



# Leveraging HP StorageWorks XP enterprise storage on HP NonStop servers

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# Agenda

- Terminology
- What is enterprise storage?
- How enterprise storage is used on an HP NonStop server
- How HP NonStop Remote Database Facility (NonStop RDF) software leverages enterprise storage



# Cluster terminology

- HP Metrocluster for NonStop servers
  - Metrocluster allows NonStop servers to be geographically separated for disaster tolerance
  - ServerNet connections up to 15 kilometers (9 miles) and NonStop RDF/ZLT connections up to 100 kilometers (62 miles) are supported configurations
- HP Continentalclusters for NonStop servers
  - Continentalclusters allows systems to be geographically separated over unlimited distances through the use of NonStop RDF over Expand networking for the ultimate in disaster tolerance

# Disaster tolerant solutions for the NonStop server



Solution	Benefit	Data replication	Comms	Storage	Distance	Time
Basic disaster recovery	Low-cost entry level	Tape backup or electronic vaulting	LAN, WAN	Any storage	Unlimited	1–7 days
Metrocluster with ServerNet	Local failover	NonStop RDF Host-based disk replication	ServerNet, DWDM, Fibre Channel	Internal disk StorageWorks XP	15 km	1–60 minutes
Metrocluster with remote disk	Regional failover	NonStop RDF Host-based disk replication	DWDM, Fibre Channel, FC over WAN	Internal disk Remote StorageWorks XP	StorageWorks XP—100 km	1–60 minutes
Continentalcluster S	Unlimited distance failover	NonStop RDF	WAN	Any storage	Unlimited	1–60 minutes

# Disk terminology

- NonStop disk volume—This is also called a “disk,” and it can be mirrored or nonmirrored
  - If nonmirrored, this is only \$Disk-P
  - If mirrored, this is made up of \$Disk-P and \$Disk-M
- LDEV (logical device)—This is a single *virtual disk image* within the XP that maps to what has traditionally been called a “disk” on the NonStop server and is given a name like \$Disk-P or \$Disk-M
- Logical unit number (LUN)—The path to a host group on an XP port
  - Two LUNs per XP LDEV, the primary and the backup (for example, \$Disk-M and \$Disk-MB)

# RAID—Redundant Array of Independent Disks



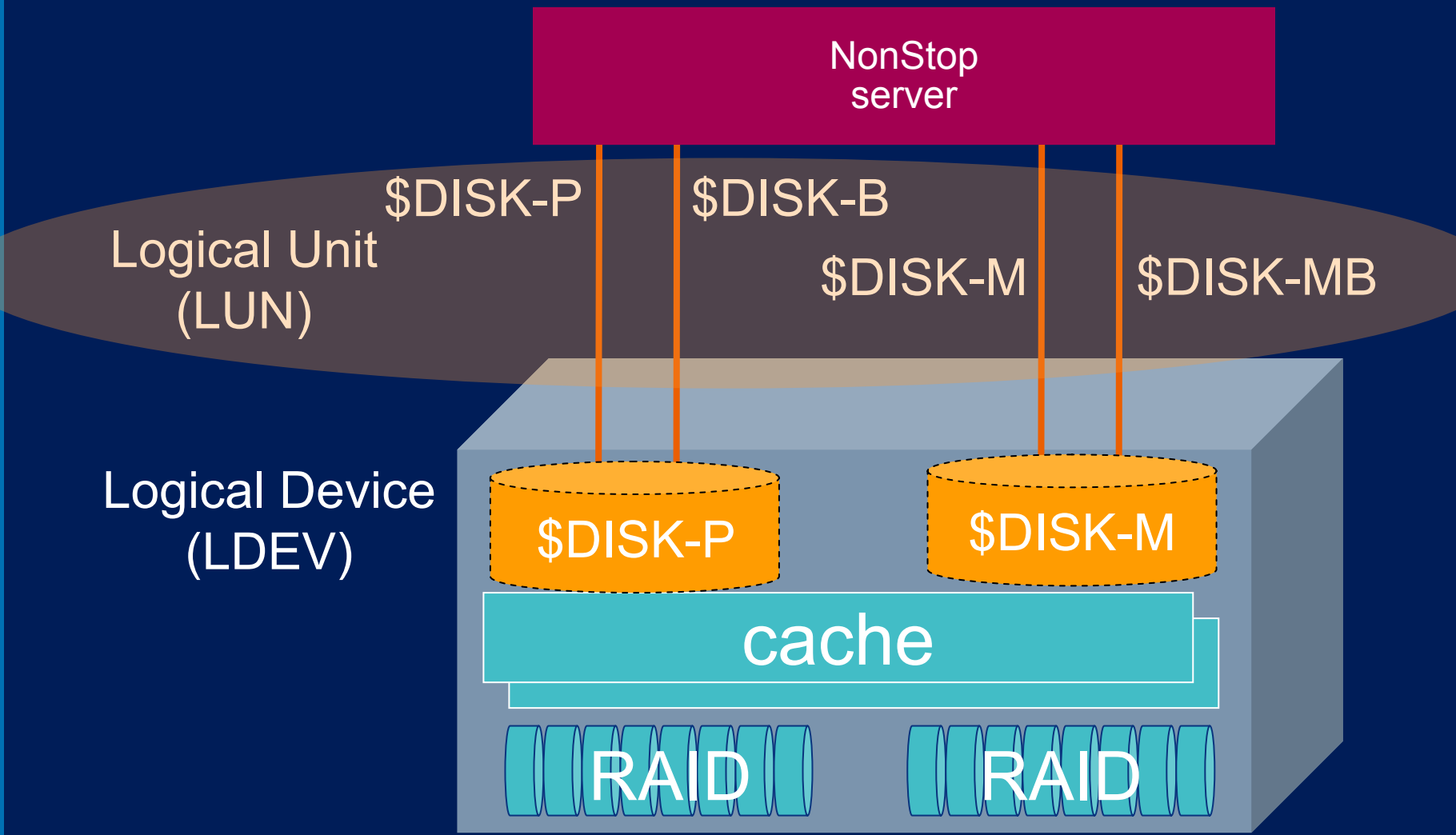
- RAID 1—Traditional mirroring
  - Two drives for each LDEV
- RAID 5—Level 5 provides data striping at the byte level and also stripe error correction information, resulting in excellent performance and good fault tolerance
  - Level 5 is one of the most popular implementations of RAID

# Enterprise storage system



- Storage system with intelligent firmware
  - Highly available, with terabytes of storage
  - Multiplatform support
- Usually no data interchange between platforms

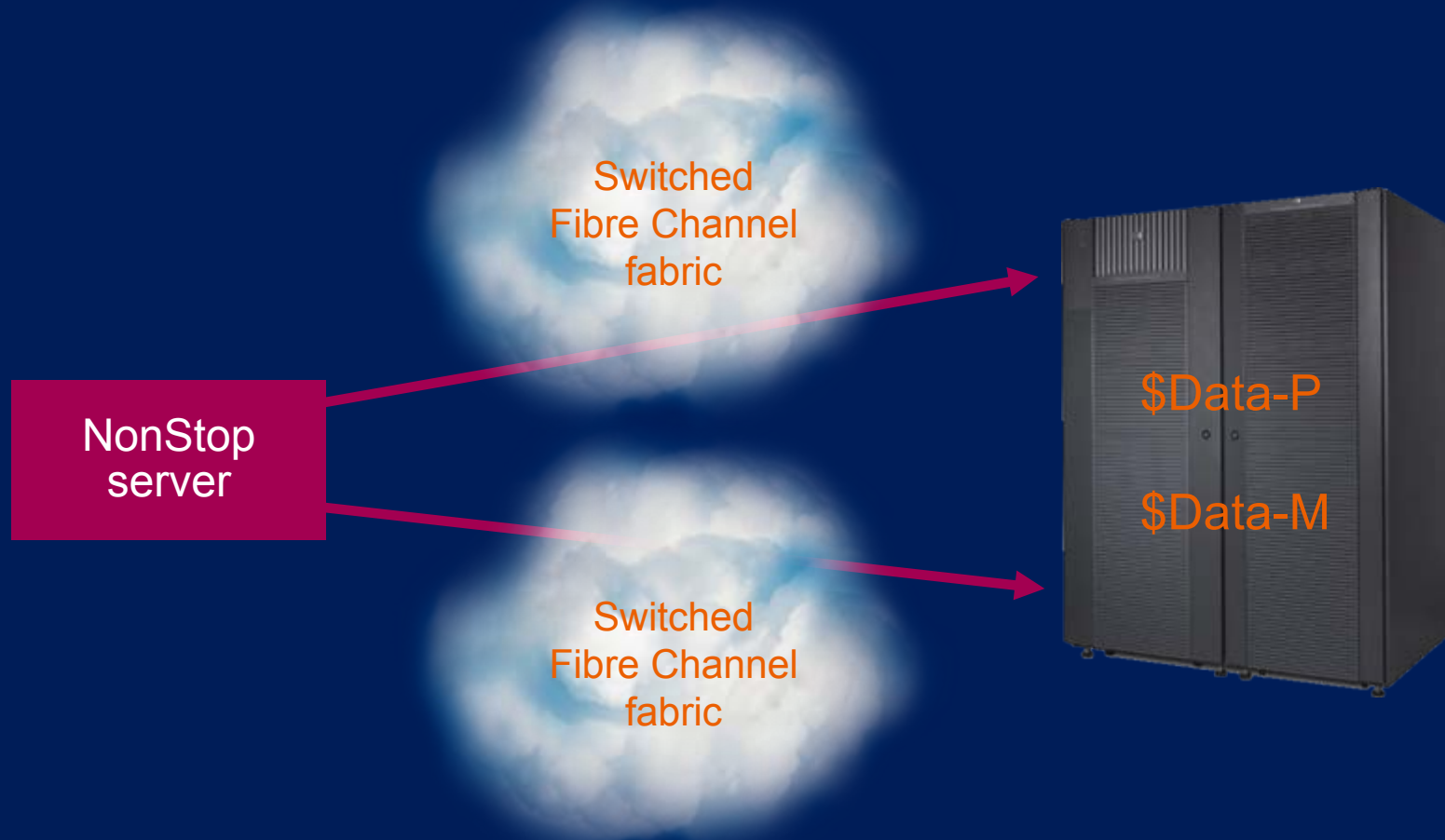
# LUN versus LDEV



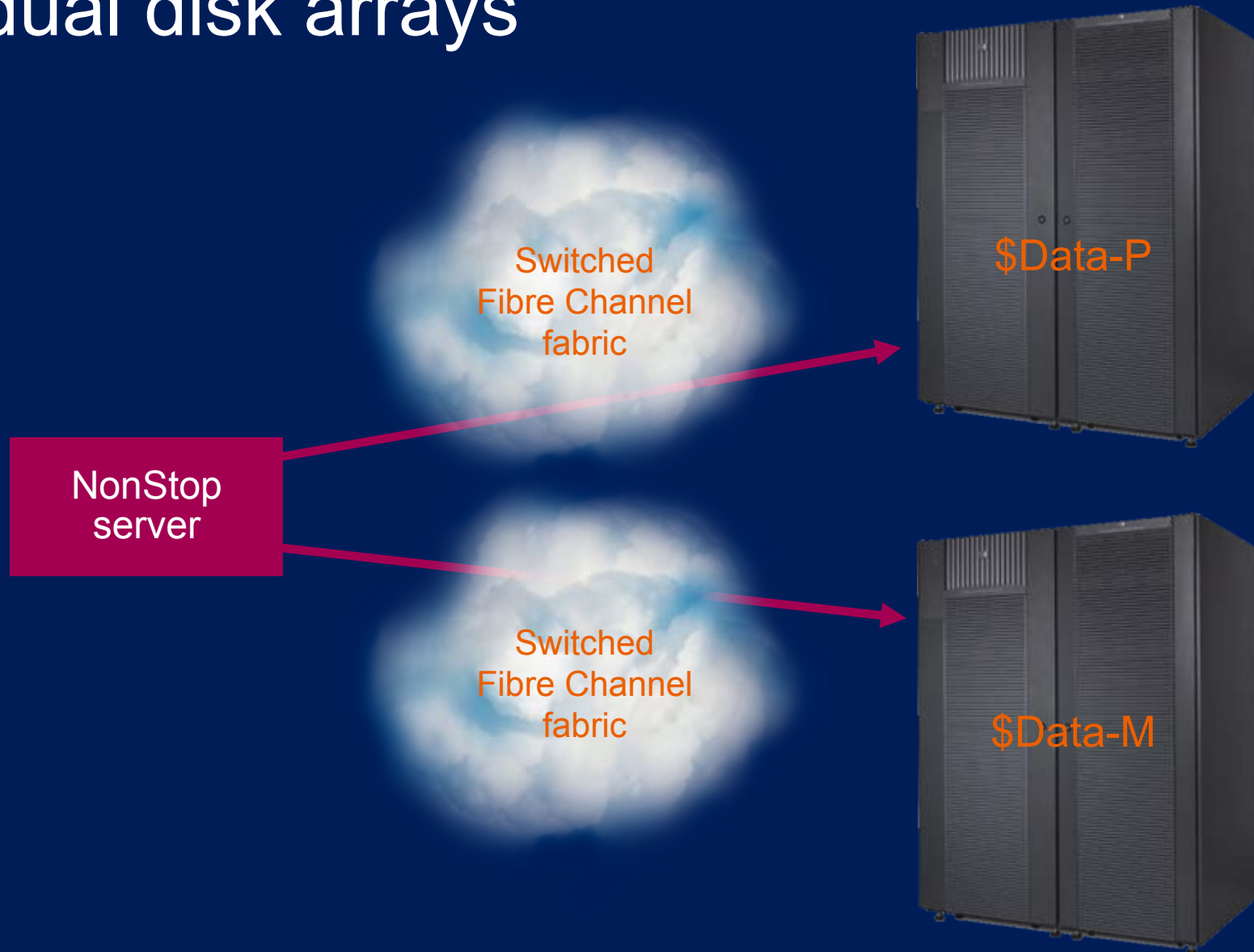
# How much mirroring is enough?

- Host-based mirroring (\$Disk-P, \$Disk-M) on enterprise storage is strongly recommended
  - Host-based mirroring provides better protection against connection path and enterprise storage problems, taking full advantage of error recovery of NonStop system-based mirroring, whether using one or two enterprise storage disk arrays.
- One StorageWorks XP may be sufficient per site because it is fully fault tolerant
  - Customers need to understand their level of risk acceptance

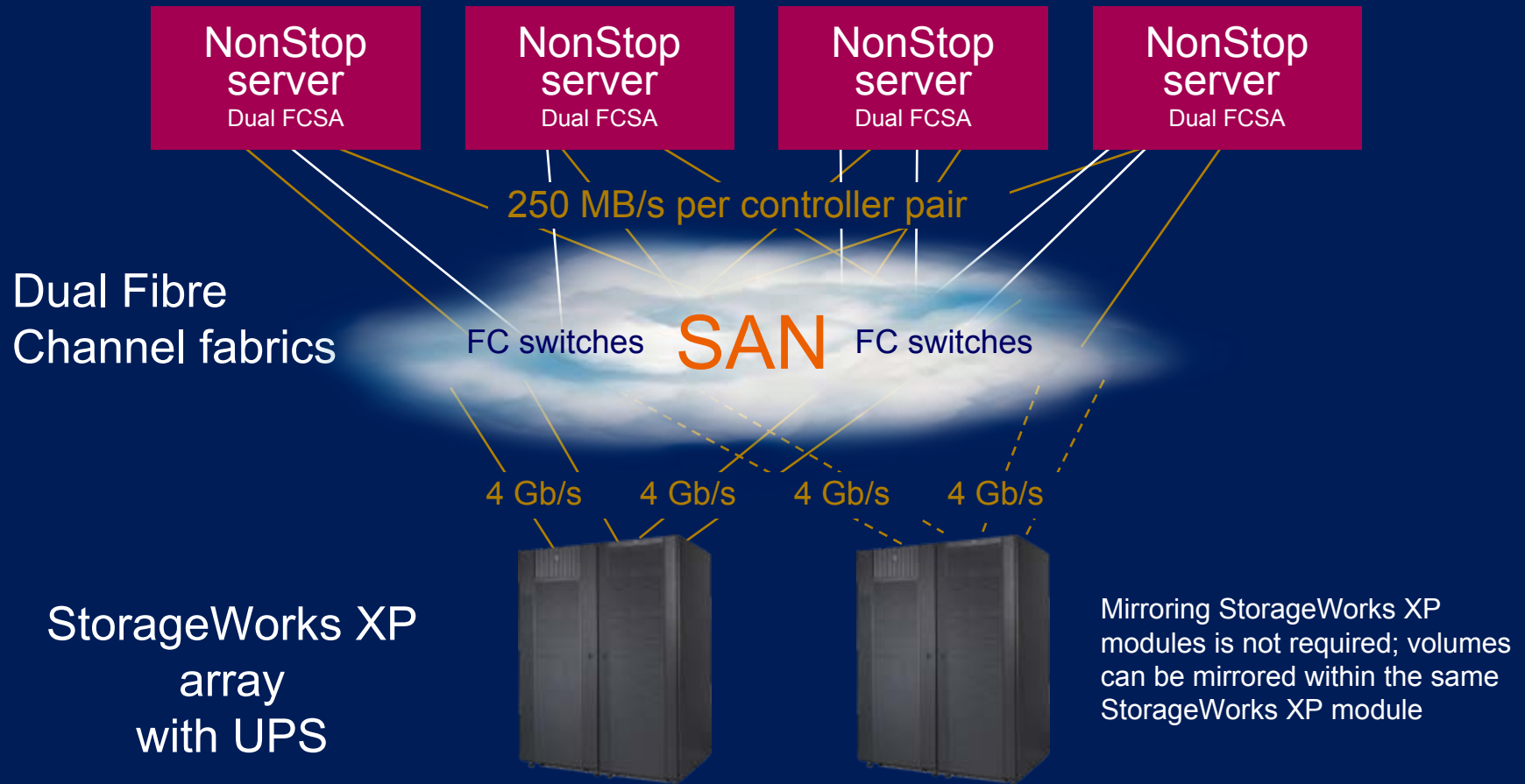
# Host-based mirroring – one disk array



# Host-based mirroring – dual disk arrays



# NonStop SAN architecture



**HP StorageWorks XP enterprise storage**

# How enterprise storage is used on a NonStop server



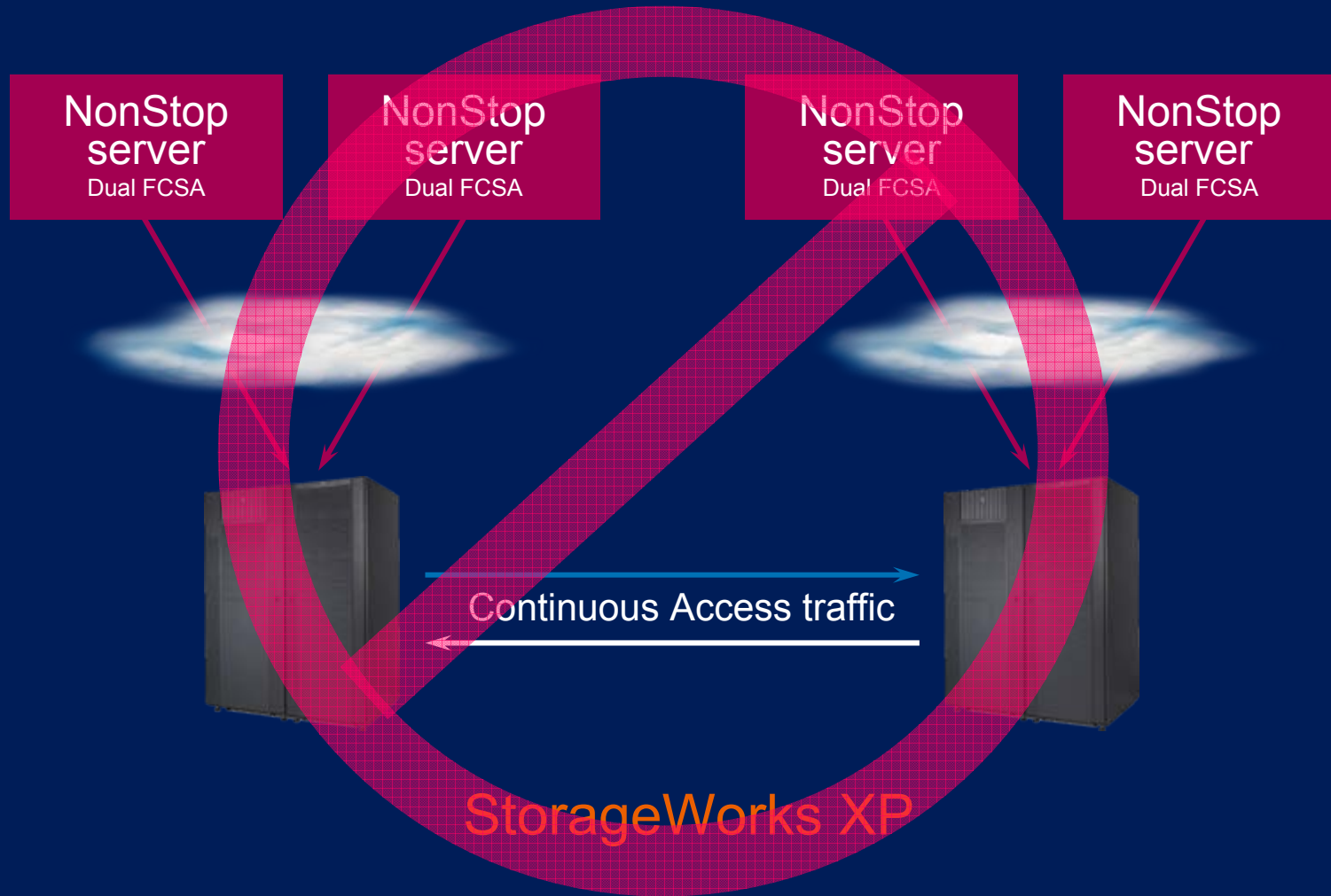
- Only one server can mount an XP LDEV at a time
  - No loss of functionality; two NonStop servers could never mount the same internal disk at the same time either
  - Two systems still can open the same file using remote access over HP Expand networking software
- NonStop RDF/Zero Lost Transactions software leverages enterprise storage for disaster tolerance

# How enterprise storage is used on a NonStop server



- As with a traditional (internal) disk, a volume must be cleanly dismounted from one system before it can be mounted on another system
  - All files on the volume closed, volume disabled in NonStop TMF, disk cache flushed, and volume removed through Subsystem Command Facility (SCF)
- Business copy is minimally supported—the application must be quiesced just as if you are using the “backup” program
  - NonStop TMF cannot make a disk snapshot transactionally consistent

# Continuous Access is not supported for NonStop server volumes



# How enterprise storage is used on a NonStop server



- When a system crashes, for whatever reason, the disks mounted on it **cannot** be switched to a different system—most of the time
  - When a system is restarted after a crash, NonStop TMF automatically recovers disk volumes and the audited files on them using the audit trails
  - NonStop SQL keeps system-specific information in its files
  - There is an SQL/MP fix-up utility to adjust the embedded names if you want to move a disk to a system with a different node number

# How enterprise storage is used on a NonStop server



- You could switch the system's entire disk configuration—including the NonStop TMF audit volumes—to another system with the same node name/number and bring up the original NonStop TMF configuration to start volume recovery.

# Can I mirror my entire disk configuration remotely?

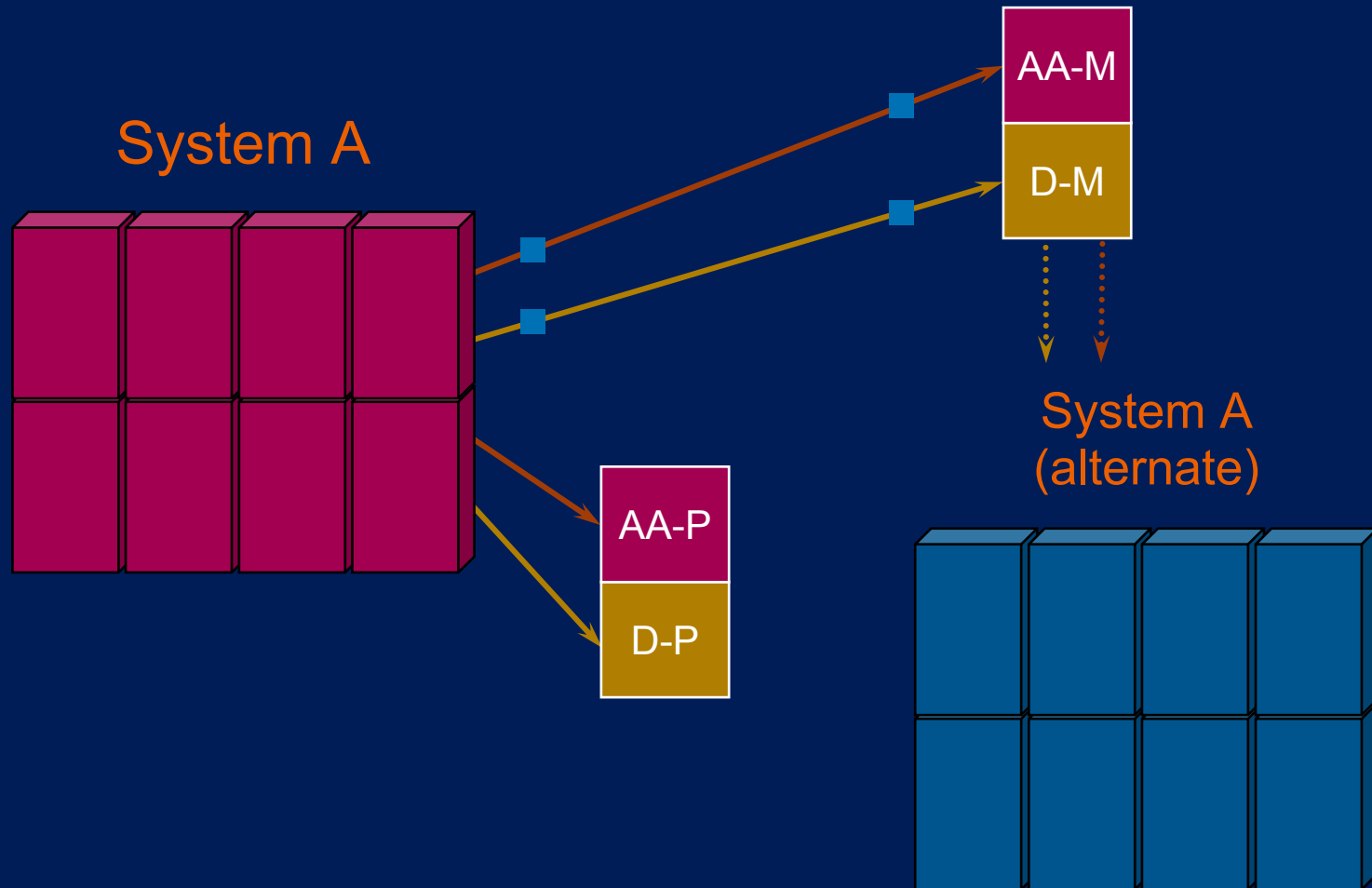


# Remember Nomadic Disk?

February 11, 2005

- HP announces the end of sales of the Nomadic Disk technology for HP NonStop S-series servers. Nomadic Disk technology was first introduced in 1995 for use with NonStop K-series servers.
- The functionality of Nomadic Disk is available through the use of HP StorageWorks XP Disk Array.

# Can I mirror my entire disk configuration remotely?



# Can I mirror my entire disk configuration remotely?



- If you mirror your entire disk configuration remotely, it could be switched to another system if the primary system fails; however...
  - The target system must have same node name/number
  - Substantial communications bandwidth is required
  - Information is sent twice: database files and NonStop TMF audit trail

# Can I mirror my entire disk configuration remotely?



- Even a 10-second communications outage could have catastrophic consequences because you have to revive all your mirrors (smart revive can mitigate this somewhat)
- Losing one remote mirror before a total failure can make your entire database unrecoverable
- NonStop TMF will perform volume recovery on system startup
  - If NonStop TMF needs a dump tape to complete volume recovery, where is it?
- How often would you exercise the failover process?

# Steps to switch an entire disk configuration

1. Stop applications on the backup system
2. Stop NonStop TMF
3. Stop operating system
4. Rename system
5. Start operating system
6. Switch disks to the backup system
7. Start NonStop TMF with the configuration from the failed system
8. Volume recovery by NonStop TMF
9. Integrate existing disks into the moved NonStop TMF configuration
10. Integrate both systems' tables into the same NonStop SQL catalog
11. Reconfigure NonStop TMF tape catalog if necessary
12. Take new online dumps
13. Bring up applications

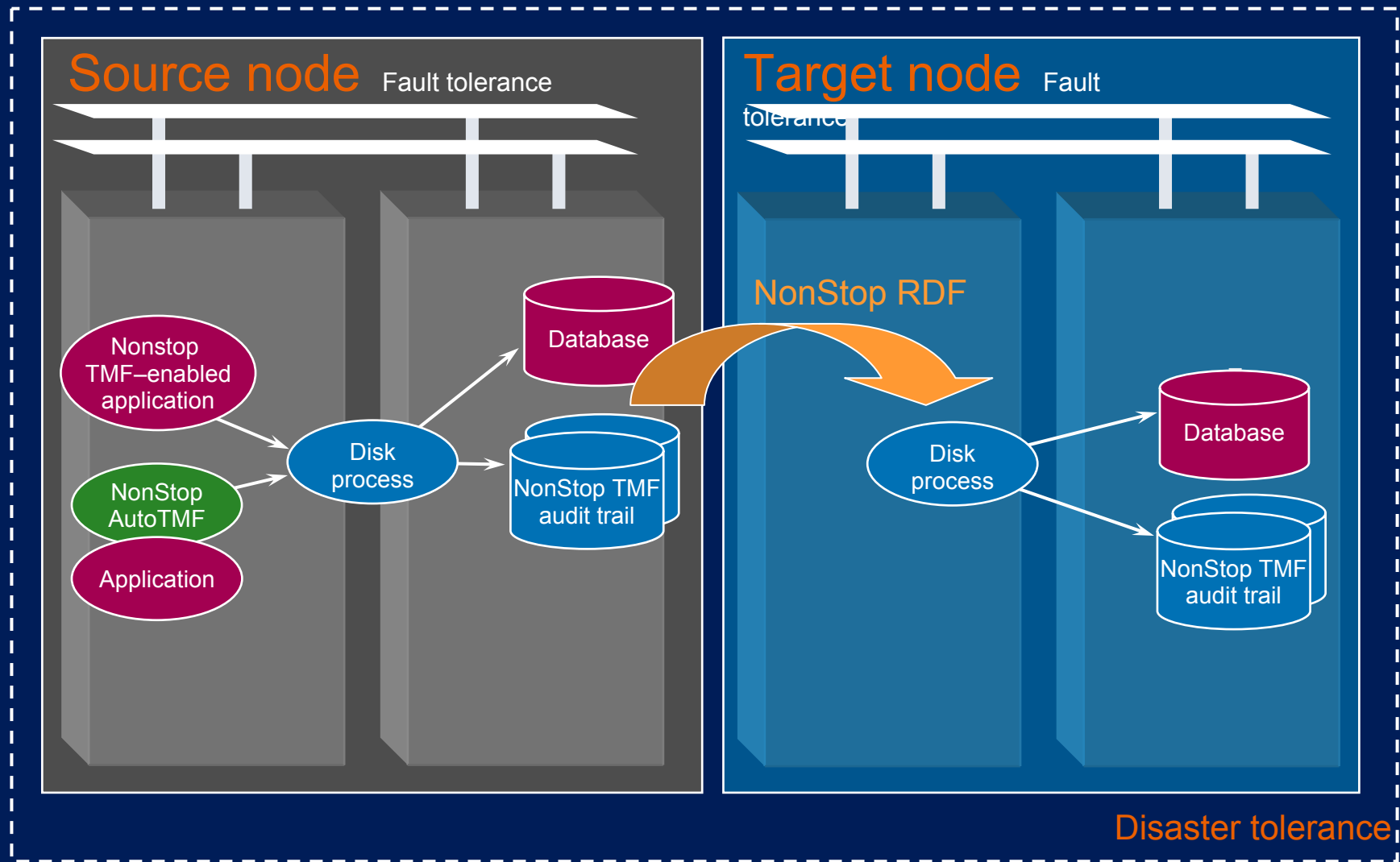


There must be an easier way for another system to take control of my database after a system or site failure

# There is: NonStop RDF software

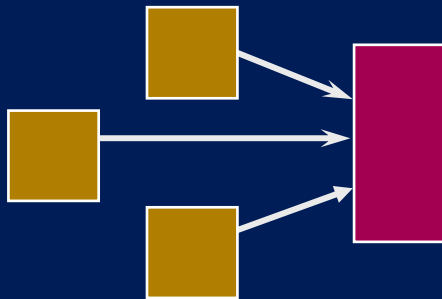
- High-speed, low-latency database replication software
- Peer-to-peer replication for NonStop servers only
- Focused on disaster tolerance
- Uses low-level system interfaces

# NonStop TMF and NonStop RDF software: Unbeatable for NonStop system-to-system replication

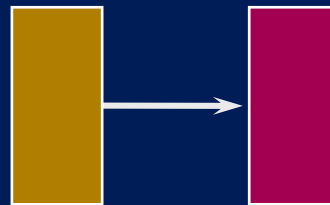


# Some NonStop RDF topologies

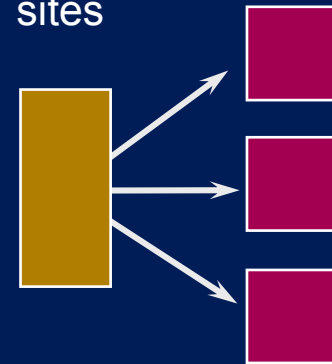
Centralized



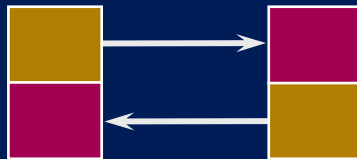
Simplex



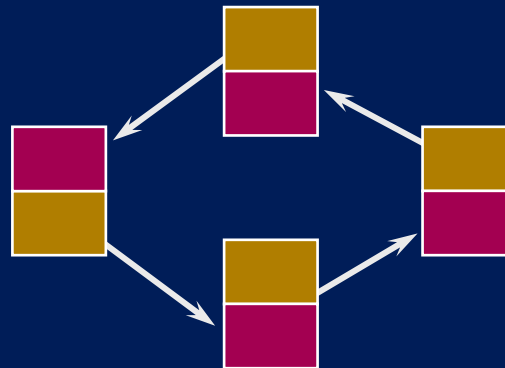
Multiple duplicate sites



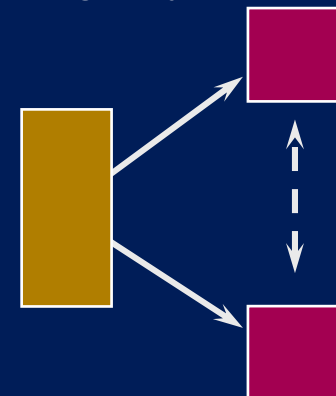
Reciprocal/  
split workload



Ring



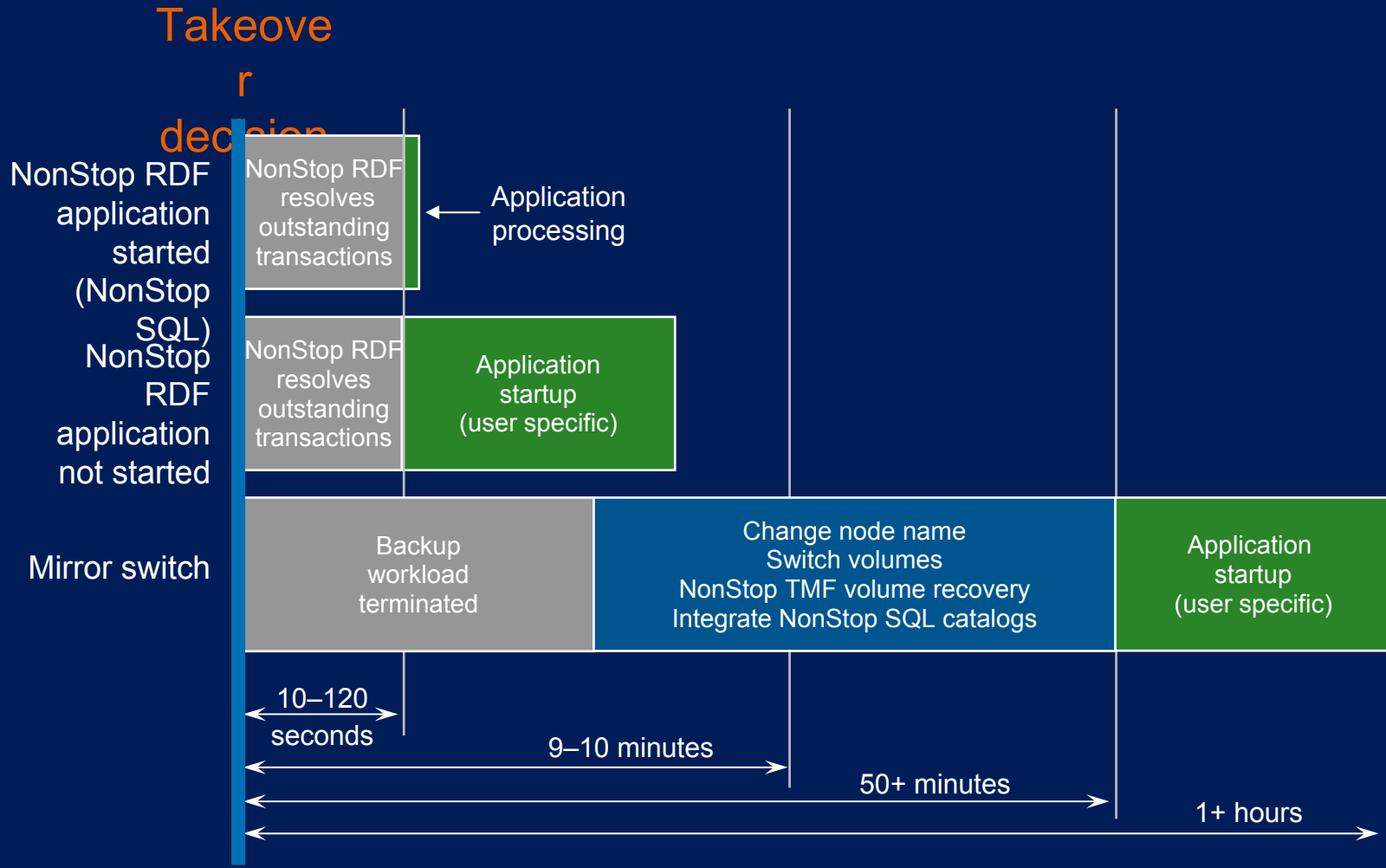
Triple contingency



# NonStop RDF failover

1. Issue NonStop RDF takeover command
2. Start applications

# Backup system takeover timeline





NonStop RDF/ZLT  
software leverages  
enterprise storage.

# The issue of “lost” transactions

- All asynchronous replication products (including NonStop RDF) are vulnerable to losing some transactions if there is an unplanned outage of the primary system
  - Some have lower latency than others
  - NonStop RDF has the lowest latency in the NonStop system environment because parts of it are built into the operating system
- Synchronous or lockstep replication
  - Guarantees no loss of transactions
  - Increases commit response times
    - Transaction cannot commit until data is committed in backup database
    - Greater distance = greater latency = lower TPS

# Our solution: NonStop RDF/ZLT

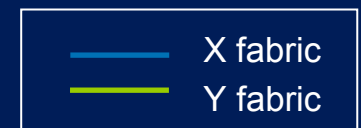
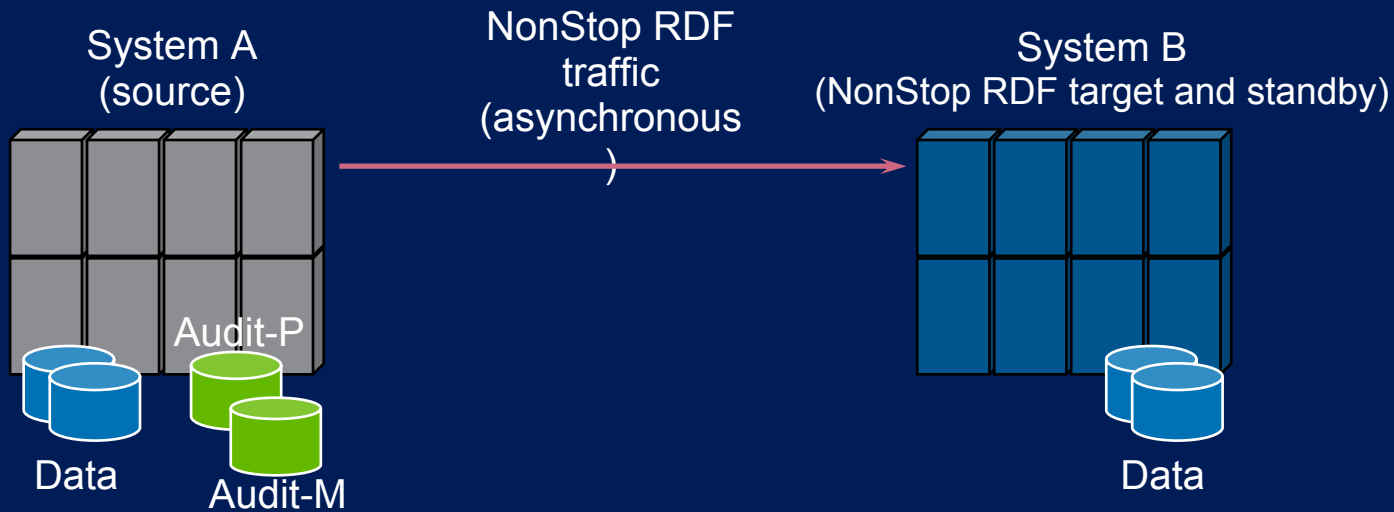
- A new member of the NonStop RDF family, NonStop RDF/Zero Lost Transactions (NonStop RDF/ZLT [SA88V1]) can eliminate the loss of committed data even after an unplanned outage—without any application changes
- NonStop RDF/ZLT software was shipped on June 1, 2004
  - HP Services must be involved in planning and configuration

# How NonStop RDF/ZLT leverages StorageWorks XP

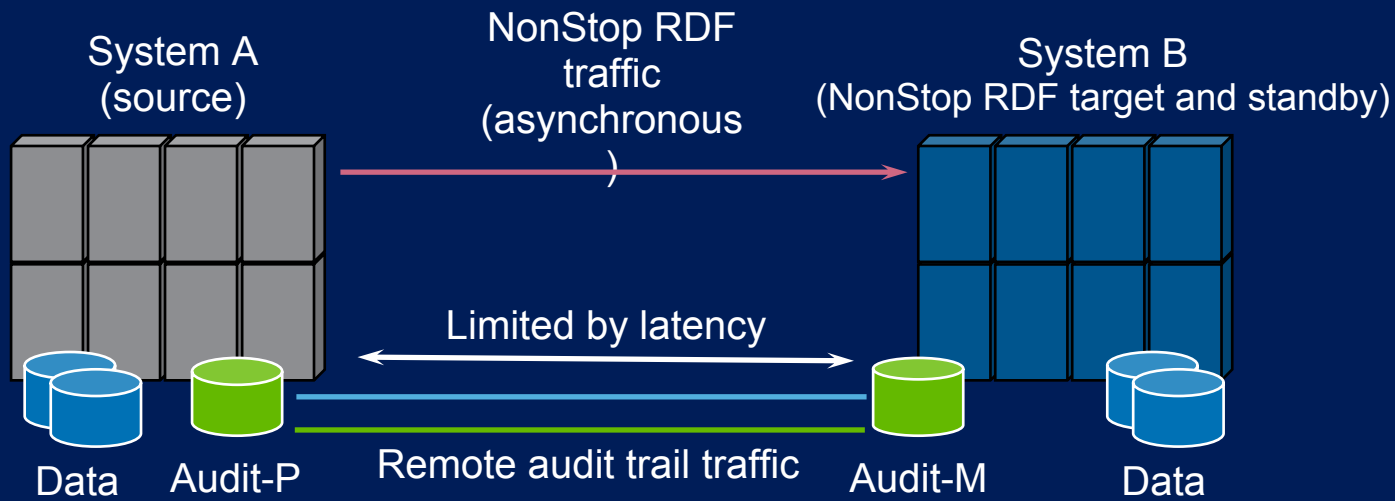


- For each audit trail volume in the NonStop RDF configuration, one of the two disk mirrors making up the volume is located remotely from the system it is protecting
- NonStop RDF standby system
  - Can be a third system
  - Can be the target system itself
  - Caveat: The audit trail volume names must be unique across the source and standby systems
- The distance from system to remote volume is dictated by the customer's latency and throughput requirements—  
There is no change up to 100 kilometers (62 miles)
- If the standby system is not the target system, there is no distance limit for location of the target

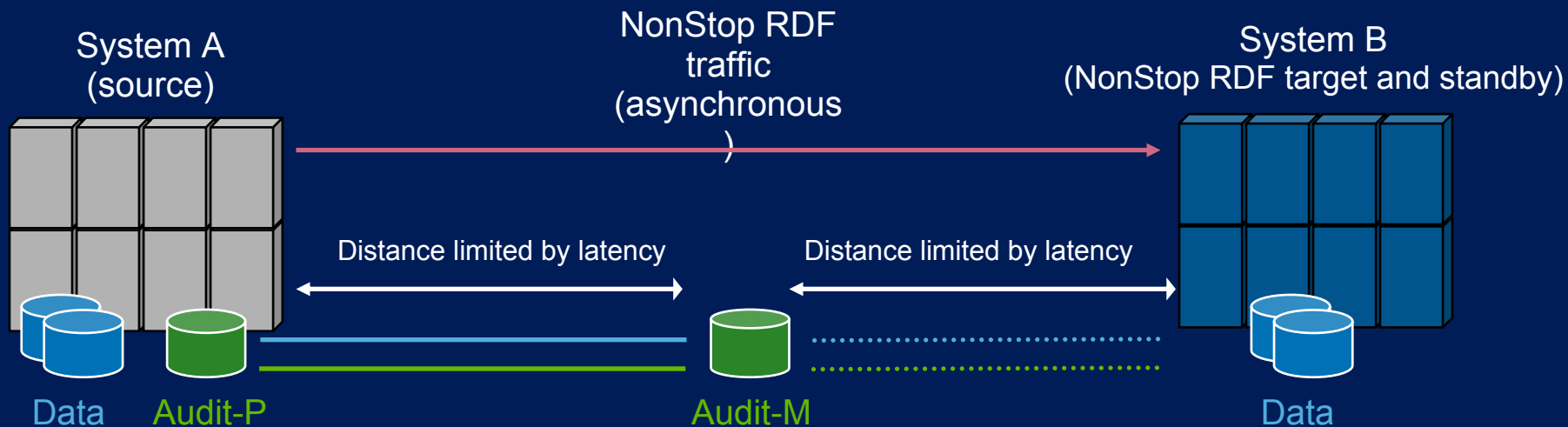
# NonStop RDF without ZLT configuration



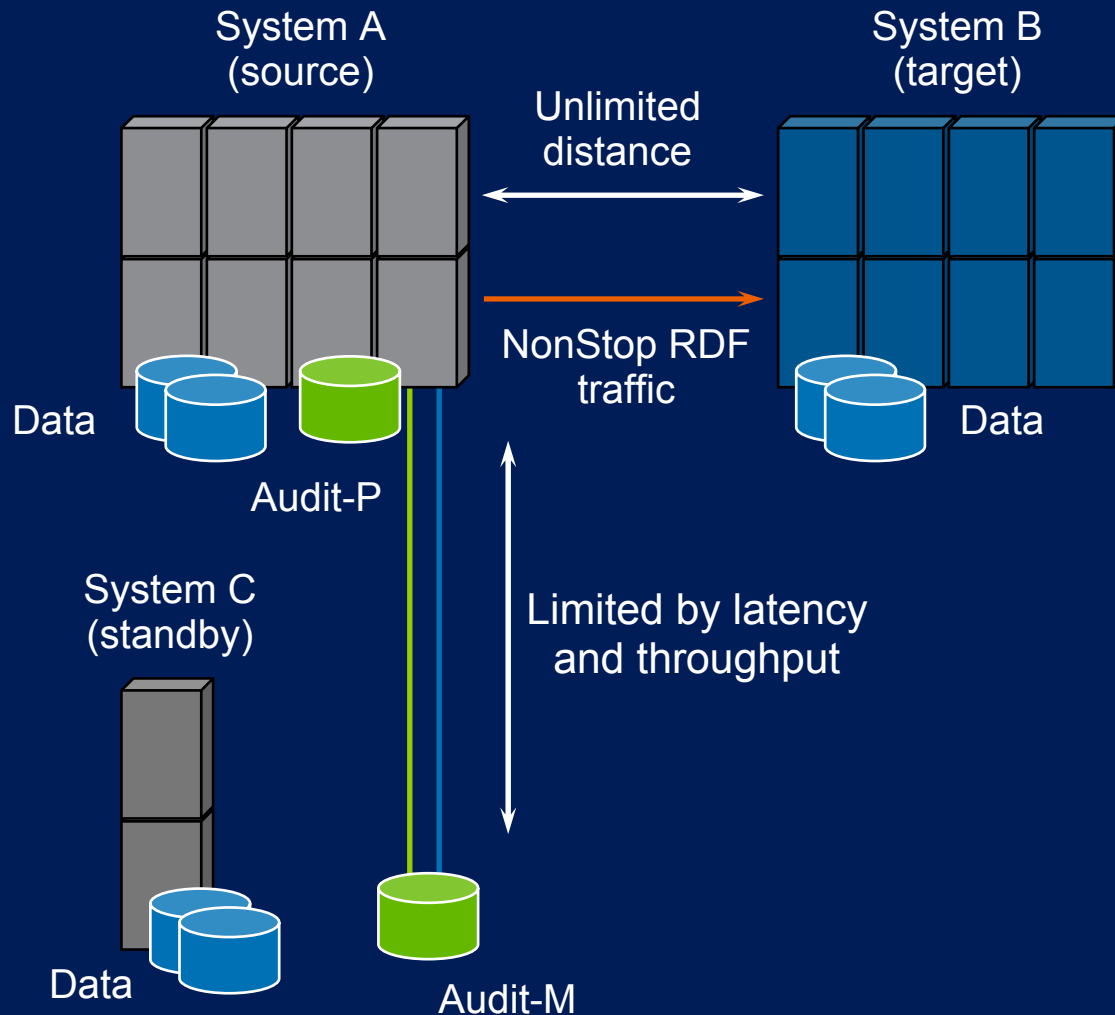
# NonStop RDF/ZLT moves the audit mirror to the backup site



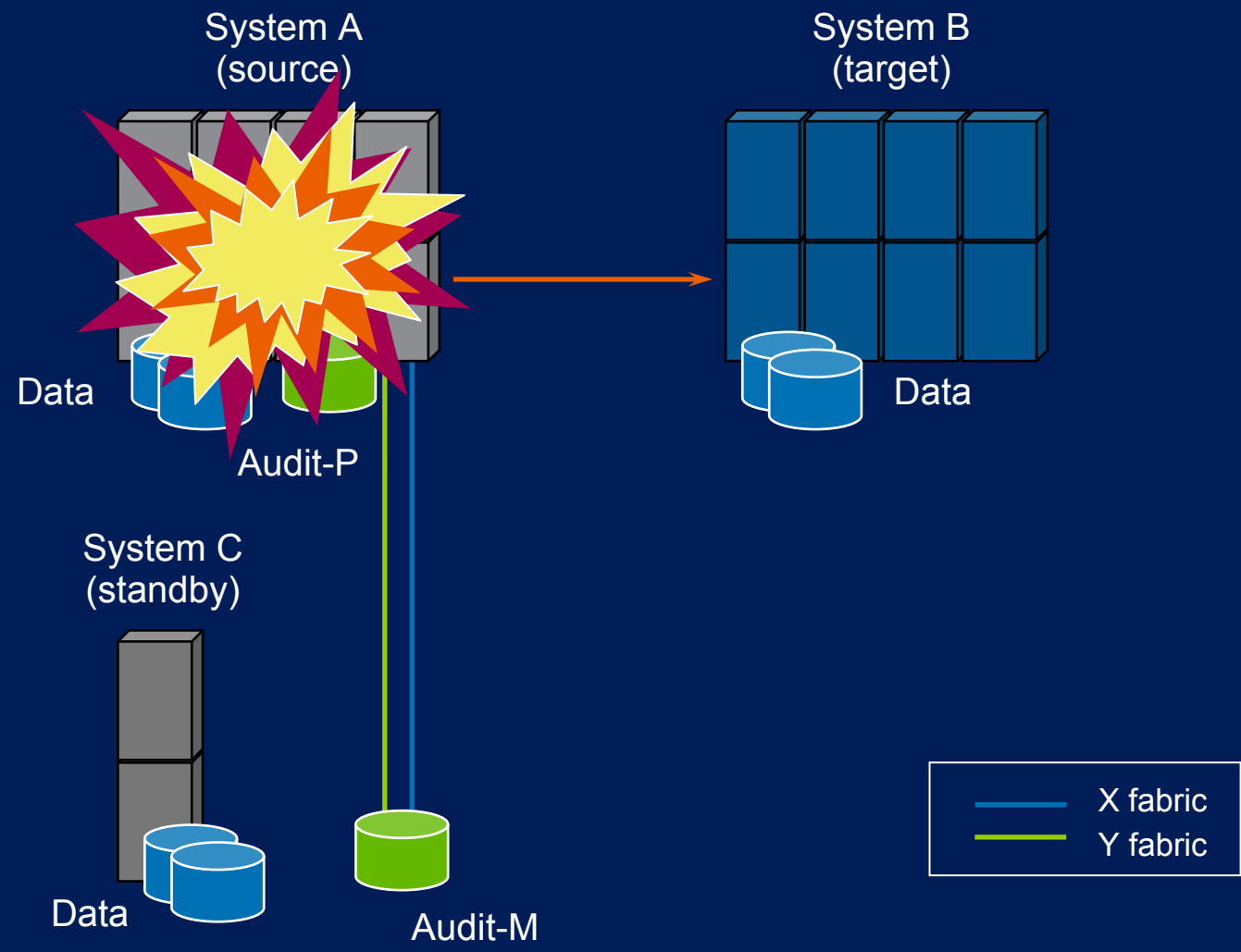
# NonStop RDF/ZLI moves the audit mirror to a location in between the sites



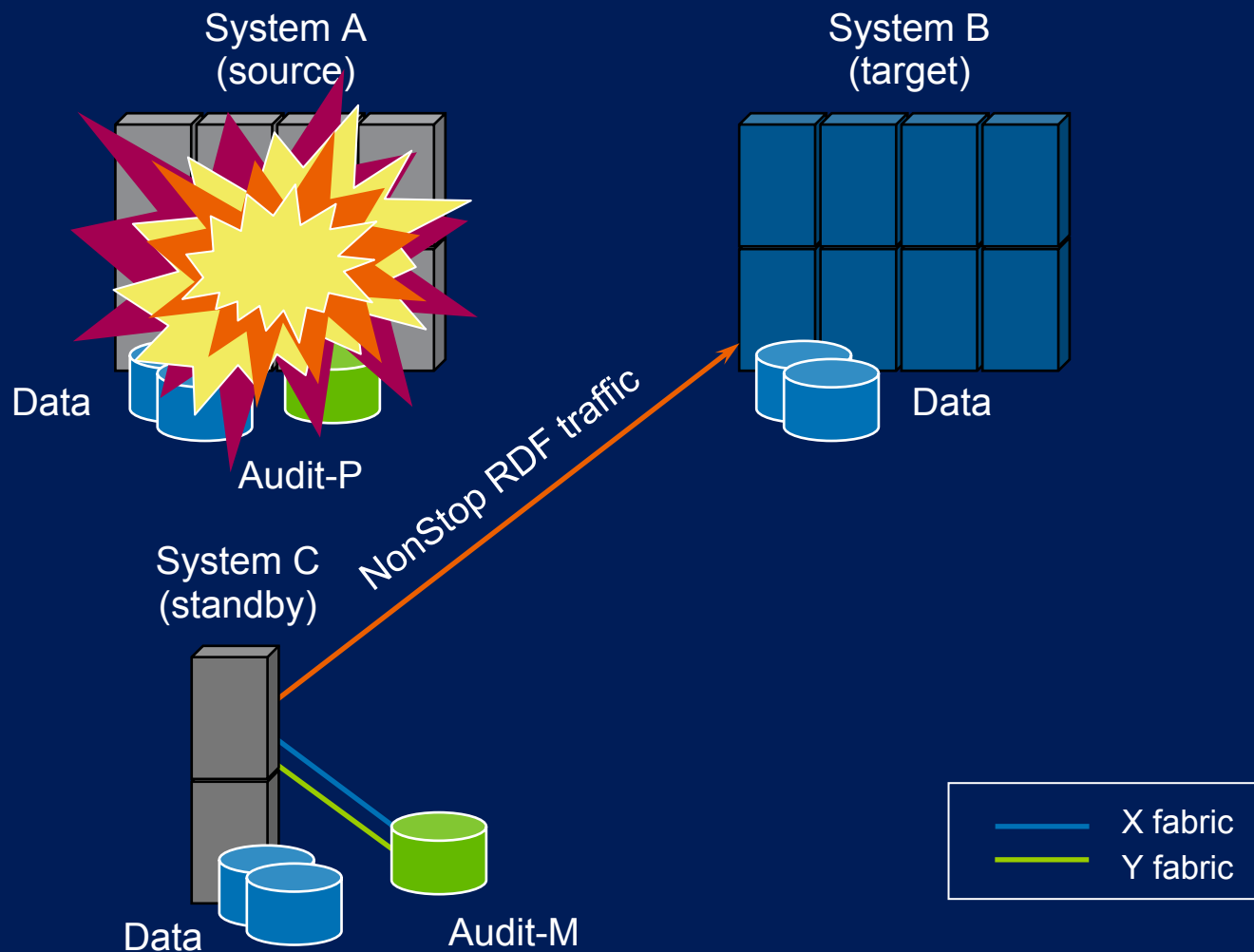
# NonStop RDF/ZLI remote mirror with third system as standby: Normal processing



# NonStop RDF/ZLI remote mirror with third system as standby: **Source system fails**



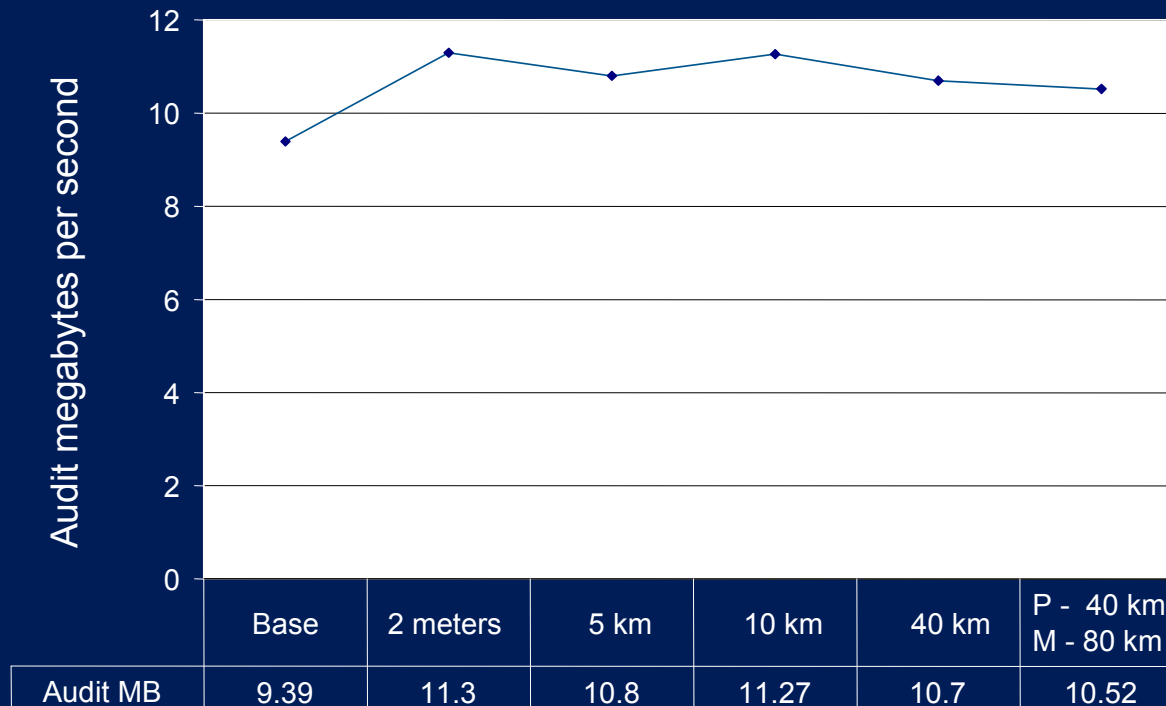
# NonStop RDF/ZLT remote mirror with third system as standby: NonStop RDF recovers in-flight transactions



# NonStop TMF audit trail performance

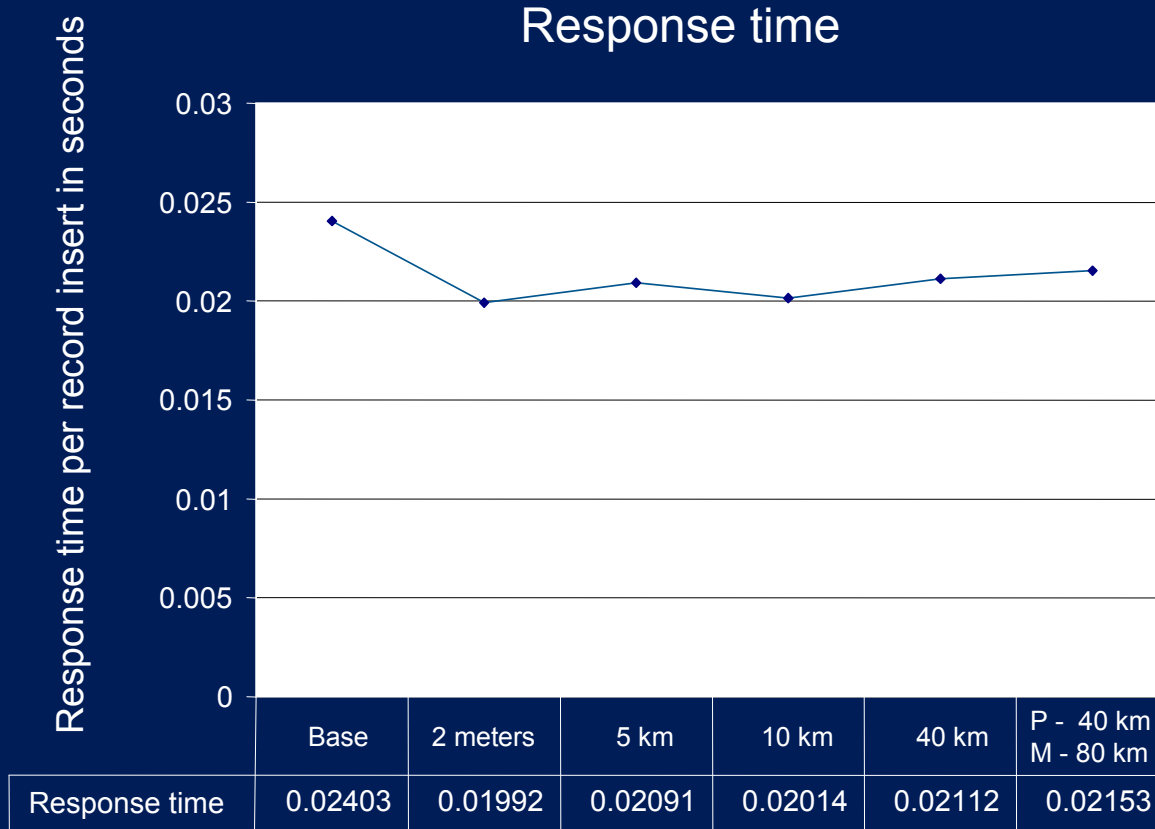


Audit generation in MB/s



Disclaimer: Future product plans, dates, and functionality are subject to change without notice.

# NonStop TMF audit trail performance



Disclaimer: Future product plans, dates, and functionality are subject to change without notice.

# NonStop RDF/ZLT remote mirror summary



- With access to the remote mirror, no transactions are lost
  - NonStop RDF reads all remaining audit prior to actual takeover processing
  - Lower overhead method delivers the same result as lockstep
- Distance is limited by disk technology
  - Fibre Channel is estimated at 100 kilometers
- What if an audit mirror goes down prior to unplanned outage?
  - If local mirror, no transactions are lost during NonStop RDF takeover
  - If remote mirror, some final transactions may be lost
    - In the future, the user will be allowed to determine whether to continue or to stop transaction processing

# Why do I need NonStop RDF if I have enterprise storage?

- More flexible
- Much lower communications bandwidth
- Faster failover
- Easier to exercise—and switch back
- Both systems can be processing transactions in reciprocal or split workload configuration
- Backup system does not need to be brought down during NonStop RDF failover processing

# Contrast RDF with Enterprise Storage



## NonStop RDF failover

1. Issue NonStop RDF takeover command
2. Bring up applications

## Entire disk switch

1. Stop applications on the backup system
2. Stop NonStop TMF
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10. Integrate both systems' tables into the same NonStop SQL catalog
11. Reconfigure NonStop TMF tape catalog if necessary
12. Take new online dumps
13. Bring up applications

# For more information

- [hp.com/go/nonstopcontinuity](http://hp.com/go/nonstopcontinuity)
- [hp.com/go/continuity](http://hp.com/go/continuity)
- [ron.lapedis@hp.com](mailto:ron.lapedis@hp.com)
  
- <http://nedmigration.cac.cpqcorp.net/domains/Enterprise Storage.htm>
- [nomi.trapnell@hp.com](mailto:nomi.trapnell@hp.com)

Q & A

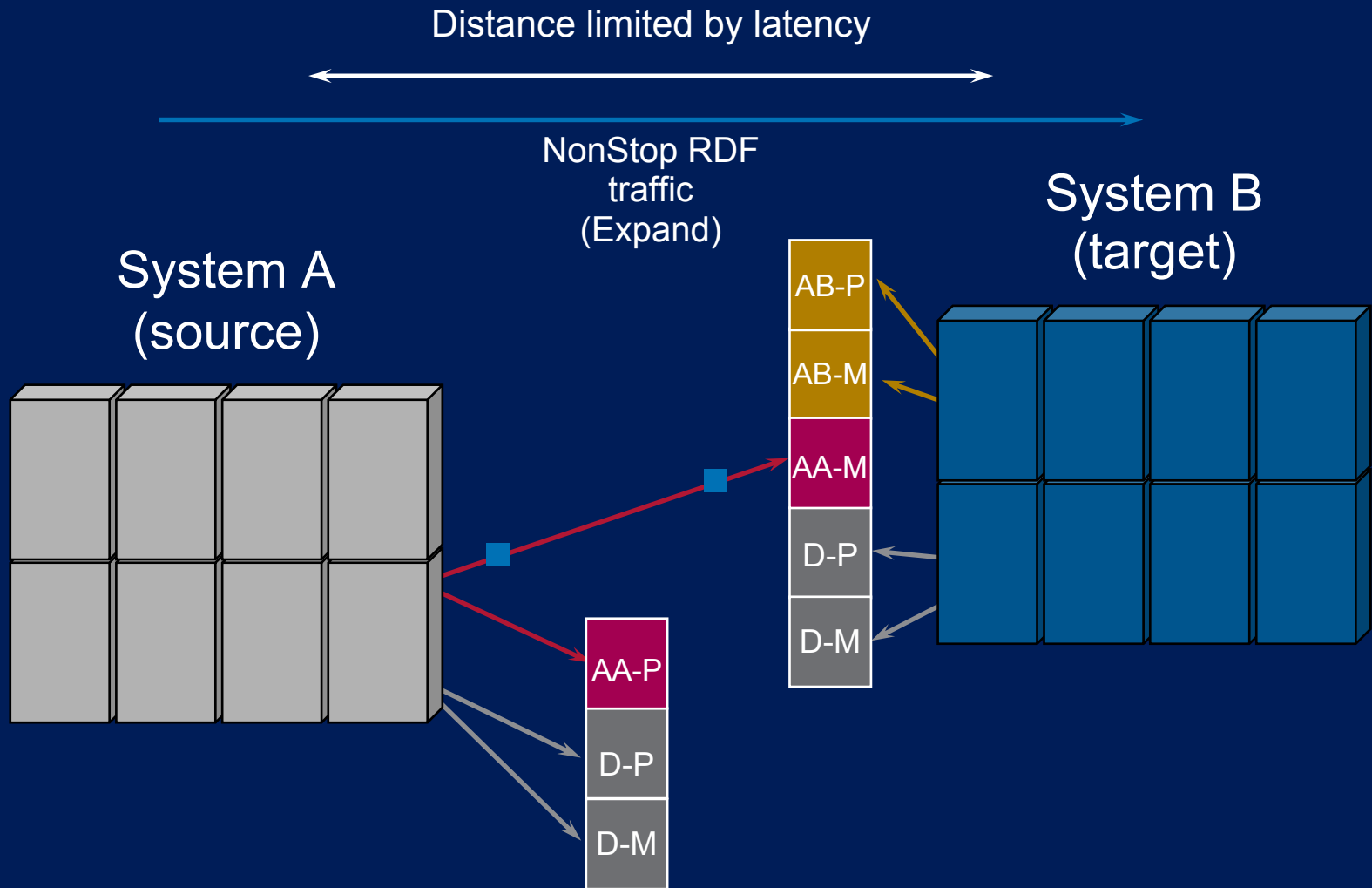




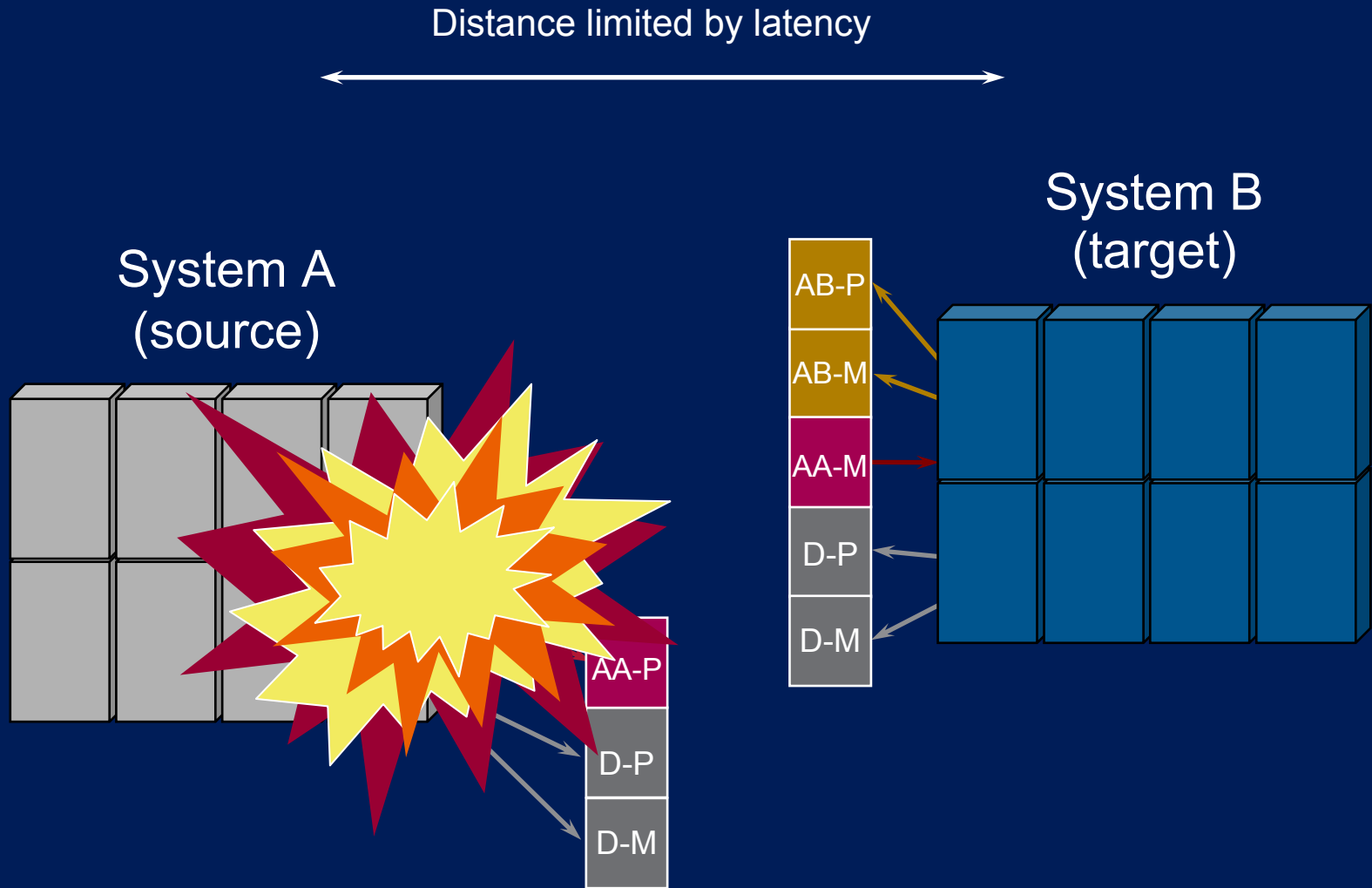
# Presenter notes

- The next slides show some StorageWorks XP configuration examples and can be inserted after slide 43.

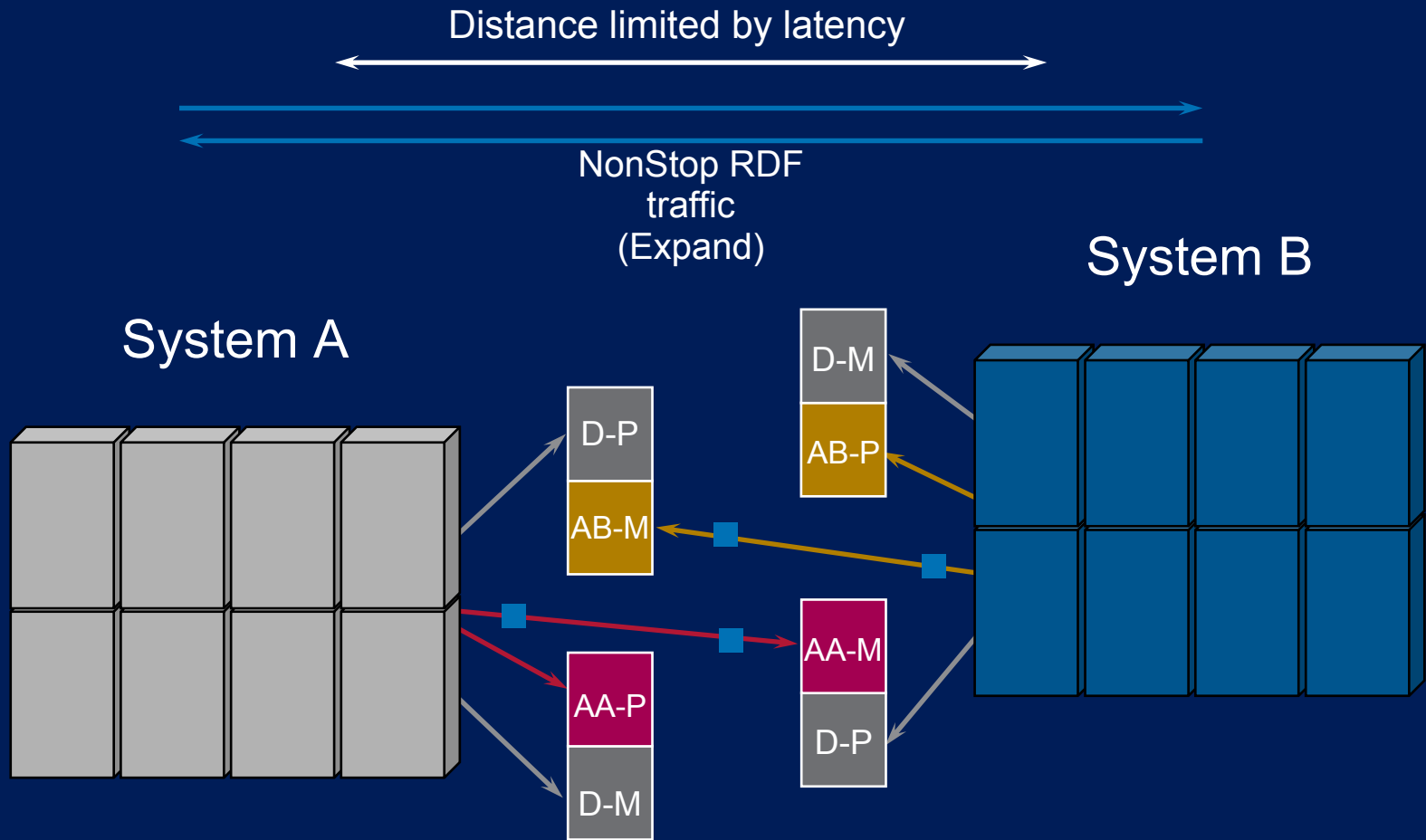
# StorageWorks XP with IP switches: Single direction



# StorageWorks XP with IP switches: Single direction



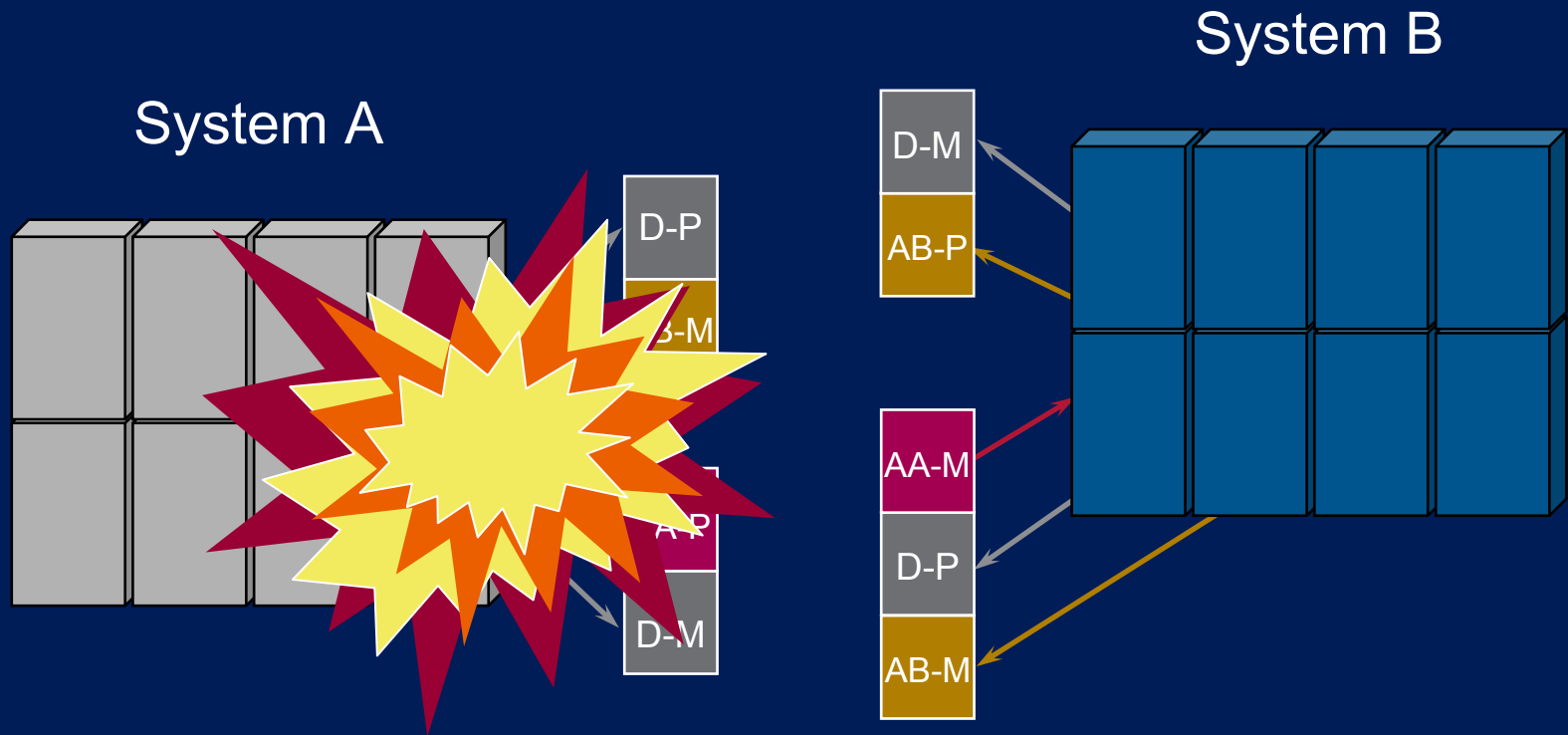
# Dual StorageWorks XP with IP switches: Reciprocal direction



# Dual StorageWorks XP with IP switches: Reciprocal direction



Distance limited by latency





# Presenter notes

- These slides describe HP's Business Critical Services (BCS) and can be inserted where you like for emphasis

economics

It's all about ~~IT features~~

Are you being served?

improving / service-



ITe = cost ↓ + quality ↑ + risk ↓ +

HP Services are required for installation of both the StorageWorks XP disk array and NonStop RDF/ZLT

customers need to mitigate risk!

enhanced business agility

MUS- cost ↑

# Why services for the NonStop server?

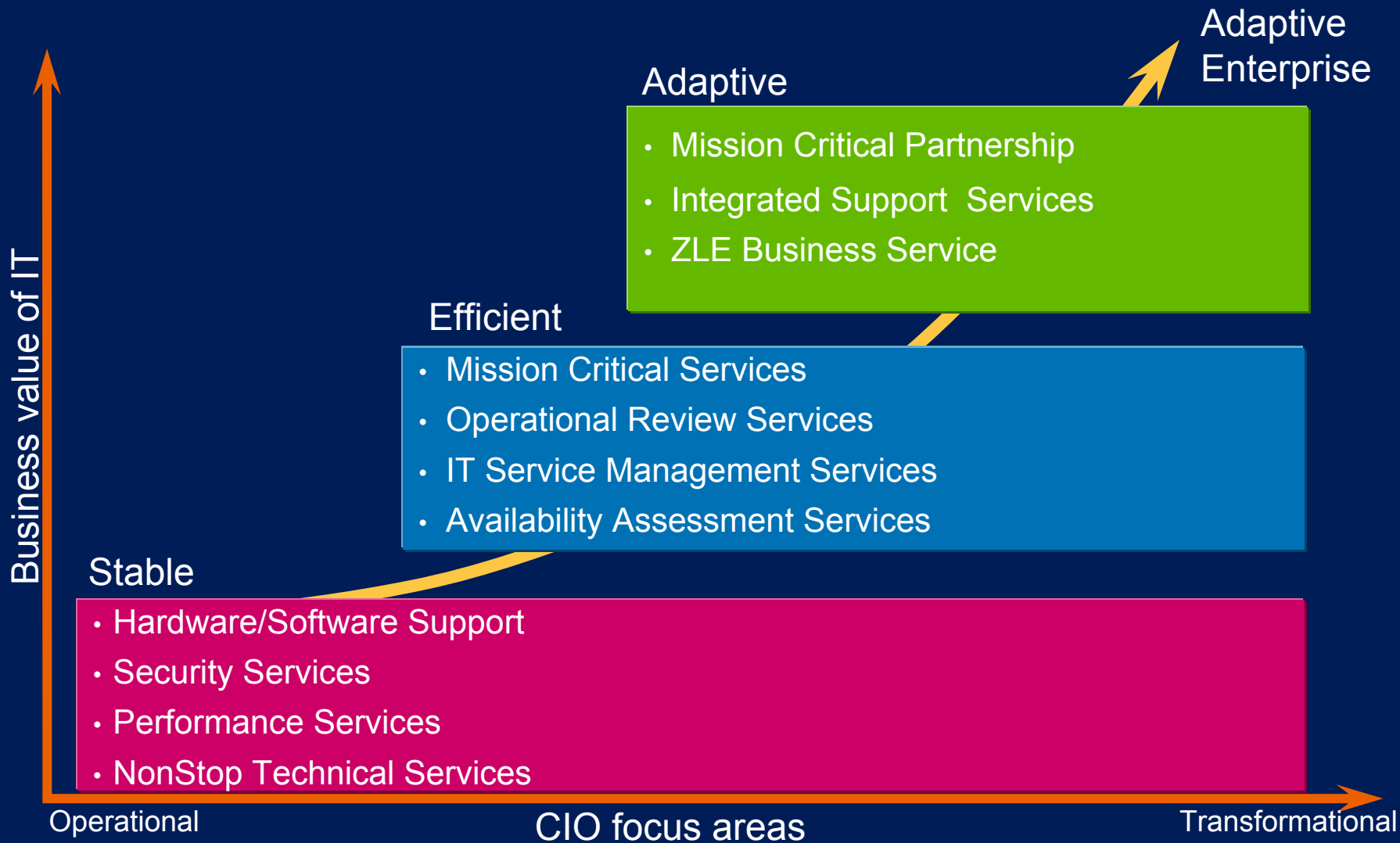
Ensure that the rest of your infrastructure is as robust as your NonStop server.

Achieve the high levels of IT availability and performance required by your adaptive enterprise through people and processes:

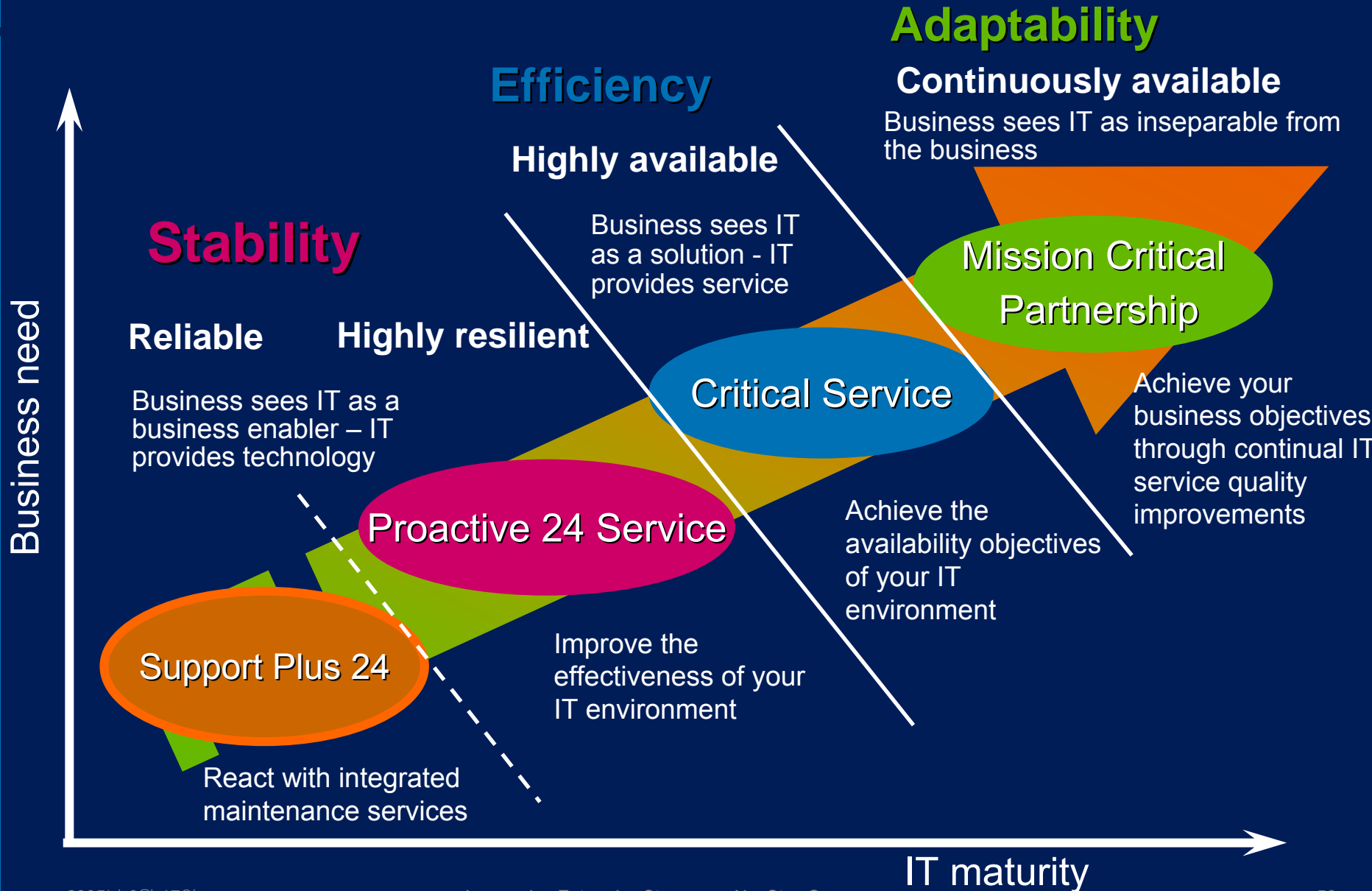
- Comprehensive processes and tools
- Proactive services
- Reactive services
- Support partnerships
- Account management



# HP services which help your journey to adaptability



# NonStop Server Support Portfolio



# Services for the NonStop server value proposition

Enable agility in a business-critical environment by providing a highly available, secure, manageable, scalable IT infrastructure.



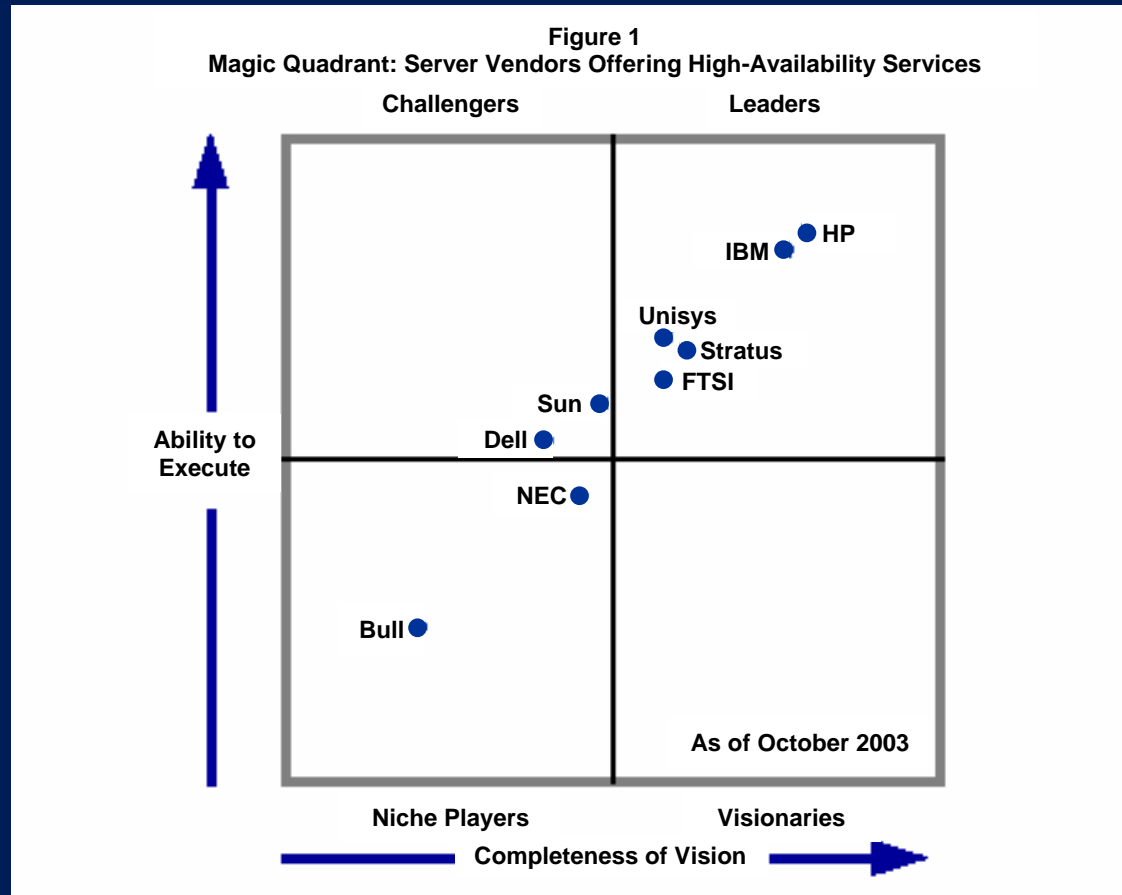
101010

**Track  
record**

# Gartner Magic Quadrant

## Evaluation of selected server vendors for their High Availability services

The Magic Quadrant is copyrighted October, 2003, by Gartner, Inc. and is reused with permission, which permission should not be deemed to be an endorsement of any company or product depicted in the quadrant. The Magic Quadrant is Gartner, Inc.'s opinion and is an analytical representation of a marketplace at and for a specific time period. It measures vendors against Gartner defined criteria for a marketplace. The positioning of vendors within a Magic Quadrant is based on the complex interplay of many factors. Gartner does not advise enterprises to select only those firms in the "Leaders" quadrant. In some situations, firms in the Visionary, Challenger, or Niche Player quadrants may be the right matches for an enterprise's requirements. Well-informed vendor selection decisions should rely on more than a Magic Quadrant. Gartner research is intended to be one of many information sources including other published information and direct analyst interaction. Gartner, Inc. expressly disclaims all warranties, express or implied, of fitness of this research for a particular purpose.



Source: Gartner Research Note, October, 2003, Server Vendor's High-Availability Services: Magic Quadrant

# Can the rest of your infrastructure support your NonStop server?



## Industry average MC availability

- 27 hours per year downtime\*
- 99.69% availability

• \$108K/hour mean\*

• \$2,916K cost of downtime

## HP Mission Critical availability

- 3.06 hours per year downtime
- 99.97% availability

• \$108K/hour mean\*

• \$330.5K cost of downtime

\*Source: Gartner : North American Customers Reveal Preferred Services for Mission –Critical Systems 9/5/03

# Why HP mission critical support?

Superior customer service experience

- >8X less downtime than industry average
- 95% of calls direct connected to technical resource within 5 minutes
- 98% of call-to-resolution time commitments met
- 20-30% of reactive calls avoided due to enabling technology's preventive analysis capabilities
- Experience and expertise
  - 5,000 high availability experts
  - thousands of mission-critical customers worldwide

# HP mission critical leadership



- #1 support company
- Leader in mission-critical support for open environments
- #1 in storage consulting and support services
- Gartner Group High Availability Magic Quadrant leader
- SAP award of excellence every year since 1995
- Leader in high availability for support for Windows environments

# Business value enabled by Mission Critical Services



Complete, accurate  
back office settlements  
Investment Banking

Reliable delivery of  
multimedia services  
Wireless telecom carriers

Accurate, timely  
customer billings  
Wireline telecom carriers

Ensure quality and  
safety of food  
processing  
Food manufacturing



24 x 7 electronic trading  
capability  
Investment banking

Reduce manufacturing  
design cycle times  
Consumer electronics  
manufacturing

Improve supply chain  
efficiency and accuracy  
Retailing and  
manufacturing

Maintain retail shelf  
inventory  
Retailing

# Summary

- Delivering and measuring IT business value is critical to IT success
- Proactive, comprehensive approach is needed to:
  - Minimize the business risk of downtime
  - Increase IT quality of service
  - Manage IT costs
  - Gain agility
- HP Mission Critical Services assist IT in achieving these objectives



# HP Services: committed to your success



- Continued support of legacy systems
- Unsurpassed experience and expertise
- Lifecycle services using a holistic approach
- Designing, building, managing, and evolving customer infrastructures to meet business challenges
- Proactive service partnership
- Comprehensive consistent, global support
- Best-in-class tools, processes, and remote support through Global Customer Support Center (Support Center Practices Certified)
- Investment in continuous improvement

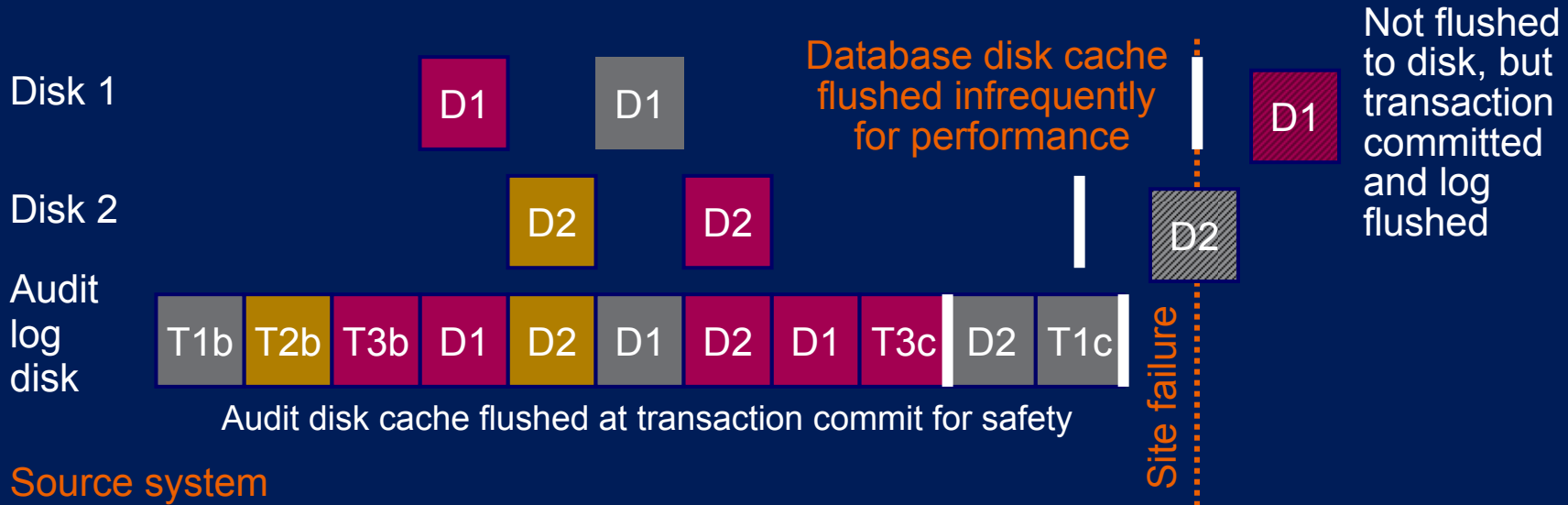


**Your satisfaction is the measure of our success!**

# Presenter notes

- This slide is an animated illustration of why replicated Enterprise Storage (Continuous Access) does not show a consistent image of the database and needs software support from the OS or database management system to make it so.

# Physical disk does not equal logical database



## Target system

