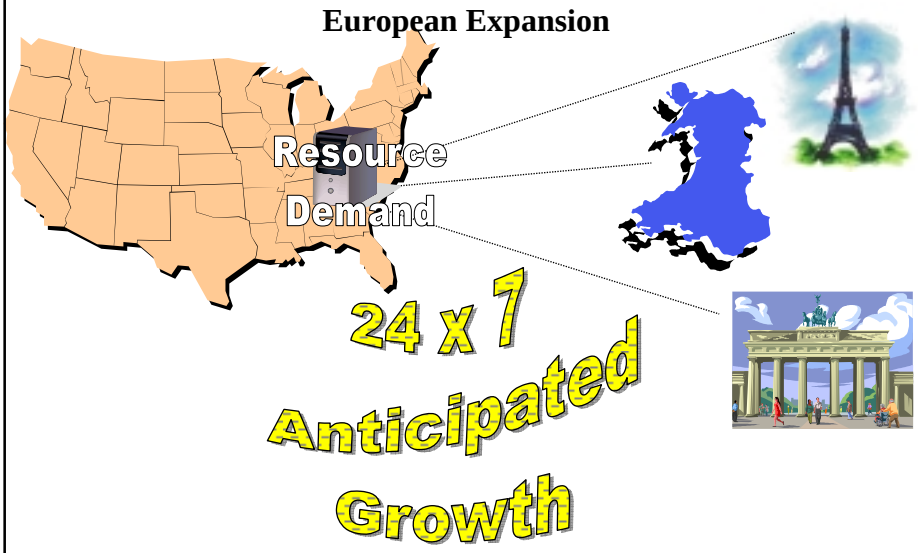
A Fresh Look at the Mainframe

The Mainframe Design Point
Fundamentally Better

ODI's New Applications Will Quickly Gain Momentum



Fundamental Capabilities that make System z a Better Platform

- Easy to grow capacity rapidly (Scalability)
- Continuous operations (Availability)
- Flexible use of computing capacity (High Utilization)
- Ease of management

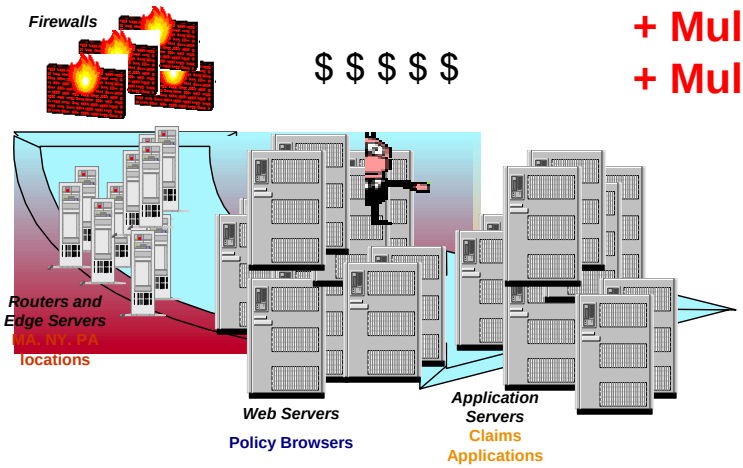
Approaches to Scalability: Distributed vs. Mainframe

Distributed: scale out

Mainframe: both scale up and scale out

Distributed Server Scale Out

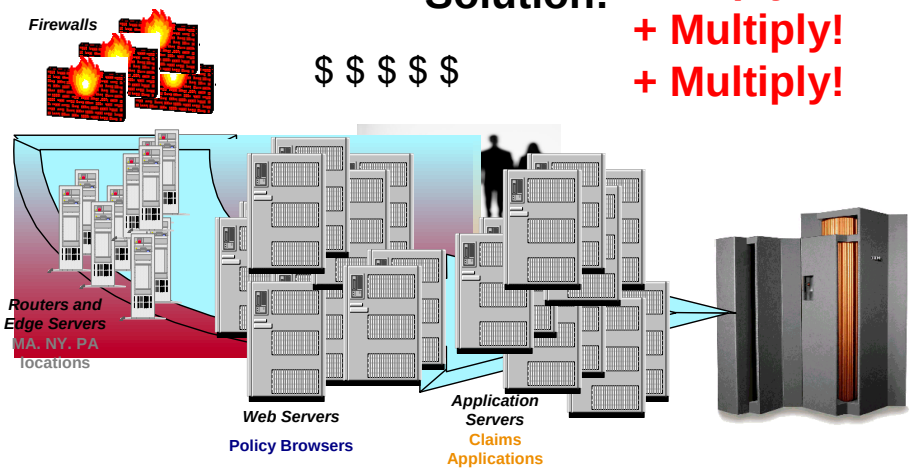
Solution: **+ Multiply!**
+ Multiply!
+ Multiply!



How quickly can more capacity be added?

The Mainframe Solution

Solution: **Multiply!**
+ Multiply!
+ Multiply!

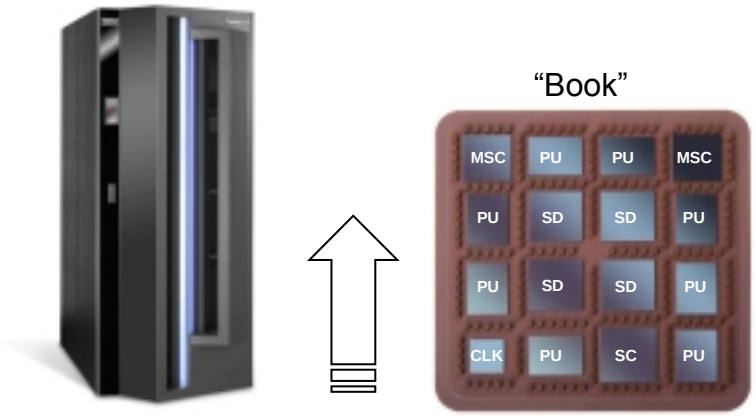


Scaling on System z

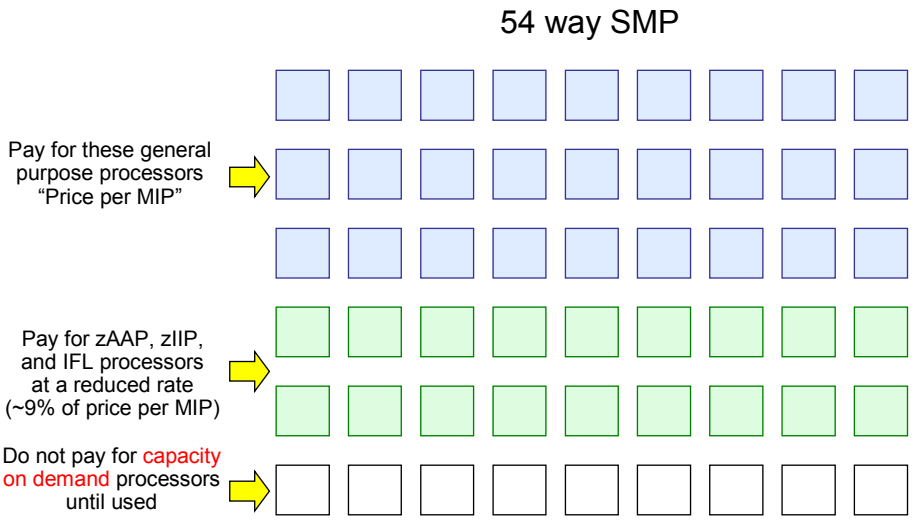
- Up to 54-way scaling in single SMP (18,000 MIPS)
- SYSPLEX clustering enables further growth with virtually no limit
  - Clustering up to 32x32-way
- I/O Bandwidth available to support growth
- Capacity on Demand
  - Grow as needed by turning on processors
  - Add processors without a shutdown
- System automatically uses new resources without re-engineering of systems or applications
- Automatically respond to changing business conditions

CPU Capacity on Demand

Permanent Growth - Customer Initiated Upgrade (CIU)
Temporary Growth - Capacity On Demand (COD)
Nondisruptive addition of CPs (Software model upgrade)
ICF, IFL, zAAPs and memory (8 GB memory increments)



Capacity on Demand Allows Non-disruptive Growth



Mainframe Capacity On Demand

www.ibm.com/servers/resourcelink

Use Pre-shipped Hardware

NO DISRUPTION

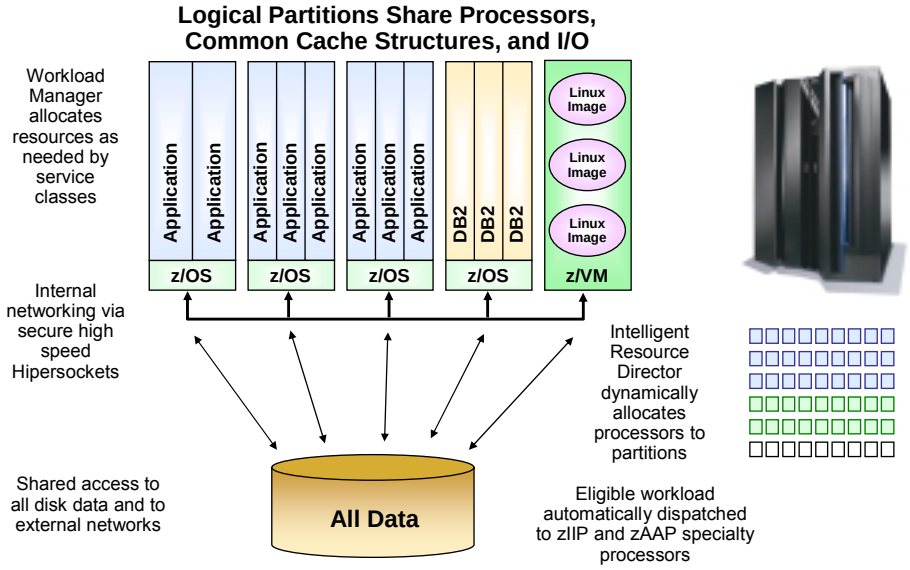
Add more memory too !

Measurable Benefits using CoD

- Provides extra processing power to meet business demands
- Activate dormant processing capacity
- Quickly scale up non-disruptive without adding more servers
- Enables server consolidation to a single platform to reduce operational cost
- Allows investment in future paying only for immediate requirements
- Provides a convenient means of testing resources with minimal investment

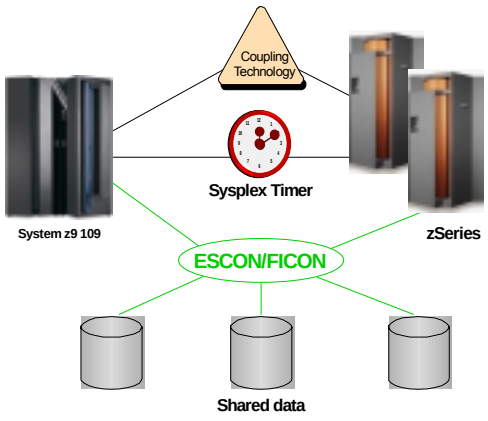
Quickly add more capacity

Micro Virtualization in System z Enables Immediate Use of Additional Processors

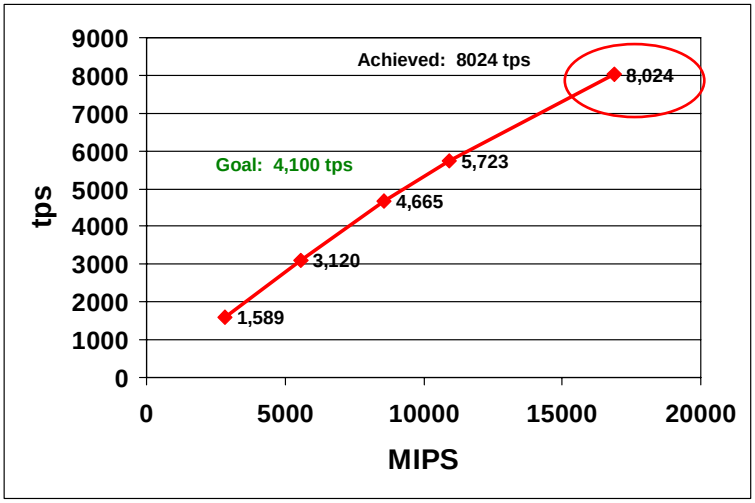


Parallel Sysplex provides additional Scalability

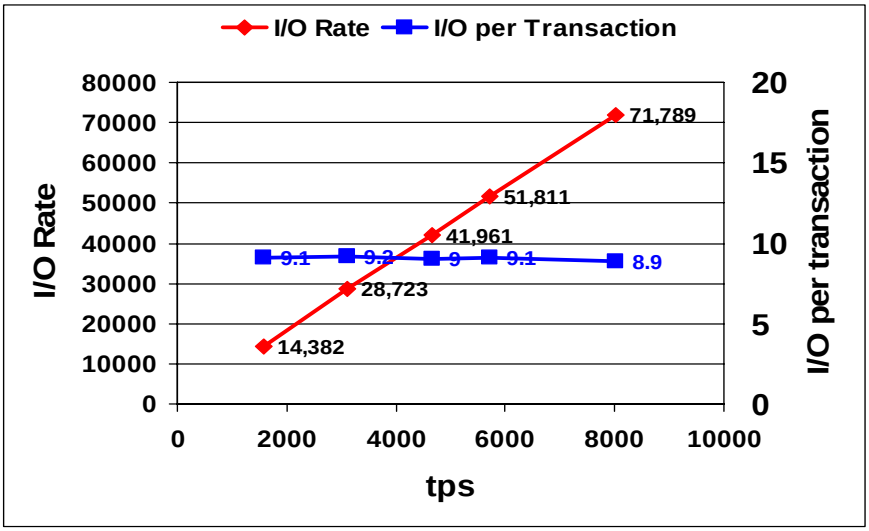
- Enhanced scalability - system resources from up to 32 machines in the sysplex can be used to handle capacity growth
- Various subsystems (CICS, DB2, MQ etc.) all can take advantage



Performance Benchmark for a Large Asian Bank



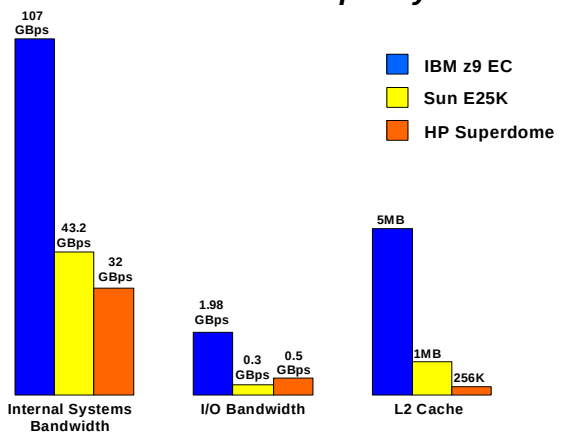
Scalability Requires I/O Capacity



IBM Mainframe Offers Superior I/O Bandwidth Throughout the System

Comparison of mainframe with distributed

Per Processor Capacity



Fundamental Capabilities that make System z a Better Platform

Key customers have decided that System z is the best platform for critical business operations. Why?

- Easy to grow capacity rapidly (Scalability)
- Continuous operations (Availability)
- Flexible use of computing capacity (High Utilization)
- Ease of management

How Important is High Availability? Fractional Improvements Make a Difference

Example 1: Financial Services Company

- $300B assets, 2500+ branches, 15M customers
- Retail banking, loans, mortgages, wealth management, credit cards
- CRM System – branches, financial advisors, call centers, internet
- Number of users – 20,000+

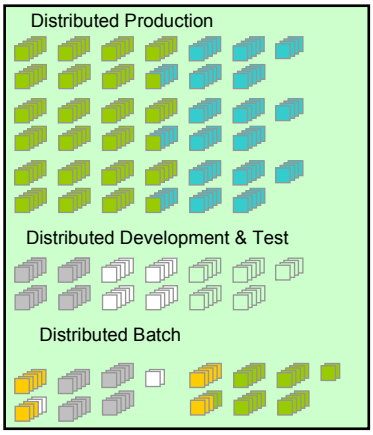
	Unix/ Oracle	*zSeries/ DB2*
Availability %	99.825%	99.975%
Annual outage	15h 20m	2h 11m
Cost of Downtime	**$45.188M**	**$3.591M**

Sources: ITG Value Proposition for Siebel Enterprise Applications, Business case for IBM eServer zSeries, 2004 & Robert Frances Group, 2005

Financial Impact of Downtime Per Hour

Industry segment	*Cost*
Energy	$2,818K
Telecommunications	$2,066K
Manufacturing	$1,611K
Financial	$1,495K
Information Technology	$1,345K
Insurance	$1,202K
Retail	$1,107K
Pharmaceuticals	$1,082K
Banking	$997K
Consumer Products	$786K
Chemicals	$704K
Transportation	$669K

Why Does the Mainframe Achieve Better Availability?



- Too many piece-parts to achieve comprehensive reliable and serviceability (RAS)
- Even harder with 3 different vendors responsible for overall RAS

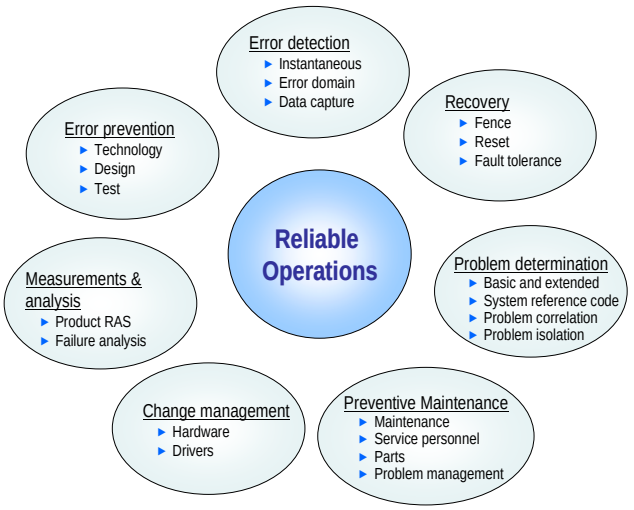
Mainframe

- Comprehensive approach to RAS
- Software designed to leverage sysplex failover
- Continuous availability is often achieved

A Comprehensive Design for RAS Provides the Foundation for "Five 9's" Availability

- System z comprehensive approach to hardware reliability and serviceability
  - Measurement and analysis of failure history during design
  - Error prevention before shipment
  - Error detection during runtime
  - Error correction while running
  - Problem determination to decide if maintenance is required
  - Ongoing maintenance capability around the world
  - Change out parts while running

Example of IBM Mainframe Comprehensive Design for Hardware RAS

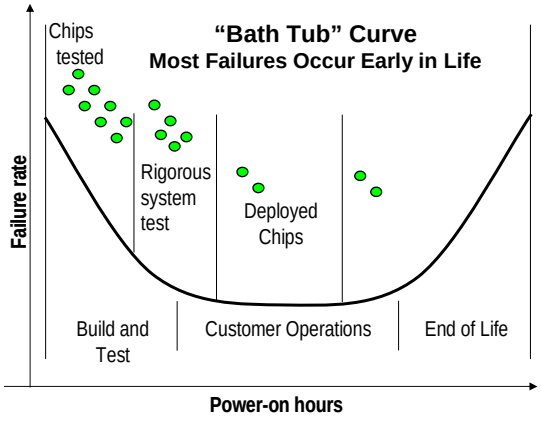


Change management examples:

- Replace parts while system is running

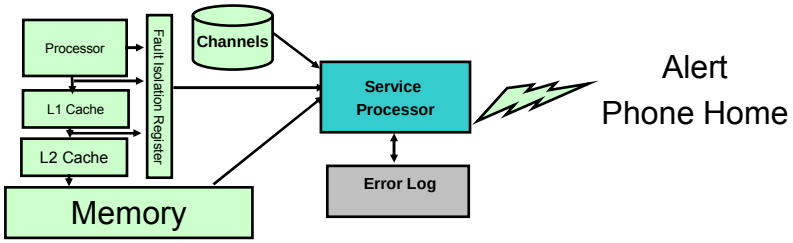
Mainframe Chips are Stress Tested to Ensure the Highest Availability

- All chips and subsystems are stress tested under extreme conditions
  - Millions of test patterns
  - Burn in at 150% of the typical voltage
- Designed to detect and remove defective chips as early as possible in life cycle
- Chips have 10X more reliability than other industry standard components when shipped



Mainframe Service Processor Monitors Failure Detections

- Real-time monitoring of recoverable errors
  - Memory
  - Caches
  - Internal Bus Parity Errors
  - Errors are detected and reported before they become "hard" errors
- Redundant Internal Paths and components
- Automatic "Phone Home" capability to alert IBM to potential problems before they cause an outage
- Hot-pluggable replacement of most major components – no downtime required for upgrades and repairs in many cases



Mainframe Service Processor Replaces Failed Processing Unit with Pre-Installed Spare

- Processing Units (PU) not required for a specified configuration remain dormant
- Spare PUs can be utilized for concurrent replacement or for concurrent capacity upgrades
- If there is a processor failure, sparing first searches for a spare PU on the *same book*; next on an *adjacent* book on the ring; or on *any* available spare PU in the server
- If there are no spares, the processor availability feature recovers the application to another PU and makes a service call automatically
- Redundant paths to cache and memory

Preventive Maintenance: Backed by People and Parts Capabilities

- IBM provides a comprehensive parts-stocking system to ensure fast access to all mainframe server parts.
- The problem tracking is managed through RETAIN
- The system is managed on the basis of the criticality of each part to server operation, the expected replacement rate of those parts, and geography (location of server types, models, and features).
- Service representatives can **dial in to the failed server** to perform remote diagnostics.
- If the onsite CE requires additional support, the service structure provides 3 additional levels of **24 hours support** - **worldwide access** to error data, logs, and traces as well as to history data and problem repair data.
- The removed parts are returned for failure analysis

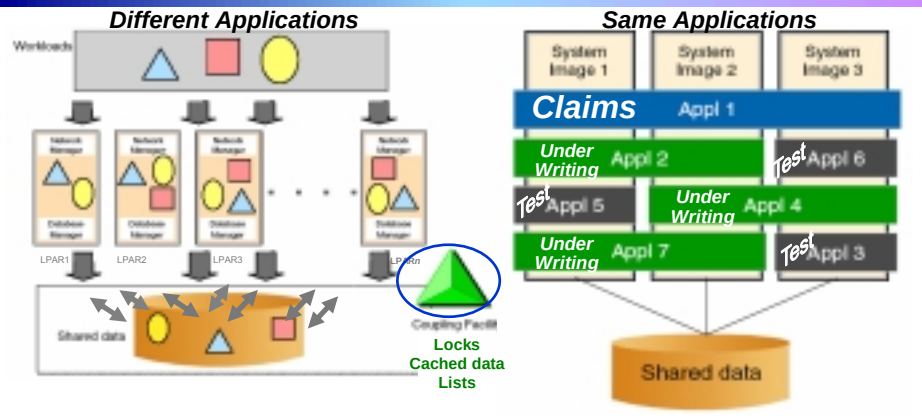
Hardware Maintenance While System is Running

Capability	System z9
ECC on Memory Control Circuitry	Self Correcting While Running
Oscillator Failure	Seamless Switch over While Running
Microcode Driver Updates	Replace While Running
Book Replacement	Replace While Running
Memory Replacement	Replace While Running (Book Offline)
Memory Bus Adapter (MBA) Replacement	Replace While Running Connectivity to I/O Domain remains
Self Timed Interface Failure to I/O	Replace While Running Connectivity to I/O Domain remains
Processor Upgrades	Replace While Running
Physical Memory Upgrades	Replace While Running
I/O Upgrades	Replace While Running
Spare CPU's	2 Pre-installed per System

Parallel Sysplex Further Improves Availability

- All machines in the sysplex are able to access all the shared disks
  - maintains availability if a machine or operating system image goes down
- Patch/upgrade various subsystems (CICS, DB2..) non-disruptively
- Multiple versions of a subsystem can coexist together (e.g.: DB2 7 and 8)
- The work of a failed subsystem instance can be taken over by any other instance in the sysplex
  - The work of a failed TOR or AOR in CICS can be taken over by any other TOR or AOR in the sysplex
  - The work of a failed WebSphere MQ instance can be taken over by any other WebSphere MQ instance
  - If a DB2 instance fails new work is modeled by the others
    - In flight work is recovered by restarting a failed DB2 instance somewhere else

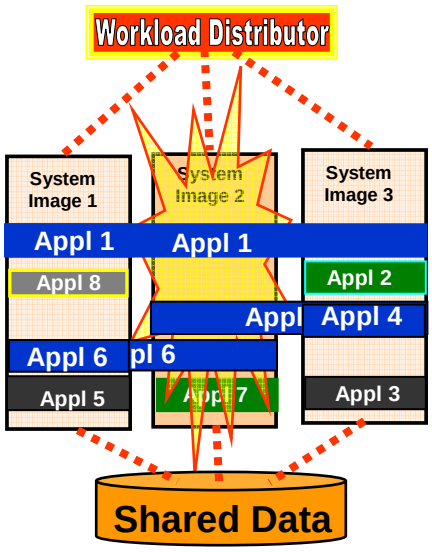
Sysplex Shared Data Enables Failover



- The Coupling Facility* provides the technology to shared data concurrently amongst different or similar workloads
- Data sharing provides for continuous availability and reliability
- CICS, IMS, DB2, MQ, VSAM, exploit the coupling facility for shared data

Sysplex Failover

Cloned Application



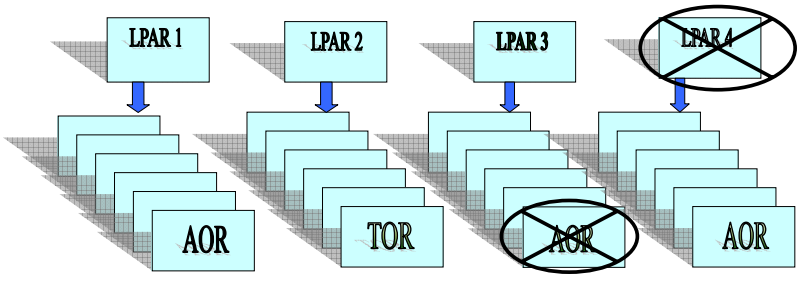
Nno move data
Maintenance
Preserve data / fail
Data validity

Continuous Operation is Not Just a Hardware Responsibility

- IBM middleware designed to exploit sysplex clustering for continued operation in the event of a system image failure
- IBM software designed to avoid shutdowns while applying maintenance updates
  - All Parallel Sysplex products including DB2, IMS, IRLM, VSAM, and CICS are designed for rolling update in a cluster

CICS Keeps Operating While Recovering Failed Regions

- AOR – Application Owning Region – runs business logic code
- TOR – Terminal Owning Region – runs presentation code



Large Asian Bank Benchmark Demonstrates CICS Resiliency from Failures

	INDUCED AOR FAILURE	INDUCED TOR FAILURE	INDUCED LPAR FAILURE
DOWNTIME	0	0	0
Steady State tps	6250	5000	6271
DB2 Recovery Time	N/A	N/A	8mins
Temporary increase in Response Time	64ms	70ms	76ms

Availability Built in by Design

"The IBM mainframe platform retains industry-leading availability characteristics even for single-system instances.

"For example, standard service availability commitments … suggest that the mainframe is delivering 99.9% to 99.99% scheduled availability versus 99.5% for distributed server platforms in non clustered configurations."

Source: ***Forrester, 2005 Mainframe Market Outlook, February 4, 2005***

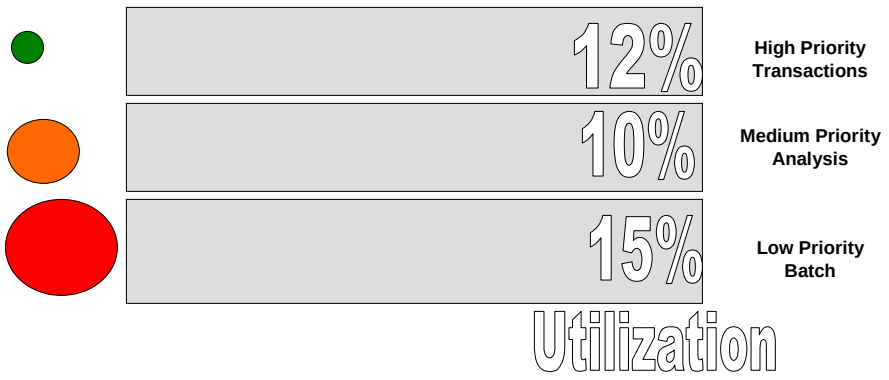
Fundamental Capabilities that make System z a Better Platform

Key customers have decided that System z is the best platform for critical business operations. Why?

- Easy to grow capacity rapidly (Scalability)
- Continuous operations (Availability)
- Flexible use of computing capacity (High Utilization)
- Ease of management

Distributed Servers

Purchased New Machines each running separate workload

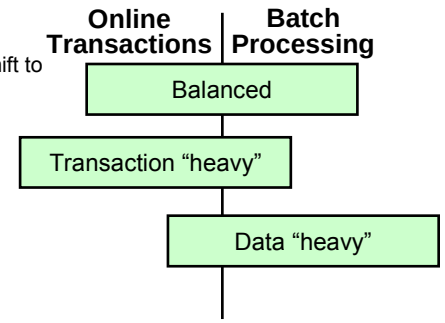


- **Purchasing separate machines had higher administration**
- **Along with lower utilization**
- **Support problems did not go away**

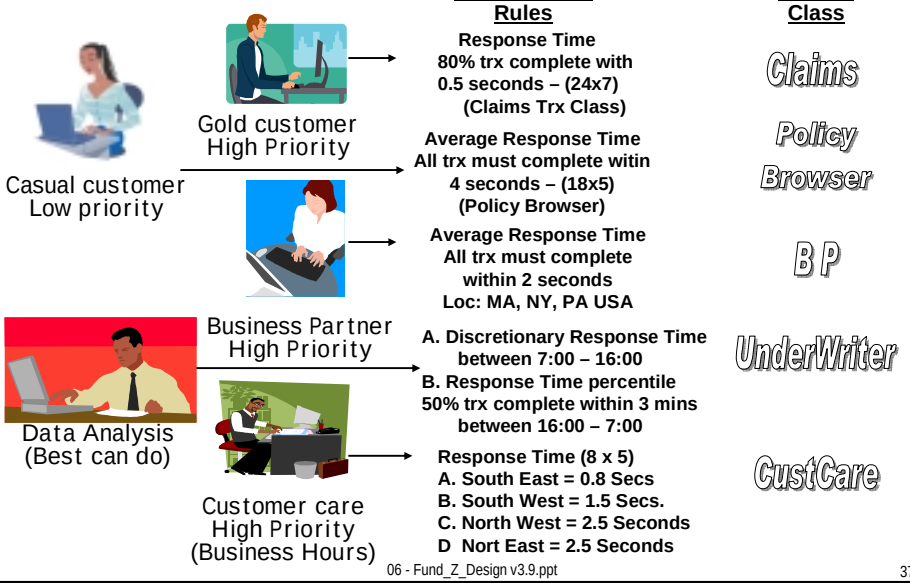
Flexible to Respond to Change

- Mainframe Workload Management
  - Policy Based (Classify Work by business value)
  - All resources pooled
  - Dynamic changes can be made flexibly

Resources easily shift to changing workloads
e.g. online vs batch



Mainframe Policy Driven Workload Management



Mainframe Workload Management

- Monitoring the workloads of various users and applications
- Monitoring system-wide resources to determine whether they are fully utilized
- Inhibiting the creation of new user workloads when certain shortages of resources exist
- Dynamically adjusting resources to meet service level objectives
- Change the priority of users automatically to adjust the consumption of system resources
- Selects the resources to be allocated, if a choice of resources exist to balance the executing workloads

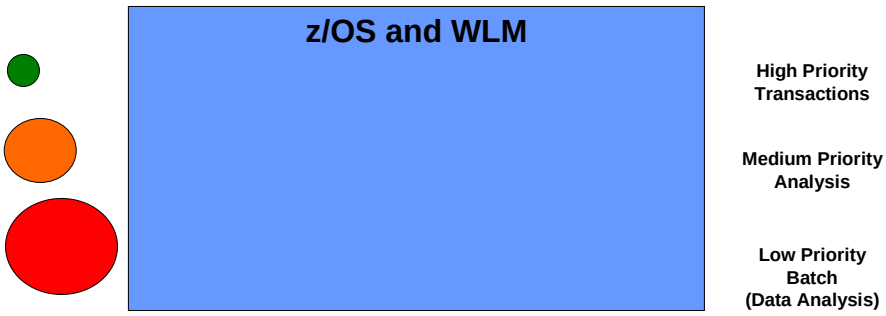
Mainframe Workload Management

Workloads deployed to z/OS can be differentiated and prioritized based on business policy, and managed to meet Service Level Agreements

Resources are automatically allocated, adjusted and reallocated to meet objectives

WLM will manage LPARs, CPUs, channels, I/O subsystems and DASD, TCP/IP connections, servers, etc.

Enables 100% utilization of capacity



Transaction type:
- Web "buy" vs "browse"
- B2B
- Batch payroll
- Test

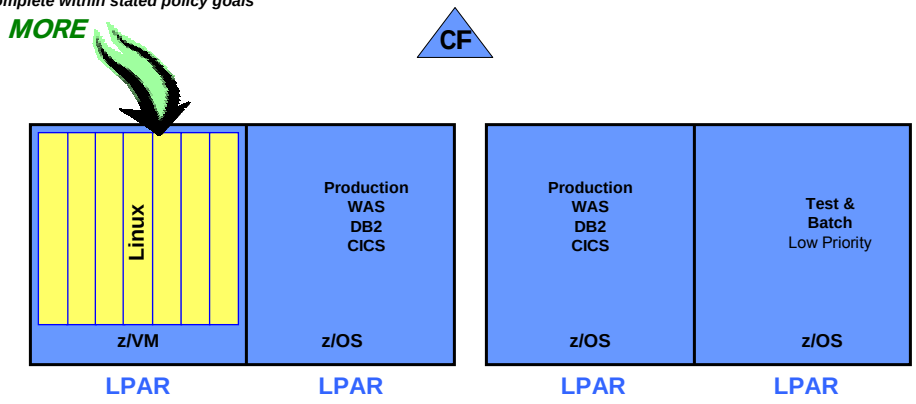
User/user type:
- Top 100 clients
- Typical clients
- Executive
- Design team

Time periods:
- 1AM - 4AM
- Mon - Fri
- Weekends
- End of quarter

Workload Management Prioritizing Across Images in a Server

"Intelligent Resource Director (IRD)" further differentiates z/OS with its ability to manage resources across multiple partitions in a server

PR/SM, IRD and WLM work together to ensure that the resources of the server are correctly balanced to enable work to complete within stated policy goals



Processor resources, data bandwidth and I/O queueing decisions are perfectly balanced across the server to manage diverse workloads within the parameters of stated business goals

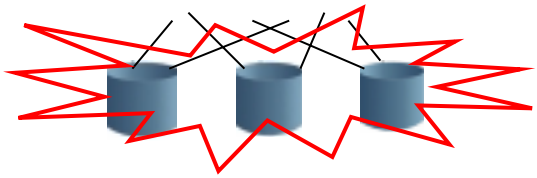
Fundamental Capabilities that make System z a Better Platform

Key customers have decided that System z is the best platform for critical business operations. Why?

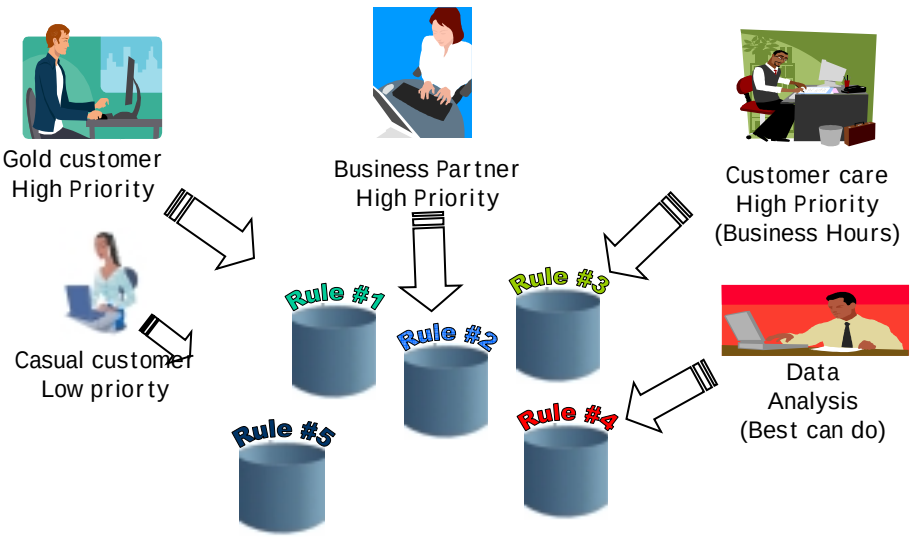
- Easy to grow capacity rapidly (Scalability)
- Continuous operations (Availability)
- Flexible use of computing capacity (High Utilization)
- Ease of management

Service Levels Manage Storage

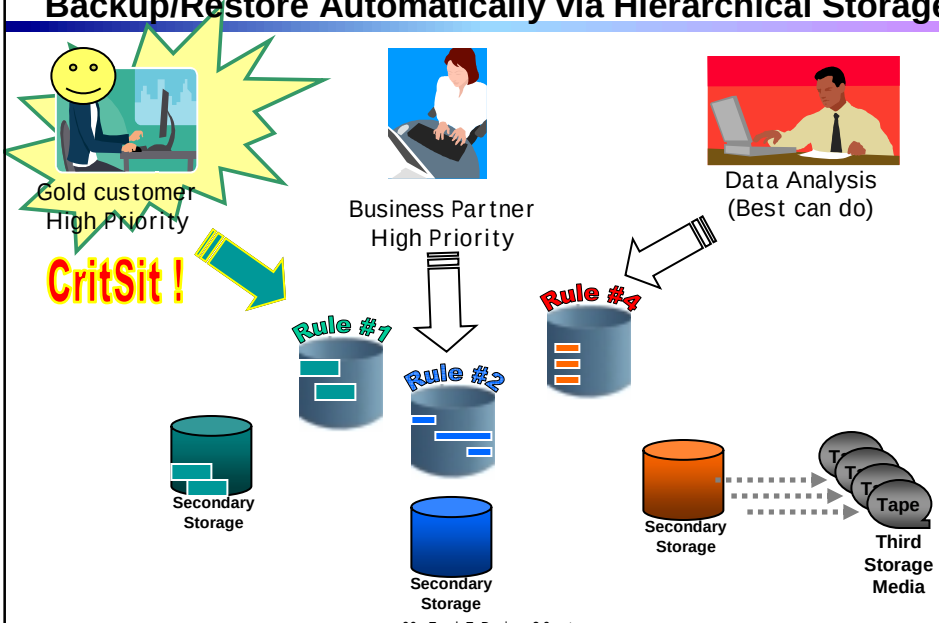
- What performance objectives are required by data
- When and how to backup data
- Whether datasets should be kept available for use during backup or copy
- How to manage backup copies kept for disaster recovery
- What to do with the data that is obsolete or seldom used



Rule-based Policy Management to Manage the Storage Process



Rule-based Policy Management to Manage Backup/Restore Automatically via Hierarchical Storage



Simply The Best Qualities of Service!

ODI's CIO

Fundamental Capabilities that make System z a Better Platform

Key customers have decided that System z is the best platform for critical business operations. Why?

- Easy to grow capacity rapidly (Scalability)
- Continuous operations (Availability)
- Flexible use of computing capacity (High Utilization)
- Ease of management