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

- Software Failure 40%
- Planned Downtime 30%
- Environment 5%
- People 15%
- Hardware 10%

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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<table>
<thead>
<tr>
<th>Service</th>
<th>Cost of Downtime (Per Hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Brokerage</td>
<td>$6,450,000</td>
</tr>
<tr>
<td>Credit Card Sales</td>
<td>$2,600,000</td>
</tr>
<tr>
<td>800 # Promotions</td>
<td>$199,500</td>
</tr>
<tr>
<td>Catalog Sales Centers</td>
<td>$90,000</td>
</tr>
<tr>
<td>Airline Reservations</td>
<td>$85,500</td>
</tr>
<tr>
<td>ATM Service</td>
<td>$14,500</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Unavailability (minutes/year)</th>
<th>System Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000 (about 5 weeks)</td>
<td>90.0%</td>
</tr>
<tr>
<td>5,000 (About 3.5 days)</td>
<td>99.0%</td>
</tr>
<tr>
<td>500 (About 8 hours)</td>
<td>99.9%</td>
</tr>
<tr>
<td>50</td>
<td>99.99%</td>
</tr>
<tr>
<td>5</td>
<td>99.999%</td>
</tr>
</tbody>
</table>
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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 vendor’s 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

Site A

Site B

Site C
Arbitrator node

RA-1
Source

RA-2
Target

SRDF Synchnrous mode only

SRDF point-to-point links

Application services relocated to other site in cluster

Disaster Event

HP WORLD 2002 Conference & Expo
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Legato Automated Availability Manager for EMC SRDF

Heartbeat Connection

Symmetrix Ping Process
Symmetrix Ping Process

W2K

Use of Symmetrix Host Ping Facility

Symmetrix

Bi-directional Remote Mirroring and Host Ping

SRDF Fibre Channel Links

Allows a process on one host to check the alive status of a process on another host

Symmetrix

Symmetrix

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HP ContinentalClusters with EMC SRDF

Site A
Primary cluster
Symmetrix

Site B
Recovery cluster
Symmetrix

SRDF Synchronous Mode only
Disaster event
Recovery package(s) started

WAN
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HP Campus Cluster using HP MirrorDisk/UX

Disaster event

Site A

Site B

Application services relocated to other site in cluster
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- 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
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• 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 ContinentalClusters 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?