



***The Modern Mainframe...
At the Heart of Your Business***

A Mainframe Primer – Continuous Availability



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Service Oriented Finance Needs a World Class Availability Solution

Our new loan application must be available to serve agents around the world 24 by 7



**Service Oriented Finance
CIO**

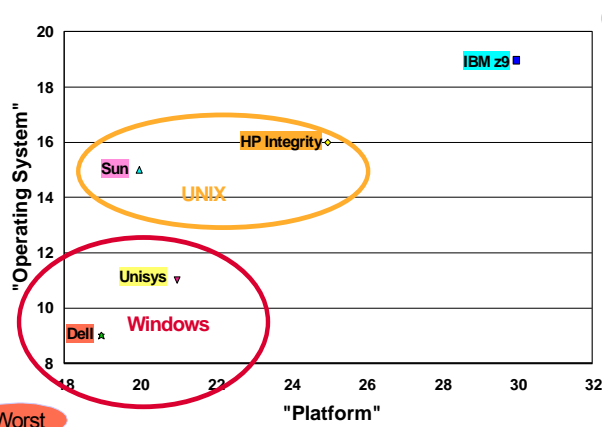
You can't do better than the availability provided by System z



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Gartner Ranks System z Tops in Availability

Workload Management Rankings - selected platforms



Best

■ **Gartner Criteria:**

- ▶ Single system availability
- ▶ Planned downtime
- ▶ Disaster tolerance & recovery
- ▶ Failover clustering
- ▶ High availability services

Worst

Source: Gartner, Server Scorecard Evaluation Model version 3, 1Q07

Five Nines is the Gold Standard of Availability

- 99.999% availability is sometimes referred to as “continuous operation”
 - ▶ **5 minutes** downtime per year out of 24x365
- Survey of 28 companies with mixed environments*
 - ▶ Average mainframe system availability = 99.993% or **36 minutes** per year downtime
 - ▶ Average distributed server availability = 99.909% or **8 hours** per year per server downtime
- Small improvements in the “nines” become more and more difficult to achieve
- Comprehensive design for availability is required for continuous operation

*March 12, 2007 IDC Survey

How is Continuous Operation Achieved?

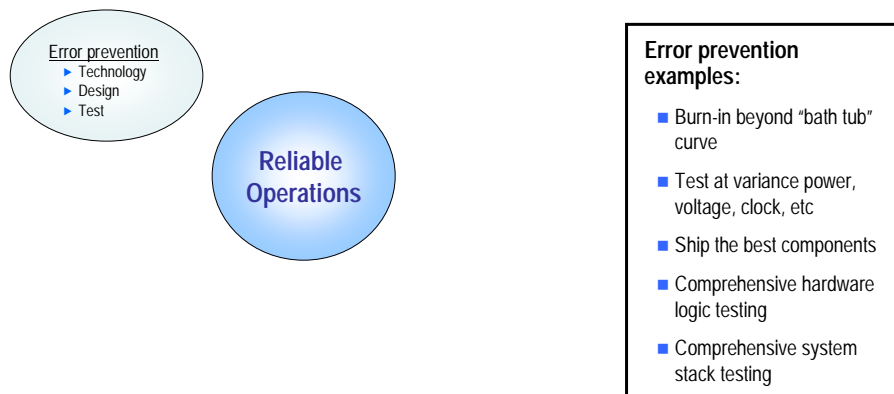
A *comprehensive* four part strategy is required:

1. Hardware reliability and serviceability
2. Cluster redundancy supported by middleware
3. Concurrent software maintenance eliminates planned outages
4. Disaster recovery

The mainframe parallel sysplex plays a key role in these capabilities

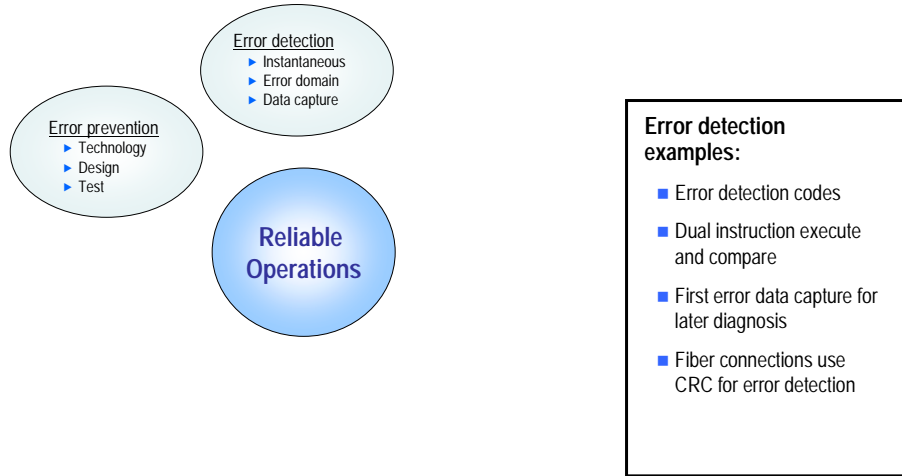
A Comprehensive Design for RAS

Examples of Hardware Reliability and Serviceability Features



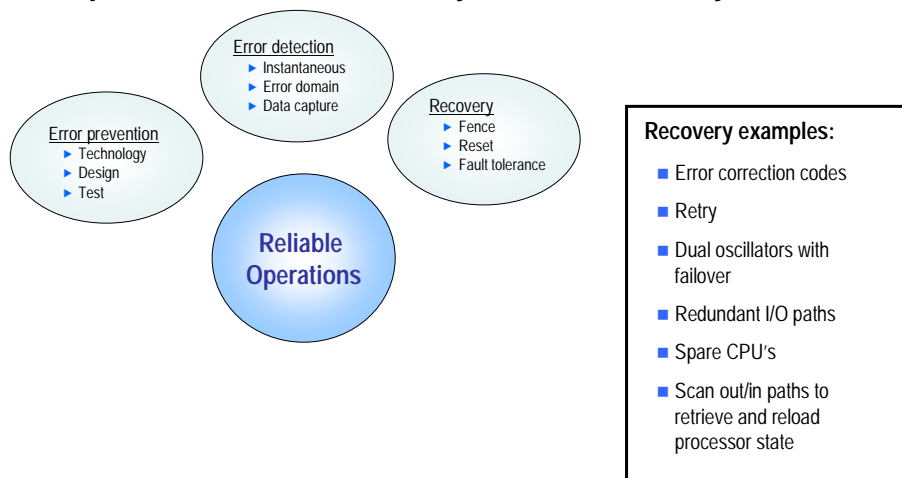
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Examples of Hardware Reliability and Serviceability Features



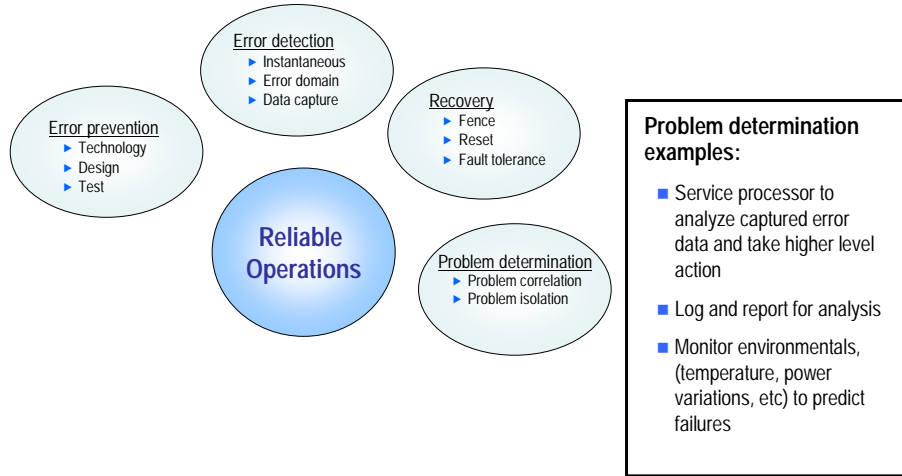
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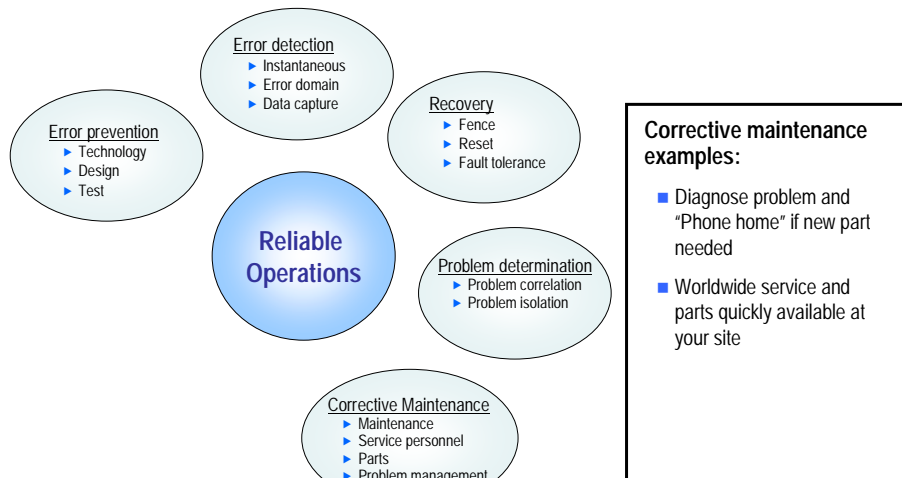
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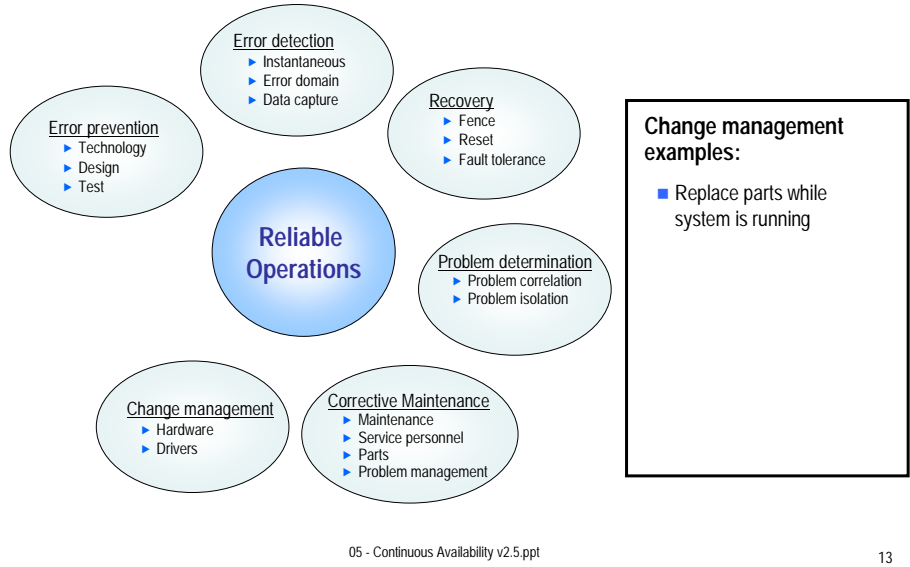
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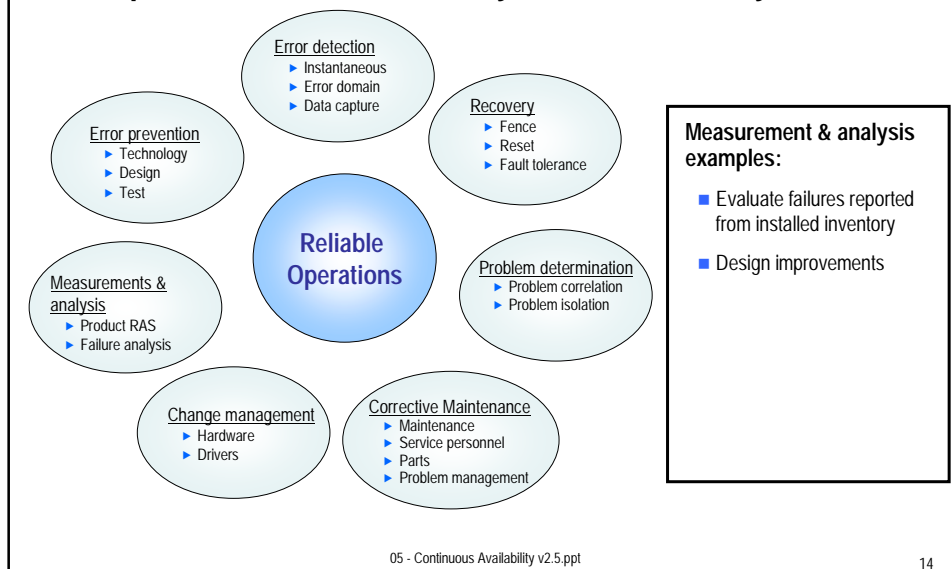
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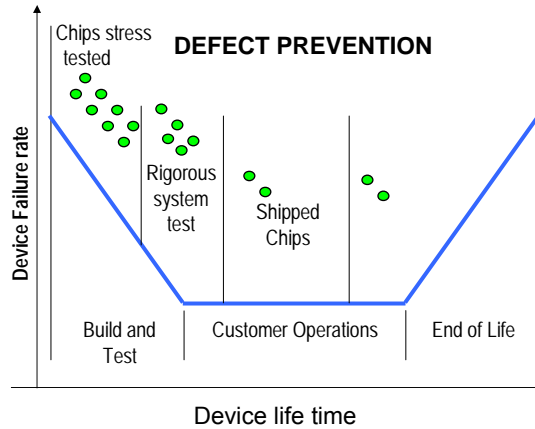
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Examples of Hardware Reliability and Serviceability Features



Rigorous Testing Beyond the “Bathtub Curve”

- Device Failures are more likely early in life
- Stress testing is designed to accelerate device aging
 - ▶ All chips are stress tested under extreme conditions
 - Burn in at 150% of the typical voltage- millions of test patterns
 - Power on hours tested at over 140 degrees Fahrenheit
- Result: Shipped chips have 10X more reliability than other industry standard components

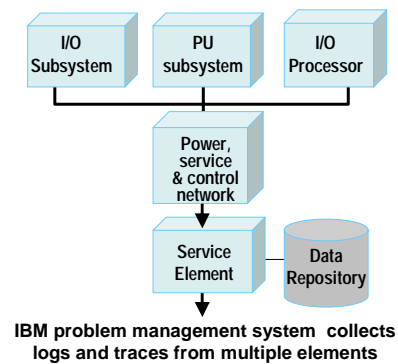


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Error Detection: First Error Data Capture

- First error data capture (FEDC) is a diagnostic feature used to gather data for analysis when there is *any* failure in the system
- Early detection - up to 70% of all test-floor-found problems for the z990 were found through FEDC
- Customer Value - obtain the right data up front if a problem occurs, to avoid asking customers to re-create a problem
- All subsystems send logs, traces, and dumps to the service processor
- Common infrastructure to collect and store data



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Spare Central Processing Units (CPU's) are Shipped Pre-Installed

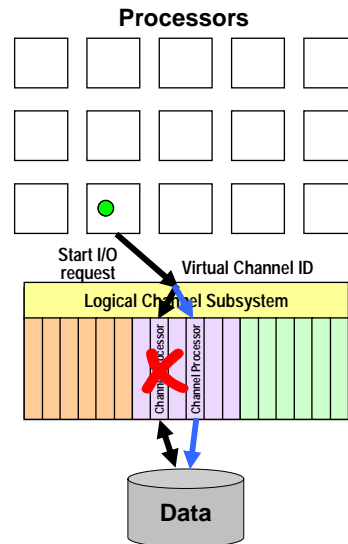
- CPU Spraying –Transparently substitute a good processor for one that is suspected of being defective
- This on-line switch is seamless, applications are not impacted
- Spraying is performed if a CPU fails and instruction retry is unsuccessful
- CPU Spraying copies state information from the failed CPU to the spare
- Between 10 to 100 spare replacements are reported worldwide each year

Service Processor automatically finds a new "spare"

- Uses spare PU on the same book
- If none are available uses an adjacent book
- Uses any available spare in the server.
- If no spares are available, recovers the application onto *another* CP and automatically phones home for a replacement.

Virtualization of I/O Channels Enables Redundant I/O Paths

- Large number of physical I/O channels are available
- Logical channels subsystem provides virtual channel identifiers
- Virtualization enables an alternative physical I/O channel to be used
 - ▶ Dynamic channel paths
 - ▶ Logical channel subsystem
 - ▶ Protection against channel processor failure
- Recover I/O operations in progress
 - ▶ I/O subsystem transparently processes I/O with built in checks



Hardware Repair and Upgrade While Running

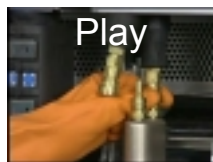
Capability	System z9
ECC on Memory Control Circuitry	Transparent While Running
Oscillator Failure	Transparent While Running
Microcode Driver Updates	Replace While Running
Book Replacement	Replace While Running
Memory Replacement	Replace While Running (Book Offline)
Memory Bus Adapter (MBA) Replacement	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
Memory Upgrades	Replace While Running
I/O Upgrades	Replace While Running
Spare CPU's	2 Pre-installed per System

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DEMO: How Does Hardware Repair and Upgrade Work?

- ▶ Example video of a memory upgrade while the system continues to run
- ▶ Service engineer dispatched through “phone home”
- ▶ Service engineer has part already ordered through our global parts replacement program
- ▶ Notice book is removed while the system is operational
- ▶ Even the service tray is included!
- ▶ Memory cards can be added easily similar to PC servicing



Types of Replacements:

1. Add a single book for processors, memory, and I/O Connections
2. Remove and replace a book
3. Allocate physical resources on other books

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2. Cluster Redundancy Supported by Middleware

- Clusters of CICS, IMS, DB2, WebSphere, or MQ exploit parallel sysplex
 - ▶ Multiple images behave like a single, logical image via clustering
 - ▶ The loss of *any one* image does not bring down the cluster
- Applications are enabled for data sharing to allow for workload balancing
 - ▶ I/O subsystems support multiple I/O paths with dynamic switching to shared data
- Dynamic workload balancing; workloads can run on any image in the sysplex
 - ▶ Failover and recovery processes are fully automated
- The result is a fault-tolerant system

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3. Concurrent Software Maintenance Eliminates Planned Outages

- IBM middleware is designed to keep running during upgrades and patches
 - ▶ Use Parallel Sysplex to take image offline
 - ▶ Multiple software versions can co-exist in the same sysplex
 - ▶ Enables rolling upgrades, one node at a time
 - ▶ Patches as well as releases can be applied without causing disruption to application availability

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Perform Other Maintenance While the Software Keeps Running

- **DB2**
 - ▶ Data Backup
 - ▶ Image copy
 - ▶ Add or modify a table schema
 - ▶ Reorganize the database
 - ▶ Partition a secondary index
- **CICS**
 - ▶ **CICS backup while open** allows for file backup while CICS has it open for update.
 - ▶ **CICS Auto-install** provides the ability for support resources to be defined dynamically on their first use
 - ▶ **CICS RDO** can dynamically add or change resource definitions and have them immediately usable without the need for a scheduled outage
- **IMS**
 - ▶ Update Type 2 and Type 4 SVC's without requiring an IPL
 - ▶ IMS V9 Dynamic Resource Definition
 - ▶ IMS V9 provides a dynamic resource manager which is implemented without having to IPL
 - ▶ IMS ACBLIB online change

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4. Systematic Disaster Recovery – The Last Layer of Protection

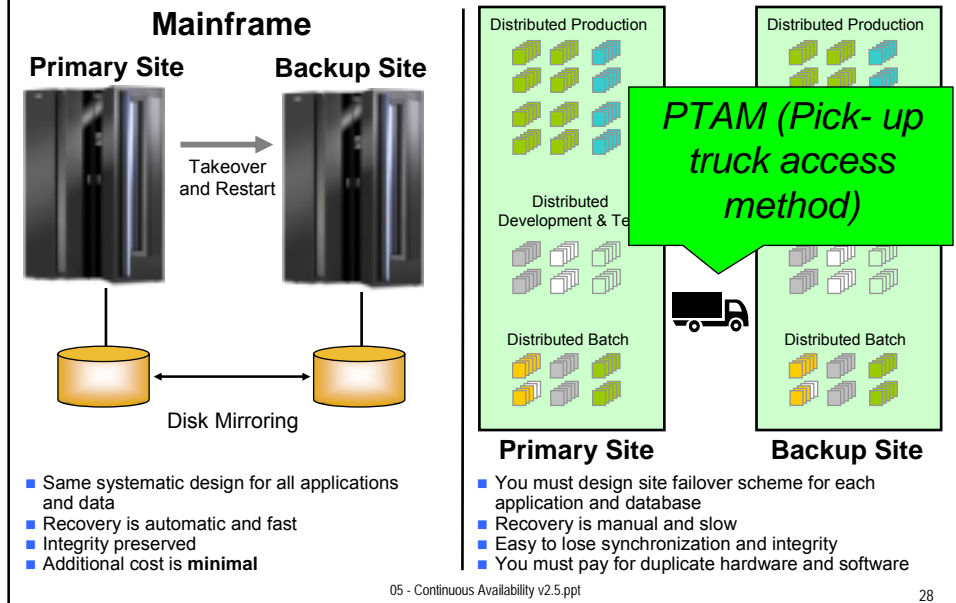


- **What's needed:**
 - ▶ Backup site capable of sustaining business operations
 - ▶ Automated, systematic site failover with data integrity preserved

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Disaster Recovery on the Mainframe vs Distributed



Geographically Dispersed Parallel Sysplex (GDPS) – Disaster Recovery

- GDPS provides systematic site failover capabilities in the event of data center disaster
 - ▶ Uses disk mirroring to failover site
- GDPS supports different recovery time requirements and different site distances with several options available
 - ▶ Metro Mirror
 - ▶ Global Mirror
- GDPS provides automation of site failover tasks to expedite recovery
- GDPS is comprised of IBM products and technologies delivered along with service components

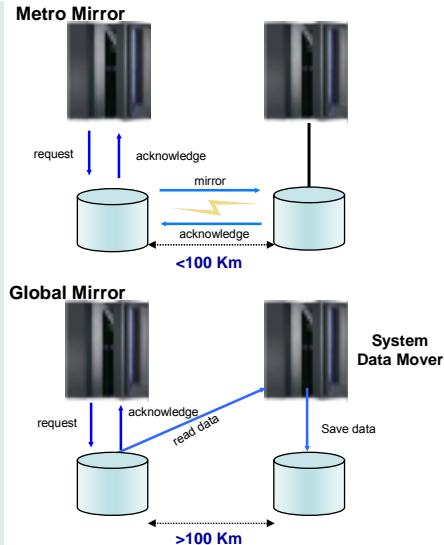
GDPS Metro Mirroring versus GDPS Global Mirroring

Metro Mirror

- Synchronous remote data mirroring
 - ▶ Controller knows "I/O is complete" when both primary and secondary disks are updated
- Supports metropolitan distance (<100KM)
- GDPS freezes the image of the secondary data at the very first sign of a disaster

Global Mirror

- Asynchronous remote data mirroring
 - ▶ Application knows the "I/O is complete" as soon as primary disk is updated
- Unlimited distance support
- Performance impact negligible
- System Data Mover is used to move data from Primary to Secondary disk



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TD Bank Best Practices



■ Background

- ▶ TD Bank has been running Parallel Sysplex
 - Sysplex-wide availability 99.998% over **10 years**
 - Only 1.5 hours planned outage
- ▶ System z is used for Customer Account Data for applications supporting Tellers, Internet Banking and ATMs

■ TD Bank Recommendations

- ▶ Keep sysplex up – do not bring it down
- ▶ Practice Rolling IPLs
- ▶ Exploit concurrent hardware upgrades
- ▶ Use automation
- ▶ Configure your sysplex for availability
 - IMS/DB2 Data-sharing
 - Transaction routing
 - Sysplex Distributor for TCP/IP
 - Online database reorganizations
 - Clone each image
 - Ensure applications exploit parallel sysplex

▶ Client Environment

- ▶ System z
- ▶ z/OS
- ▶ DB2
- ▶ IMS
- ▶ WMQ
- ▶ GDPS

Parallel Sysplex Deployment consists of five System z across two sites running 42 M business transactions a day

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Other vendors who fail to deliver this four part strategy will fall short of System z continuous availability



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