

Remote Data Mirroring Solutions for High Availability

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Remote Data Mirroring Solutions

- Agenda
 - Why remote data mirroring?
 - Physical and logical mirroring
 - Integration with clustered solutions
 - Other remote mirroring options

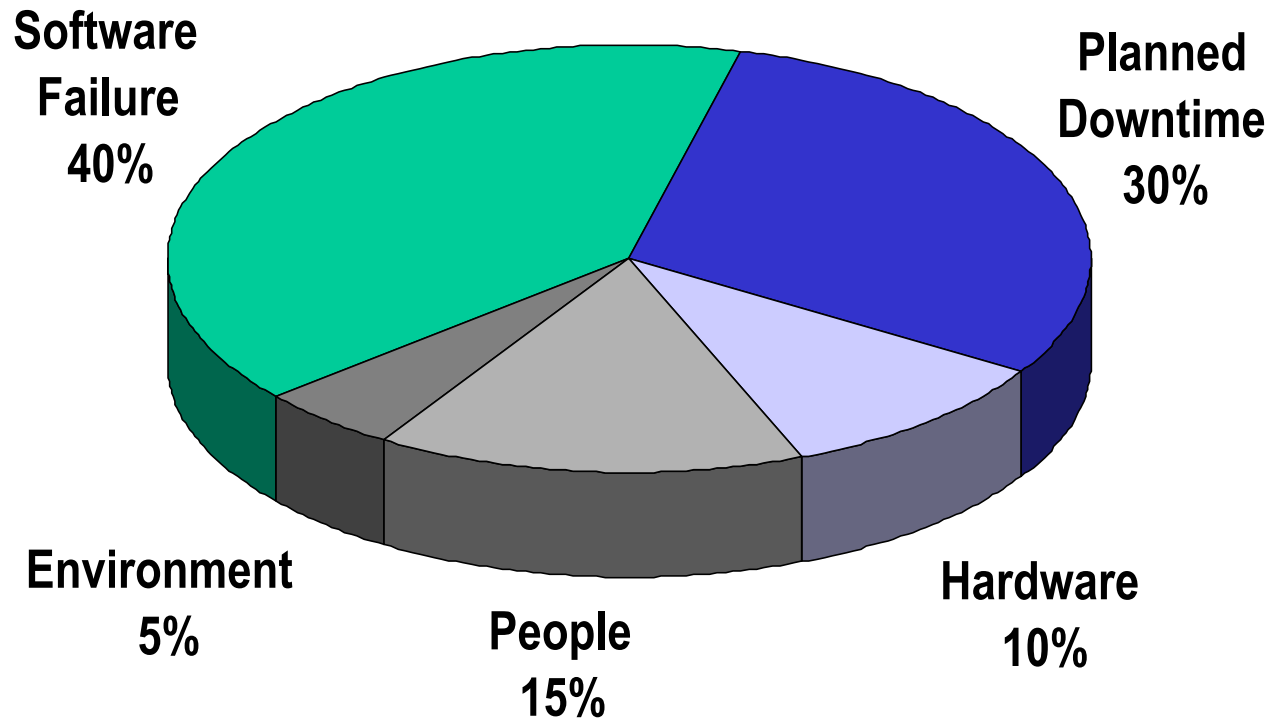
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- Why remote data mirroring?
 - Disaster readiness for unplanned events
 - Natural disasters
 - Hurricanes, earthquakes, typhoon
 - Human error
 - Accidental power shutdown
 - Other
 - Data availability for planned events
 - Upgrades
 - Operating systems and applications
 - Disaster readiness testing
 - Internal site or outsourced to service providers

Being prepared means performing readiness testing

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Causes of Downtime



Source : IEEE Computer

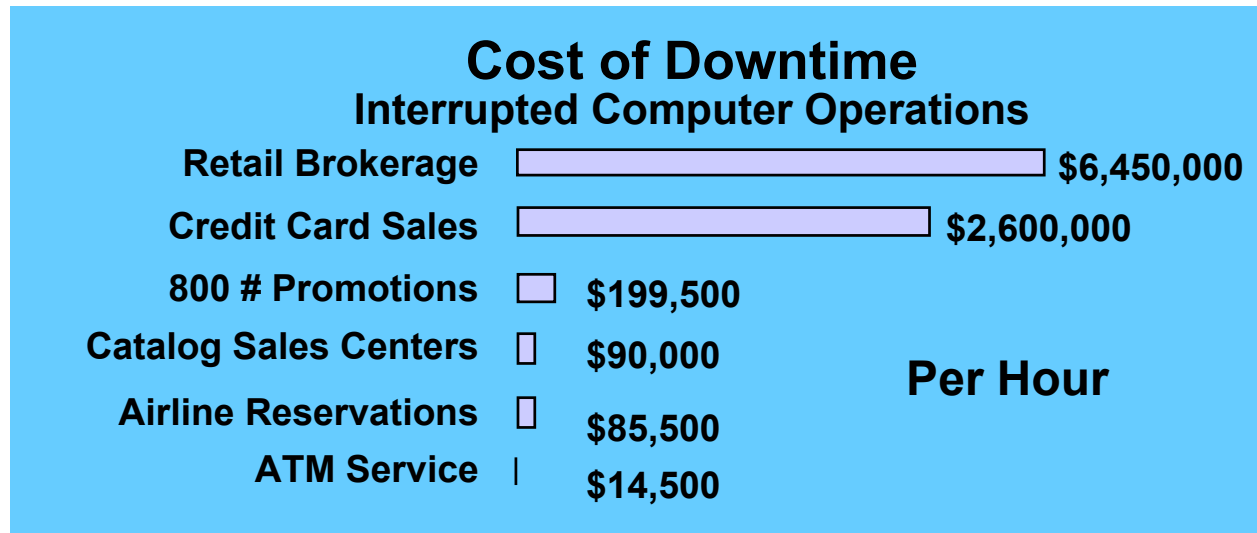
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Impact of Computer Outage

- Lost Revenue
- Loss of Productivity
- Damaged Reputation
- Financial Performance
- Other Expenses
 - Litigation
 - Cost of temporary employees for overtime
 - Equipment rental
 - Additional shipping costs

Downtime results in lost business

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Source: Gartner Group and Contingency Planning Research

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Downtime Costs Add Up

- **America Online**
August 1996 Outage: 24 hours
Maintenance/Human Error
Cost: \$3 million in rebates
- **E*Trade**
February 1999 through 3 March 1999 Four outages
Cost: 22 percent stock price hit on 5 February 1999
- **eBay**
June 1999 outage: 22 hours OS Failure
Cost: \$3 million to \$5 million revenue hit
26% decline in stock price

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Measuring Availability

Unavailability (minutes/year)	System Availability
50,000 (about 5 weeks)	90.0%
5,000 (About 3.5 days)	99.0%
500 (About 8 hours)	99.9%
50	99.99%
5	99.999%

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– Data Mirroring Solutions

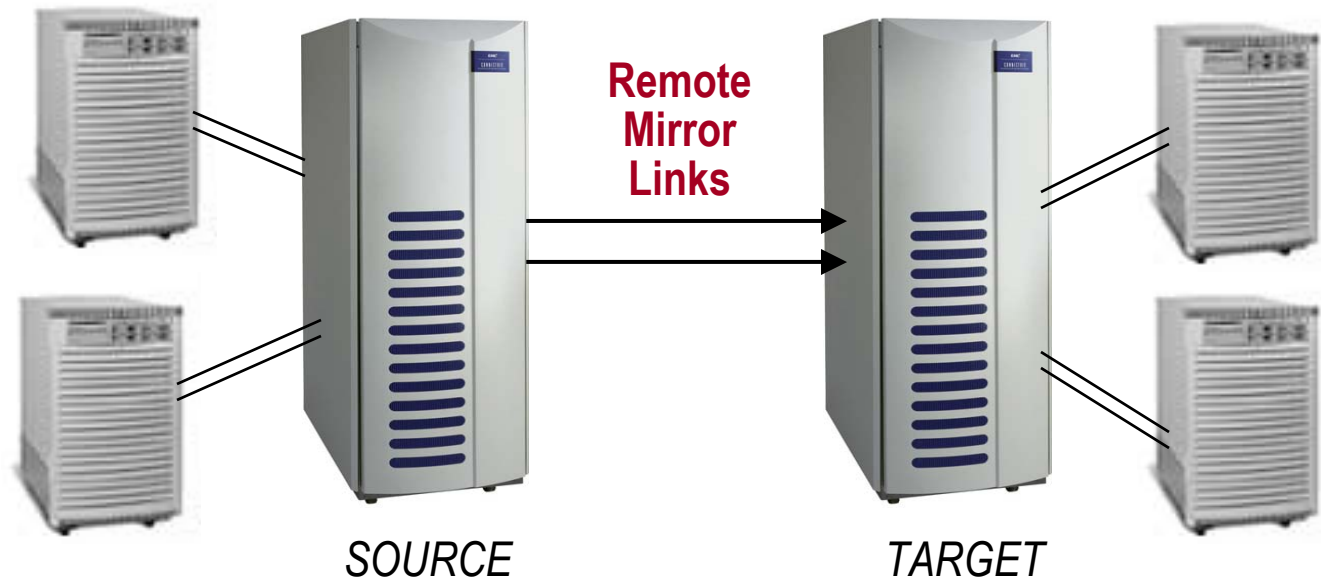
- Physical Mirroring
 - Hardware
 - » Example: EMC Symmetrix Remote Data Facility
 - Software
 - » Example: HP MirrorDisk/UX
- Logical Mirroring
 - File System
 - » Example: Quest Shareplex/UX
 - Database
 - » Example: Oracle Advanced Replication

Each has advantages and disadvantages with respect to one another

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Physical Mirroring with Hardware

- Disk mirror in real time issuing a single I/O without host CPU's
- Resynchronization is performed independent of host
- Mirror operation is at the block level

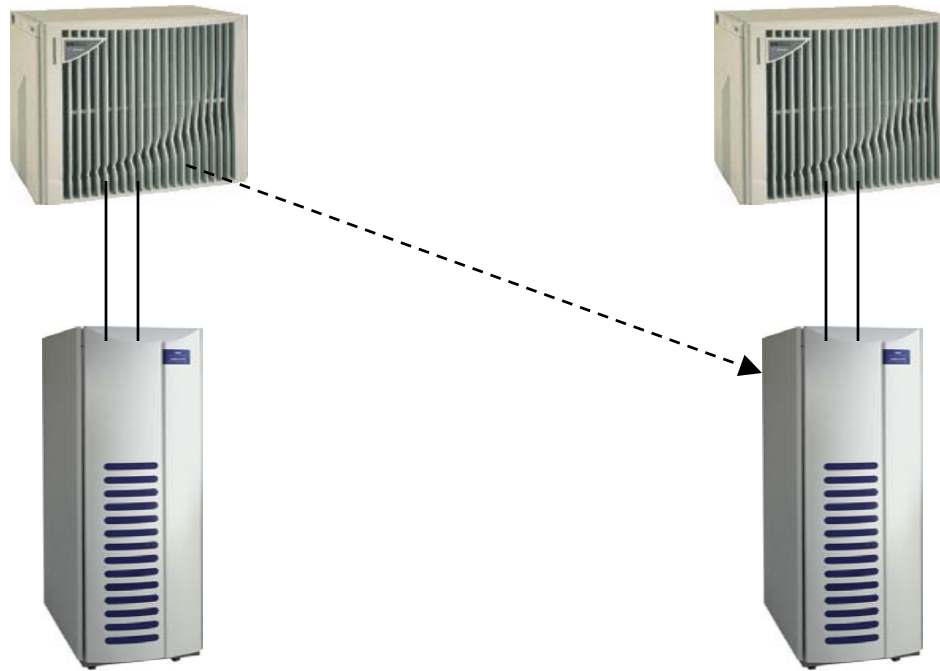


Major advantage is mirroring is not specific to a database or file system

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Physical Mirroring with Software

- Host CPU's required to perform mirroring operation issuing multiple I/O's
- Resynchronization requires host CPU's
- Mirror operation is at the block level



Major advantage is independence of any one vendors disk technology

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- Comparison of Physical Mirroring options:
 - Disk based system do not consume host CPU's
 - Single I/O issued for mirroring operation
 - Resynchronization does not consume host CPU's
 - Bit map tables maintained in storage cache vs. host memory
 - Software mirroring independent of disk technology
 - EMC or HP storage in the case of HP MirrorDisk/UX
 - Data copies are peers with software mirroring
 - May improve read performance with multiple read devices

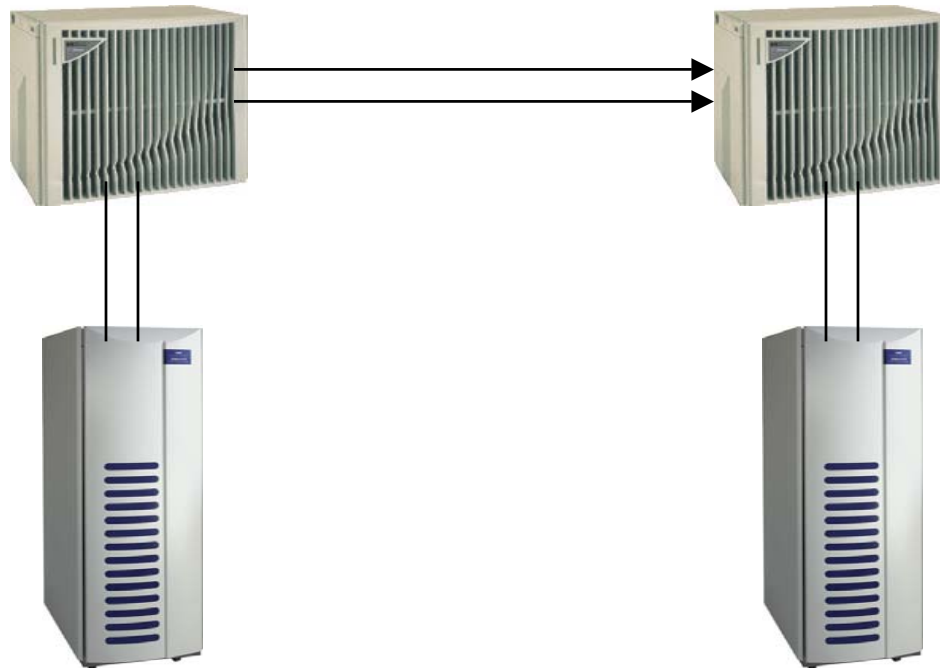
Physical mirroring when performance, data currency, and ease of management are most important

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Logical Mirroring

- File system or database specific mirroring operation issuing multiple I/O's
- Host CPU's required to perform mirroring operation
- Resynchronization may require manual intervention to accomplish

Uses network to perform mirror operation



Major advantage is data corruption at remote site unlikely since transactions are mirrored

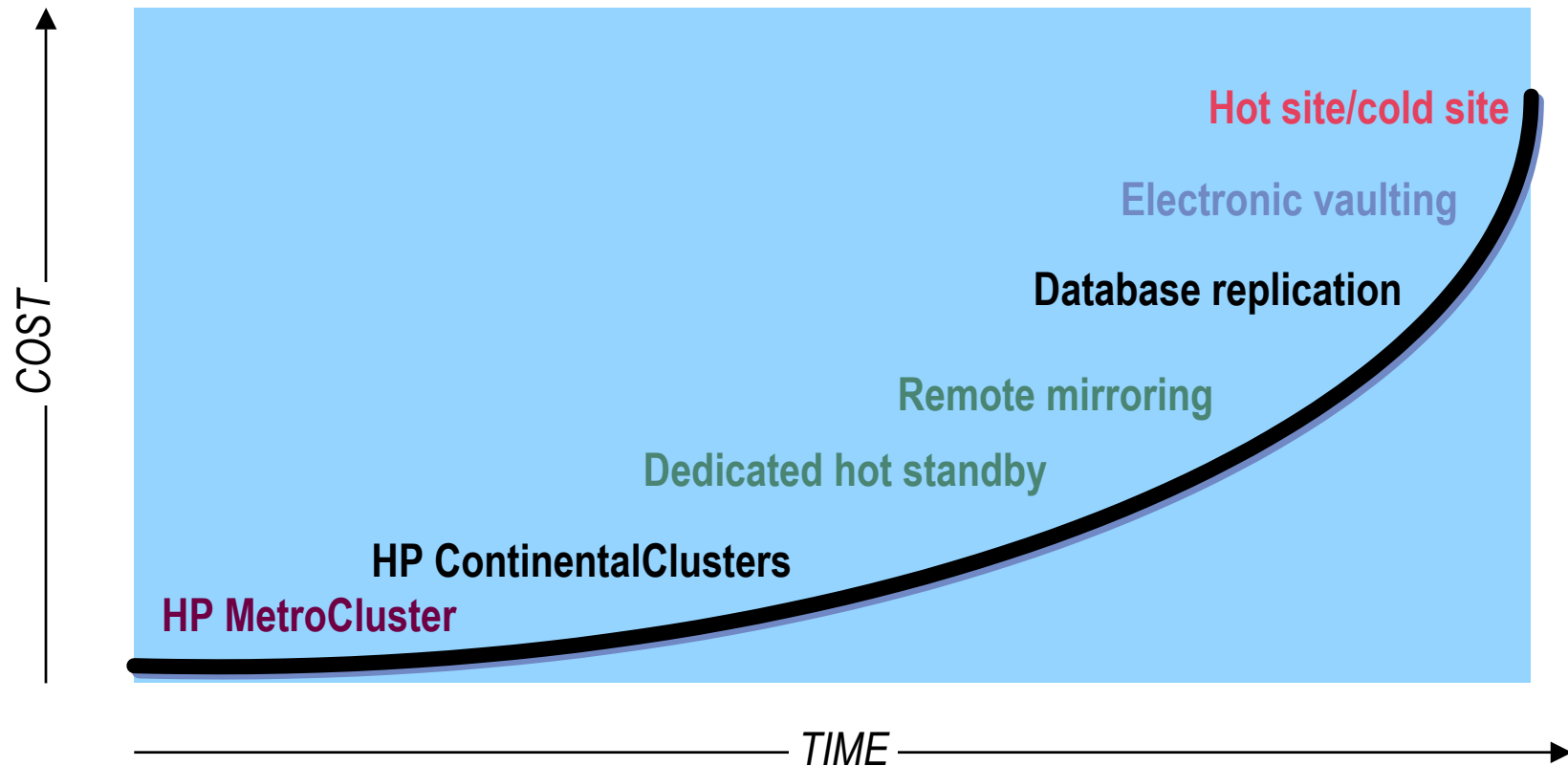
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- Comparison of Logical to Physical Mirroring
 - Remote data corruption less likely to occur
 - Remotely mirror transactions and not data blocks
 - Resynchronization may require manual intervention
 - Fail back usually requires manual process
 - Usually specific to a file system, database, or application
 - File System/Database mirroring or Transaction Monitor
 - Mirrors transactions and not data blocks
 - Results in lower performance

Logical mirroring when transactional consistency is most important

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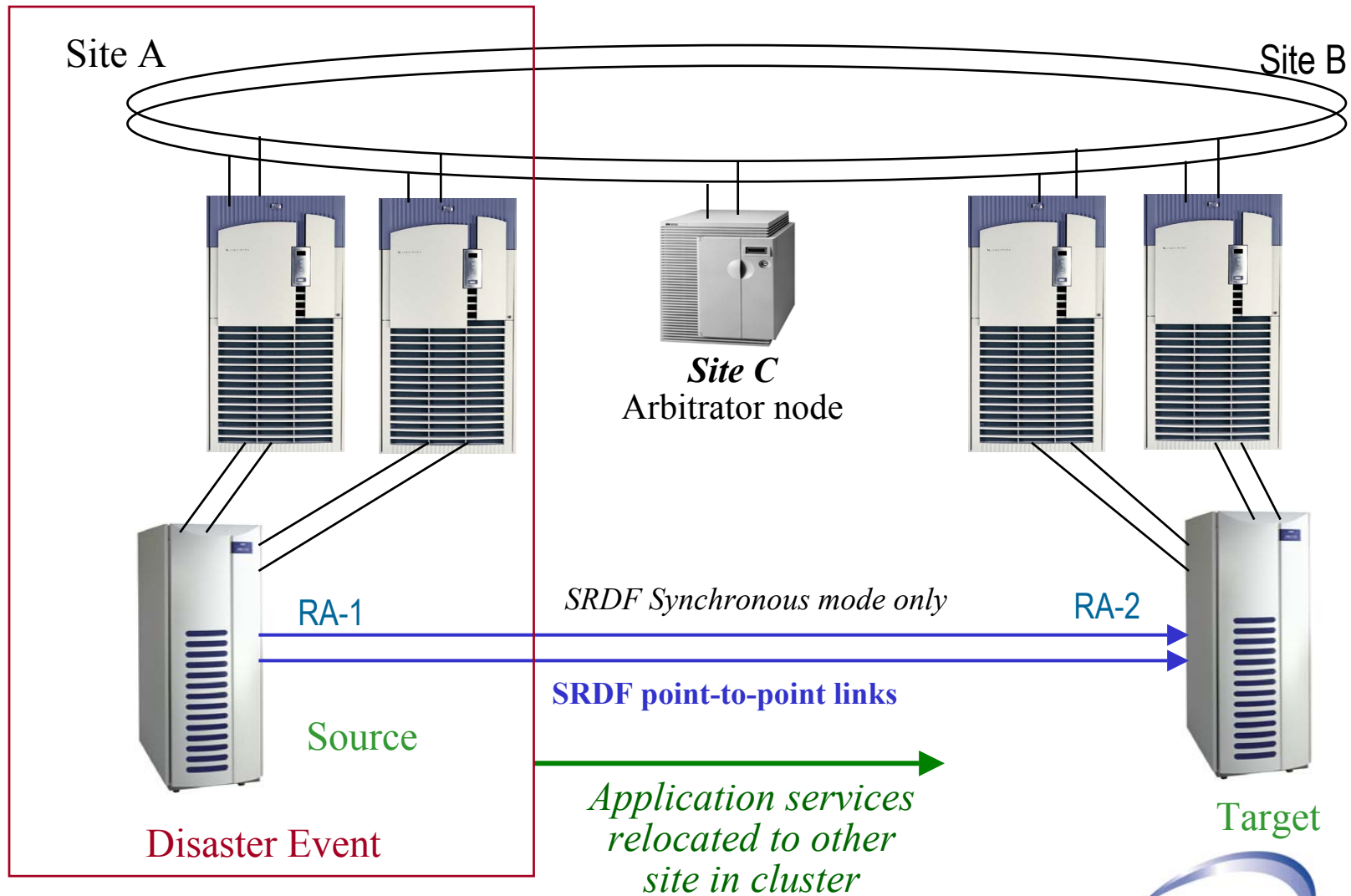
Integrated Cluster Solutions for unattended failover



Cost of inaccessibility escalates quickly over time

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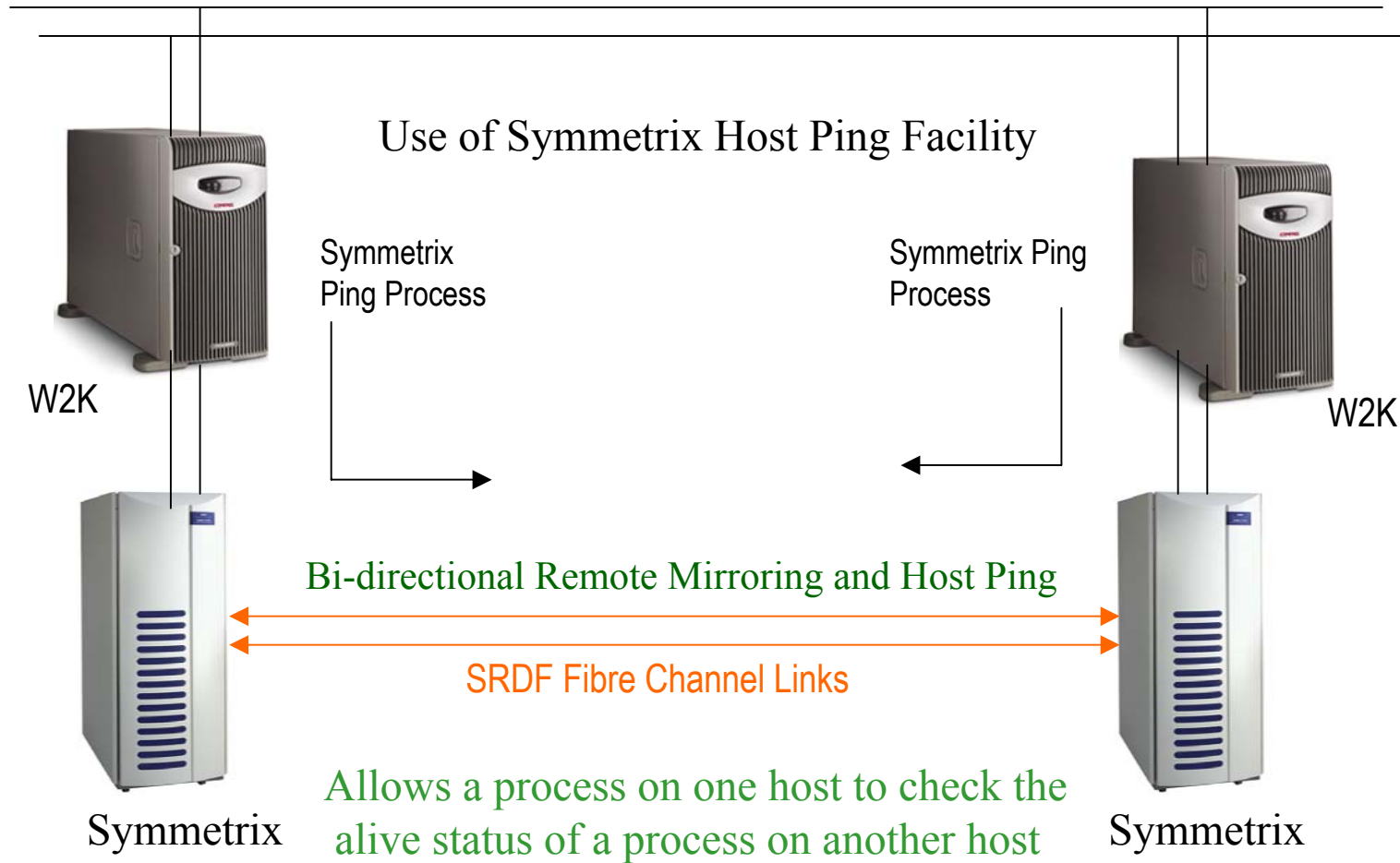
HP MetroCluster with EMC SRDF



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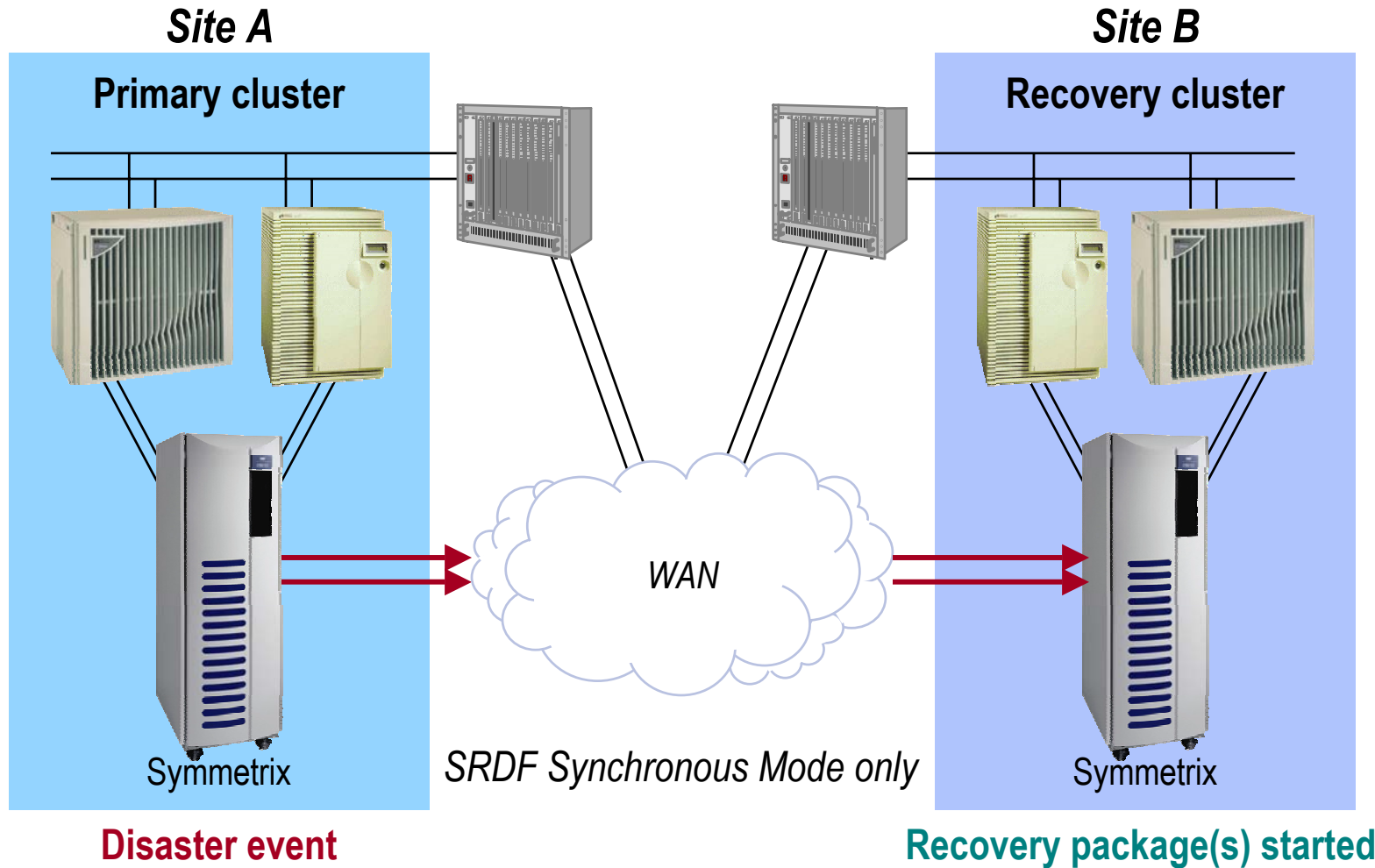
Legato Automated Availability Manager for EMC SRDF

Heartbeat Connection



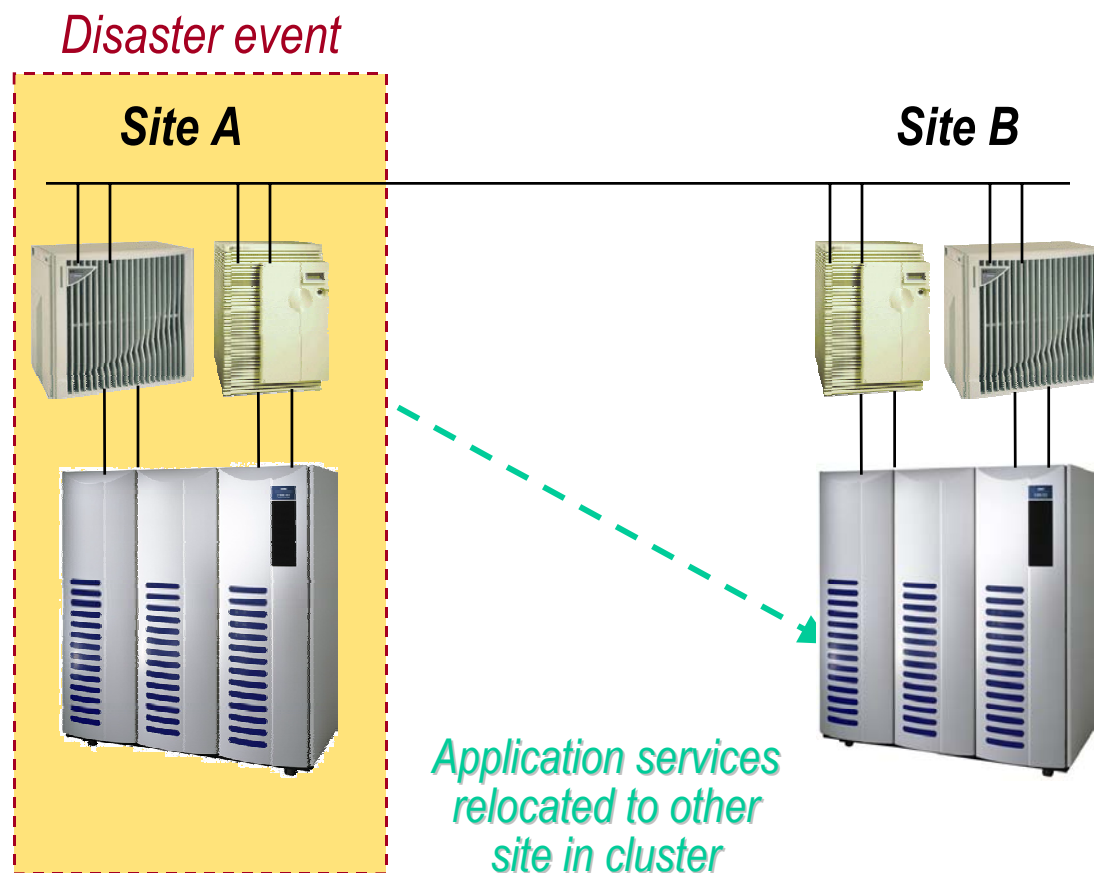
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HP ContinentalClusters with EMC SRDF



Remote Data Mirroring Solutions

HP Campus Cluster using HP MirrorDisk/UX



Remote Data Mirroring Solutions

- Advantages of automatic and semi-automatic site failover solutions
 - Rapid site recovery with no manual intervention
 - Not prone to human error during recovery process
 - Downtime avoided during off-hours periods
 - Middle of the night events in which there is minimal staffing
 - Integrated, tested, and supported solution
 - Engineered for end-user environment
 - Distances beyond that of a single datacenter
 - Tolerances beyond a single site or campus environment

Disaster tolerant solution to meet minimal downtime requirements

Remote Data Mirroring Solutions

- Important considerations when choosing a remote mirroring solution:
 - Synchronous or asynchronous operation
 - Importance of data currency
 - Requires currency up to the last committed transaction?
 - Tolerances to some data loss?
 - Support for failback process
 - Manageable resynchronization process
 - Full-copy or changed tracks/blocks
 - Ability to maintain changed data information if second fault event occurs
 - Recoverability of data at the remote location
 - Ability to roll forward committed and rollback uncommitted transactions
 - Available with physical and logical mirroring solutions
 - Use of non-synchronous mirroring may result in data loss

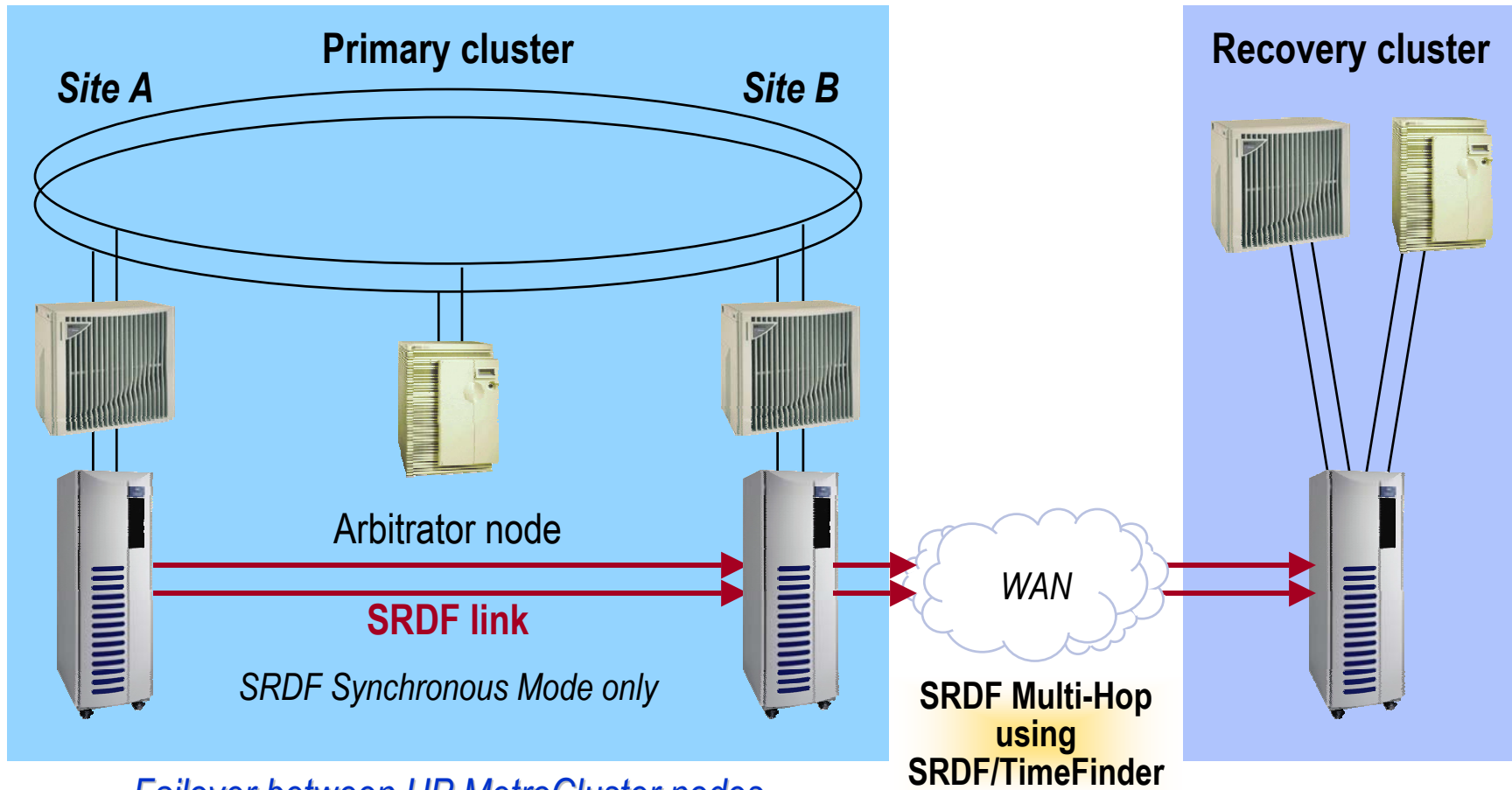
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- Other remote data mirroring options:
 - Point-in-time copies
 - Remotely mirror copies of point-in-time data
 - Addresses network costs since mirror is point-in-time
 - » Requires less network bandwidth since not real-time
 - Addresses I/O latency issues
 - » Extended distance environments
 - Database Redo-Log Mirroring
 - Remotely mirror redo-log files only
 - Addresses network costs as it requires less bandwidth

This can be most cost-effective approach for extended distance environments

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HP Continental Clusters with EMC SRDF



Failover between HP MetroCluster nodes

Example of using point-in-time mirroring to address network costs and mirror I/O delay

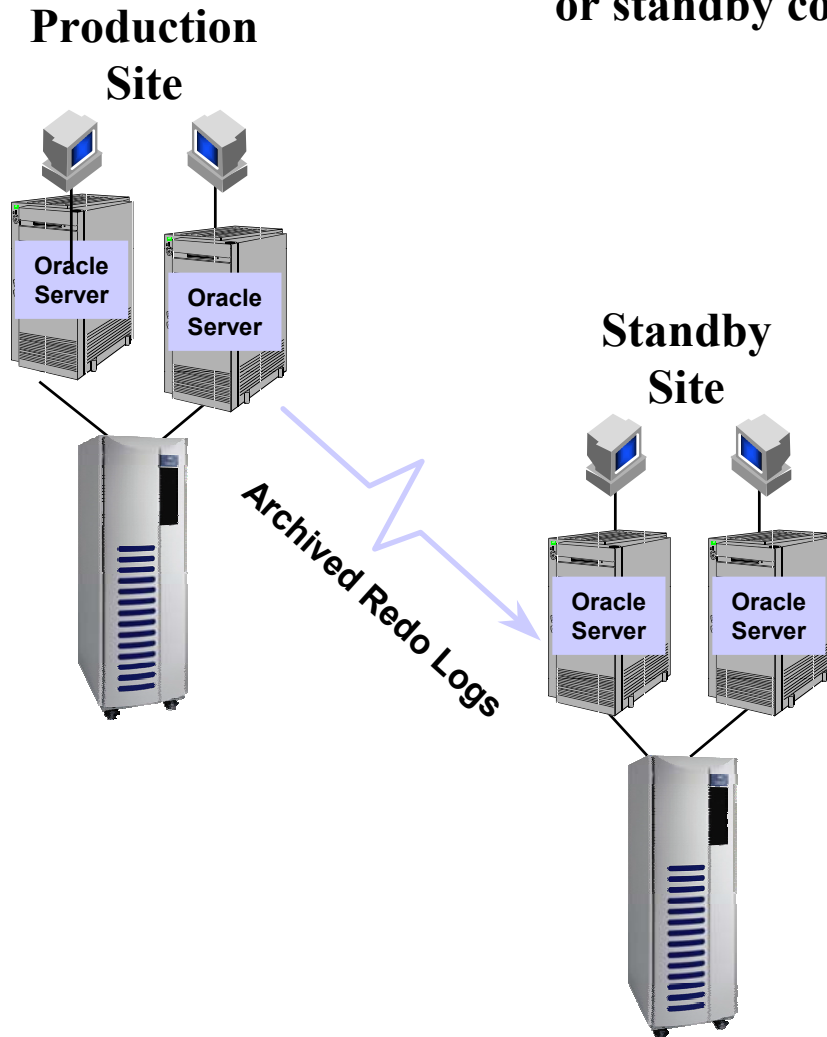
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Benefits of using Point-in-Time Remote Mirroring

- The primary cluster provides automatic site failover locally
 - Rapid recovery of mission critical environment up to last committed transaction
- Extended distance mirroring with no application latency
 - Multi-Hop (Point-in-Time) mirroring operation performed independent of real-time processing
- Multi-Hop mirroring operation for changed tracks only
 - Symmetrix maintains invalid track information reducing resynchronization time
 - Also reduces switched network bandwidth requirements
- Allows for intercontinental mirroring of data
 - Can be used for data warehousing and DSS applications

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Standby database enables the creation and maintenance of a duplicate, or standby copy of your production database



- Streamlined management of standby databases and elimination of human error
- Automatic log shipping and application
- Rules to enforce consistency between production and standby database and correct failures
- Standby database can be opened read-only and used as a reporting system

Thank You

Questions?