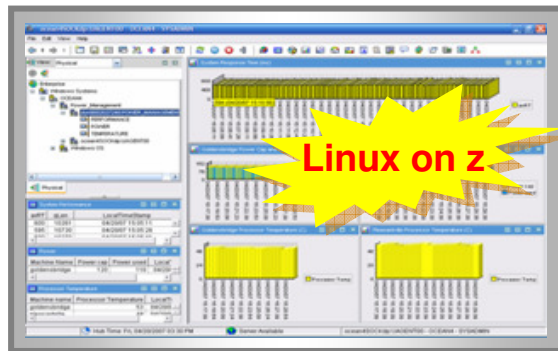*ITM Green Energy Agent: Augment performance data with power and temperature data*
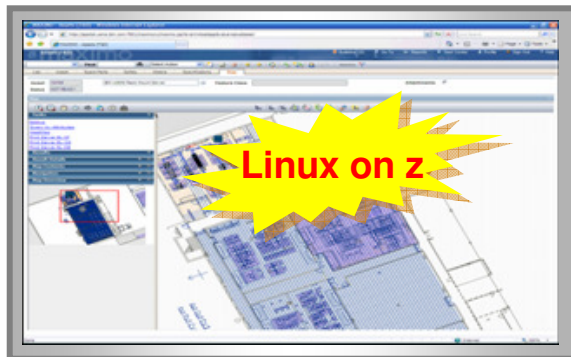
Maximo Spatial
- Thermal and configuration data
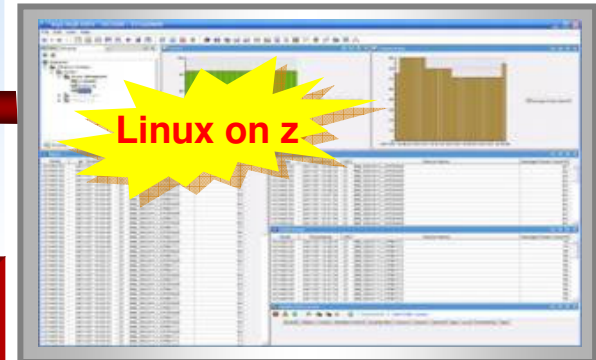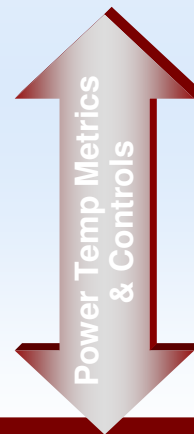- Display alert conditions

Tivoli Enterprise Portal
- Configure & display alert conditions
  - Thermal (power caps), performance
- Automate workflow for alerts

Power Temp Metrics & Controls

IBM Tivoli Monitoring
Tivoli Data Warehouse

IBM Tivoli Usage and Accounting Manager
- Track consumption
- Chargeback

IBM Tivoli Business Service Manager
- Ensure service levels maintained
- Optimize energy consumption

Provision Software in System z Virtual Linux Servers with IBM Tivoli Provisioning Manager

IBM Tivoli System Automation for Multiplatforms provides policy-based application and resource self-healing

Linux on z

System Automation Manager
Delegate
Status
Heartbeat   RSCT   Messaging
Resource Managers
Process   Network
Application   TCP/IP   Sys1
Application   TCP/IP   Sys2
Application   TCP/IP   Sys3
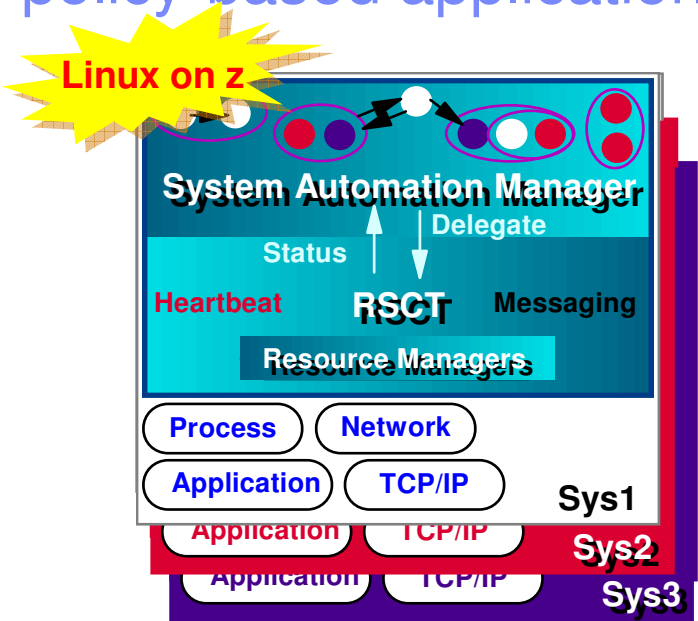
Manages application availability by:

- **Fast detection of outage through** monitoring

- **Sophisticated knowledge about** application components **and their** relationships

- Quick and consistent recovery **of failed resources and whole applications either in place or on another system in an AIX or Linux cluster**

- **64bit Support for System z Linux**
  - SLES 10 & 9

- **Support virtual communications when running Linux on System z under z/VM**
  - HiperSockets, VM Guest LAN, CTC

```
Event: On failure of DB
    Running on node1?
Stop Web on node1
        Wait until Web is Offline
        Generate Event: On Start of
        RG_Web
        Exit
    Running on node2?
Stop Web on node2
        Wait until Web is Offline
        Generate Event: Start of
        RG_Web
```

Web_appl

```
                        ssible?
                    on node1
                Wait until Web is

                Exit
    No
                it until DB is
Offline
    Generate        On Start of
RG_Web
    Exit
Running on node2?
    Restart on node2        ble?
    Yes → Start Web o    de2
                Wait until Web is
Online
                Exit
    No → Stop DB
                Wait until DB is
Offline
    Generate Event: On Start of
RG_Web
    Exit
```
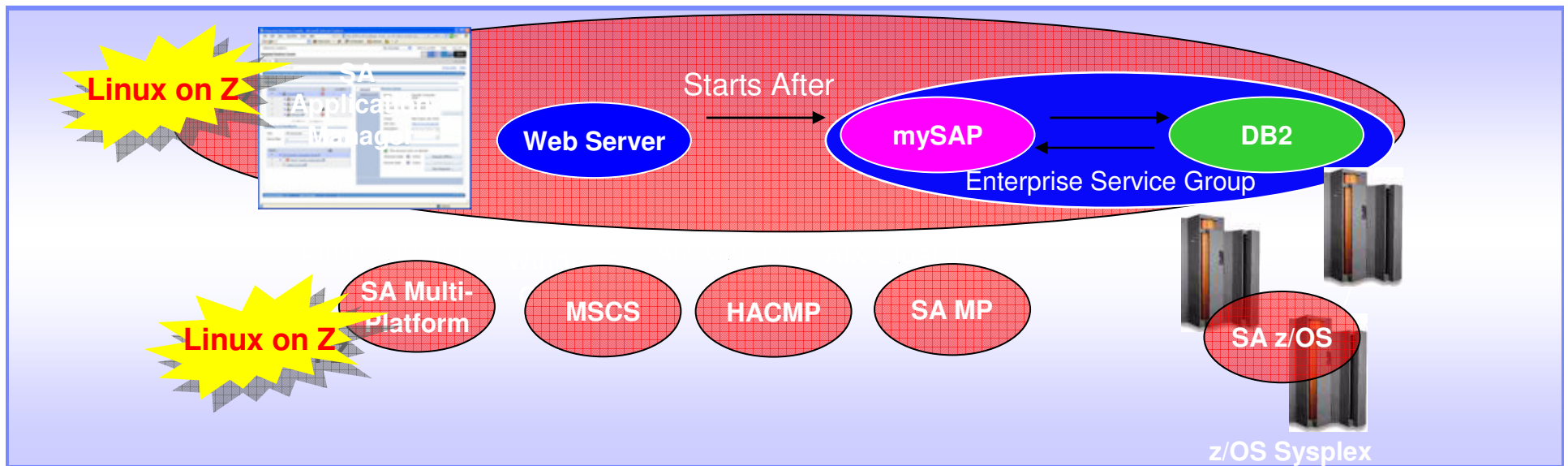
Reduce Implementation Time, Coding and Support Effort with Automation Policy

Reduce Implementation Time, Coding and Support Effort with Automation Policy

- **Clusterwide policy with**
  - **Resource information like start, stop, and monitor, preferred systems,…**
  - **Groups of resources enable Operations @ business level**
  - **Relationships model your configuration: Start/stop, DependsOn, Location**
- **No programming required**
- **New resources or systems can be added without re-writing scripts**
- **Operators can control applications on business level**
  - **Frees operators from remembering application components and relationships**

Maintain a Single Point of Control for HA/DR Automation with the IBM Tivoli System Automation Portfolio

- Provides 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 so resources start, stop or move in right sequence in right system
  - Initiate start, stop and move operations with a single click
- Includes a Business Continuity Process Manager for Enterprise Class HA/DR driven by ITIL-based processes

Linux on Z

SA Application Manager

Starts After

Web Server → mySAP ⇄ DB2

Enterprise Service Group

Linux on Z

SA Multi-Platform   MSCS   HACMP   SA MP

SA z/OS

z/OS Sysplex

Manage Assets and Measure Usage and Chargeback with Tivoli Financial Management Portfolio

IBM Tivoli Asset Management for IT

Enables customers to efficiently and effectively track and manage the lifecycle of IT assets by combining the inventory, financial, maintenance and – optionally with the Contract and Procurement Manager - contract and procurement management of IT hardware and software assets.

MRO Software acquisition Formerly known as Maximo ITAM

IBM Tivoli License Compliance Manager

Identifies software inventory, measures use activity, and automatically links complex license entitlements to installed inventory and use activity to help manage software costs and license compliance in the distributed environment.

IBM Designed Formerly known as IBM Tivoli License Manager

Linux on z

IBM Tivoli License Compliance Manager for z/OS

Identifies software inventory, measures use activity, and automatically links complex license entitlements to installed inventory and use activity to help manage software costs and license compliance in the mainframe environment.

Isogon acquisition Formerly known as SoftAudit

IBM Tivoli Usage and Accounting Manager

Collects existing data about the use of IT resources like OS, database applications and storage devices and allocates those costs to the services that IT provides to the business.

CIMS Lab acquisition Formerly known as CIMS server

Linux on z collectors

Manage Backup and Recovery with IBM Tivoli Backup and Restore Manager for z/VM

- **Backup**
  - Requested by administrators
  - Full or incremental
  - Flexible selection of disks and files to back up
  - Review job before submitting for backup
  - Catalog housed in Shared File System

- **Restore**
  - Performed by users for their own data
  - Extending to other users available via exit
  - Performed by administrators for any data
  - Selection of data to restore
    - Full screen interface or commands

- **Integration with Tape Manager for z/VM**
- **Optional compression of data during backup**
  - **Call your own compression algorithm**
  - **Use IBM provided routine**
- **Encryption exits available**
  - **Call your own routine**
  - **Use vendor-written routine, such as V/Soft Software's Encrypt/Backup for z/VM**

Manage Your Tape Devices with Tape Manager for z/VM

- **Manage tapes**
  - Define tapes in a catalog, including:
    - Free or used
    - Retention/expiration information
    - ATL/VTS or manual mount
    - Data Security Erase
  - Group tapes together into pools
    - Ownership and access control
   - Media type

- **Manage devices**
  - Define available devices
    - Dedicated or assignable
  - Group devices together into device pools
    - ATL/VTS or manual mount
    - Any other grouping you choose
      - (read only vs. write, location, etc.)
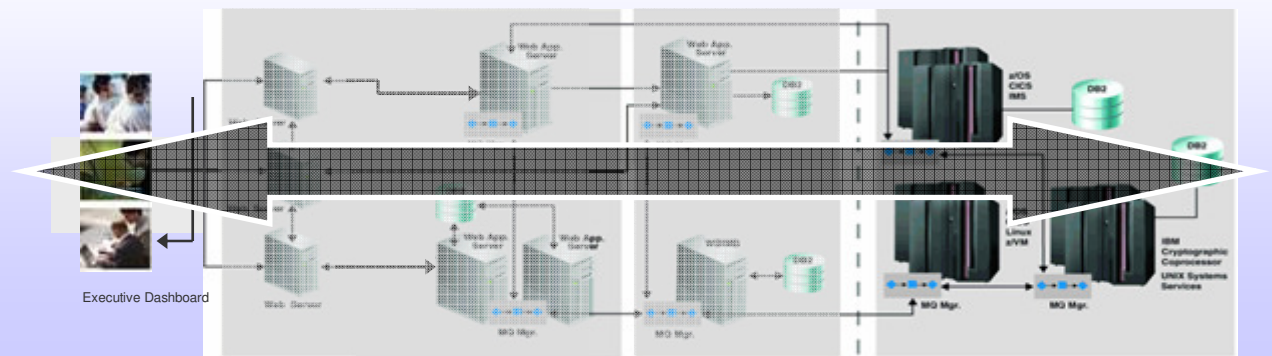 - Share devices with other systems

- **Manage mount requests**
  - Volume specific and scratch requests
  - Standard label
  - Non-label
  - Bypass label processing

Storage Management for Linux on System z
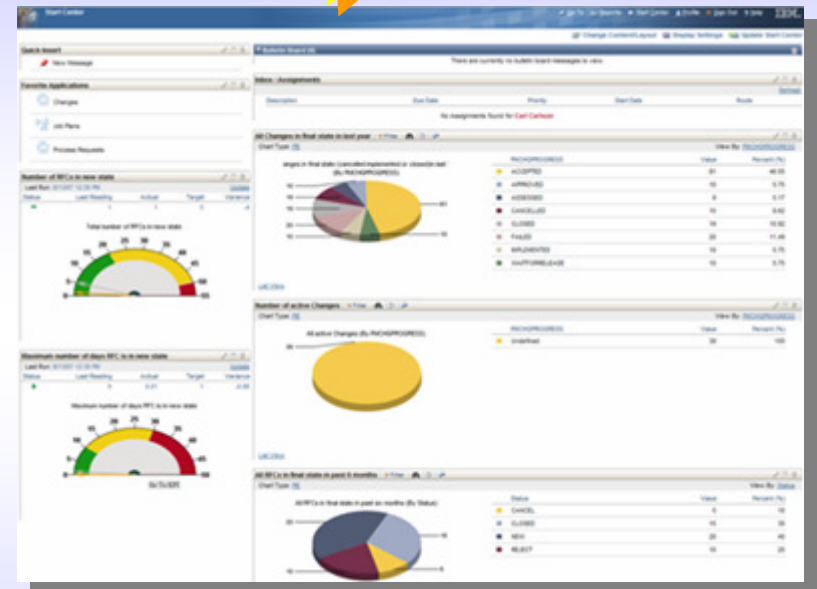
Backup, restore, protect information
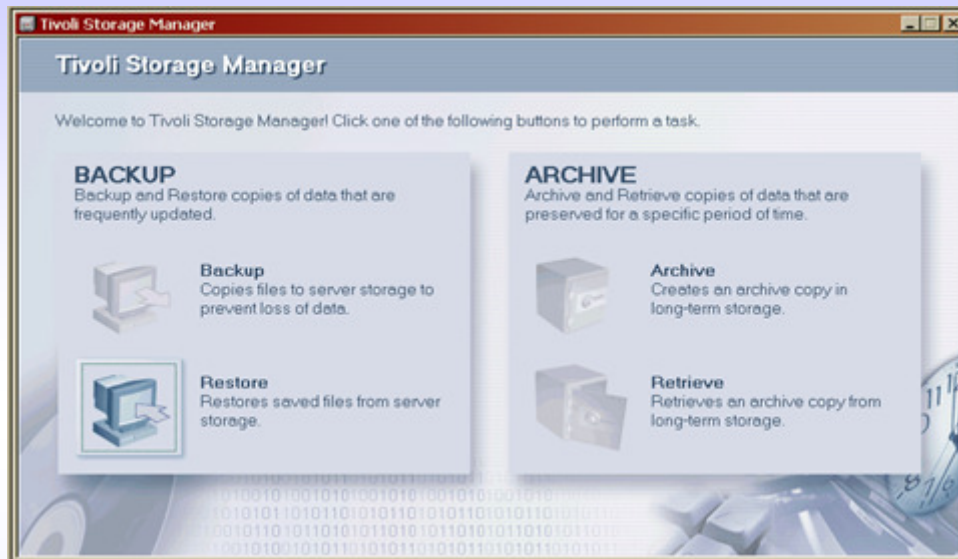
IBM Tivoli Storage Manager:
The leading data protection, retention, archive and recovery management platform for Linux on System z
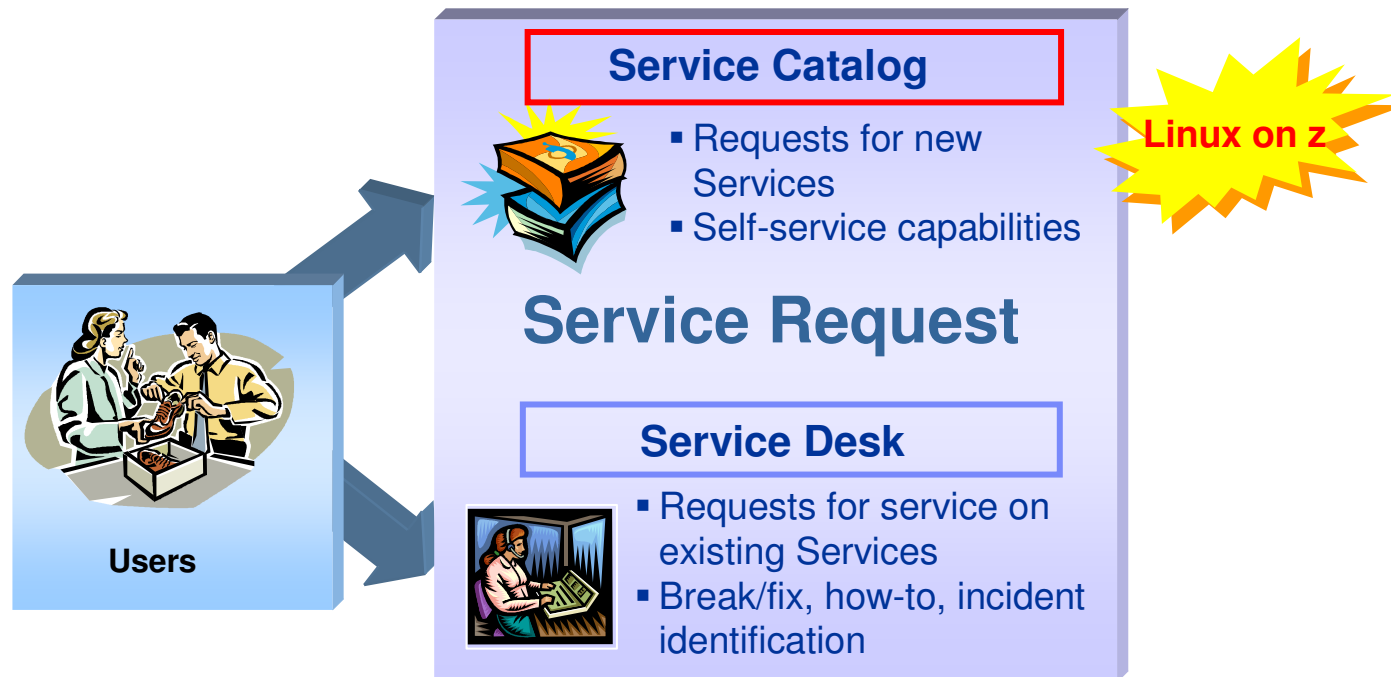
Manage Configuration Details and changes with Change and Configuration Management Database 7.1.1

- ITIL-based processes included with base product

  – Configuration Management

  – Change Management

- Discovery engine that loads and maintains a reliable and trusted CMDB

  – Based on TADDM

  – Robust reconciliation engine

  – Synchronization

  – Federation

- Release Process Manager delivers the ability to effectively manage and automate deployment of multiple related changes

- Role identification and role-based access can easily be defined

Linux on z

Integrating Service Request Management

Service Catalog

- Requests for new Services
- Self-service capabilities

Linux on z

Service Request

Service Desk

- Requests for service on existing Services
- Break/fix, how-to, incident identification
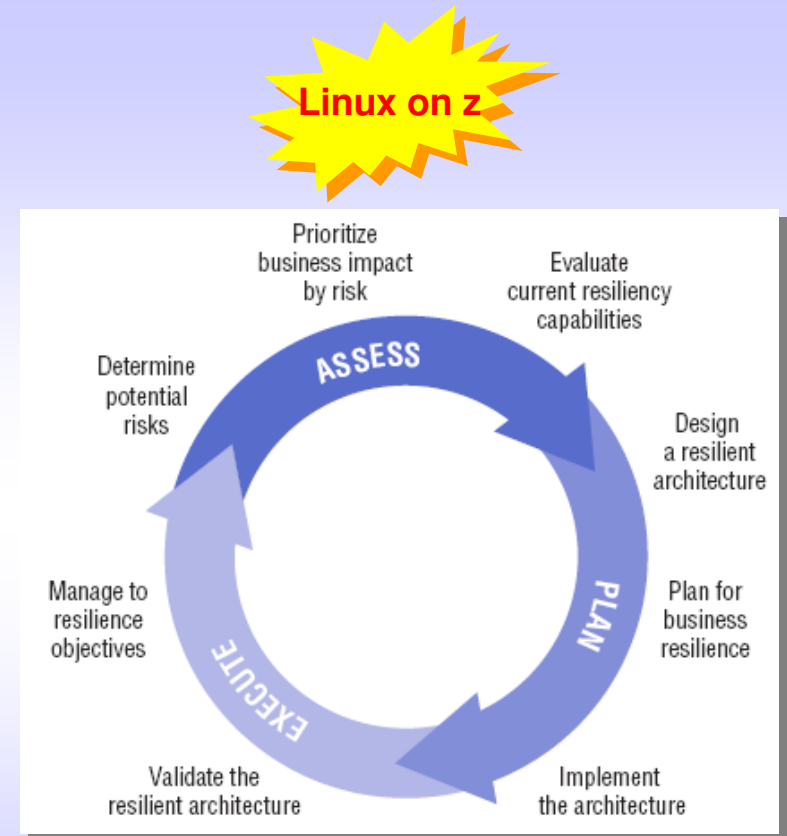
Users

- Single point of service for all end-user requests: break/fix *and* new orders.

- Integrate problem remediation and order fulfillment workflows

- Extend services beyond IT services as necessary

Manage Incidents, and Analyze and Prioritize Risk with Business Continuity Process Manager 7.1

- **Assess IT environment in Business Continuity context, in spite of ever-changing IT environment**

  – Integrate into CMDB, change and release management
  – Determine and prioritize risk and business impact

- **Define your Disaster Recovery plan**

  – Recovery Scope
  – Recovery Time and Recovery Point Objectives

- **Manage incidents cross-platform and execute appropriate plan**

- **Test plan and simulate incidents**

- **Assess reports from testing or real incidents to determine if SLAs and objects are met**

Linux on z

Prioritize business impact by risk

Evaluate current resiliency capabilities

Determine potential risks

ASSESS

Design a resilient architecture

Manage to resilience objectives

EXECUTE

PLAN

Plan for business resilience

Validate the resilient architecture

Implement the architecture

Case Study: IBM Internal Project to Consolidate Linux Servers Onto Mainframes With IFL's

- **IBM expects substantial savings by consolidating 3,917 Linux servers to approximately 30 mainframes**

- **$82M operational savings per year**

  - 86% savings in system admin cost

  - 85% savings in floor space

  - 81% savings in power

  - 57% savings in network

  - 41% savings in software support

  - 19% savings in disk storage maintenance

For More on Service Management Center for System z

Service Management Center for System z Press Release

   http://www-03.ibm.com/press/us/en/pressrelease/23596.wss

- **Learn more about IBM Service Management Center for System z**

Tivoli User Community
An active and lively community for Clients, Business Partners, and IT professionals.
Free membership provides you with valuable resources, tools and networking
capability. Log on to www.tivoli-ug.org

Tivoli Training
IBM offers technical training and education services to help you acquire,
maintain and optimize your IT skills. For a complete Tivoli Course Catalog and
Certification Exams visit www.ibm.com/software/tivoli/education

Tivoli Services
With IBM Software Services for Tivoli, you get the most knowledgeable experts
on Tivoli technology to accelerate your implementation. For a complete list of
Services Offerings visit www.ibm.com/software/tivoli/services

Tivoli Support
IBM Software Premium Support provides an extra layer of proactive support,
skills sharing and problem management, personalized to your environment.
Visit www.ibm.com/software/support/premium/ps_enterprise.html

Mainframe is the Platform of Choice for Effective Consolidation

Why? Because the Cost per Unit of Work Decreases as Workload Increases

Most TCO benchmarks
compare single applications

Most businesses operate here,
often running thousands of
applications

Cost per unit of work

Mainframe

Distributed scale out

Data Center Workload