Pulse2011

Understanding Replication Mechanisms for Reducing Downtime

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BIO

Phread F Cichowski – Tivoli Storage Worldwide Technical Evangelist

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❑ 8 years with Tivoli, first 4 as a Tivoli Storage Systems Engineer

❑ Previously worked for Alacritech, Caw Networks, EMC, and Auspex

❑ Also spent 13 years at AT&T/Bell Labs as a Systems Manager/Administrator/Programmer

❑ Interests include: antique swords, vintage guitars, and classic motorcycles

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Which mechanism is best for replicating, protecting, and recovering my data?

- IBM offers many options, how do I make sense of them?

- Is a HW or a SW solution best? Both?

- Backup solution?

- Disk solution?

- How do you manage/coordinate this?

Agenda

- Initial thoughts
- Storage based replication
- Virtualization level replication
- Software based replication

Why replicate?

Reduce Business Risk by …

- Maintain access to data at all times
  - **Continuous data access during backups**
  - **Data/application recovery from a disaster**
- Protect critical business data
  - **Meet regulatory, audit, governance requirements**
- Match disaster recovery cost to the value of the data
- Help reduce backup window times
- Help improve storage IT personnel productivity
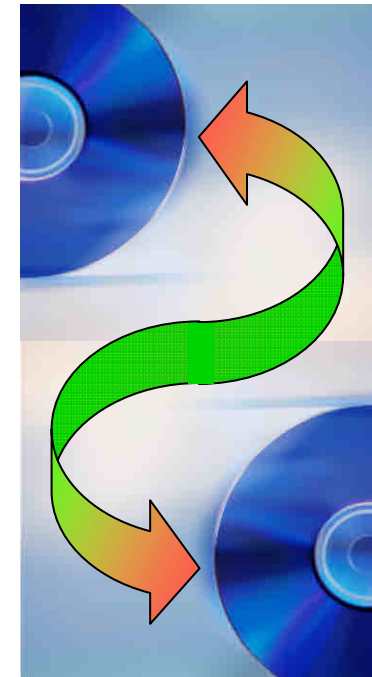
- *IBM Disk Replication is designed to provide TCO savings through high application availability and storage IT personnel productivity*

Aspects of Availability

High Availability

Fault-tolerant, failure-resistant Infrastructure supporting continuous application processing

Continuous Operations

Non-disruptive backups and system maintenance coupled with continuous availability of application

Disaster Recovery

Protection against unplanned outages such as disasters through reliable, predictable recovery

Is your critical application data adequately protected?

- Traditional once-a-night backup leaves up to 24 hours of your most recent data at risk

  Recovery Point Objective:
  How much data can you afford to lose?

  – How much data will you lose if your database server crashes at 5 PM?

  – How much will it cost you to re-create those transactions?

- It can take many hours or days to perform a full restore from traditional backup systems

  Recovery Time Objective:
  How much downtime can you afford?

  – How much application downtime can your business tolerate?

Different lines of business have different availability requirements and therefore require different *service level agreements.*

IBM.

Mobile Offices

Remote Office(s)

Data Center

FastBack Clients

TSM Clients

TSM Clients

FlashCopy Metro/Global Mirror

ProtecTIER

FastBack for Workstations

FastBack Server(s)

Storage pool

WAN / LAN

IA

Backup Cloud, Managed Services

Public/Private /Hybrid

TSM Server

DR Operations

Disk replicas

TSM Server

Storage pool

Disaster Recovery Site
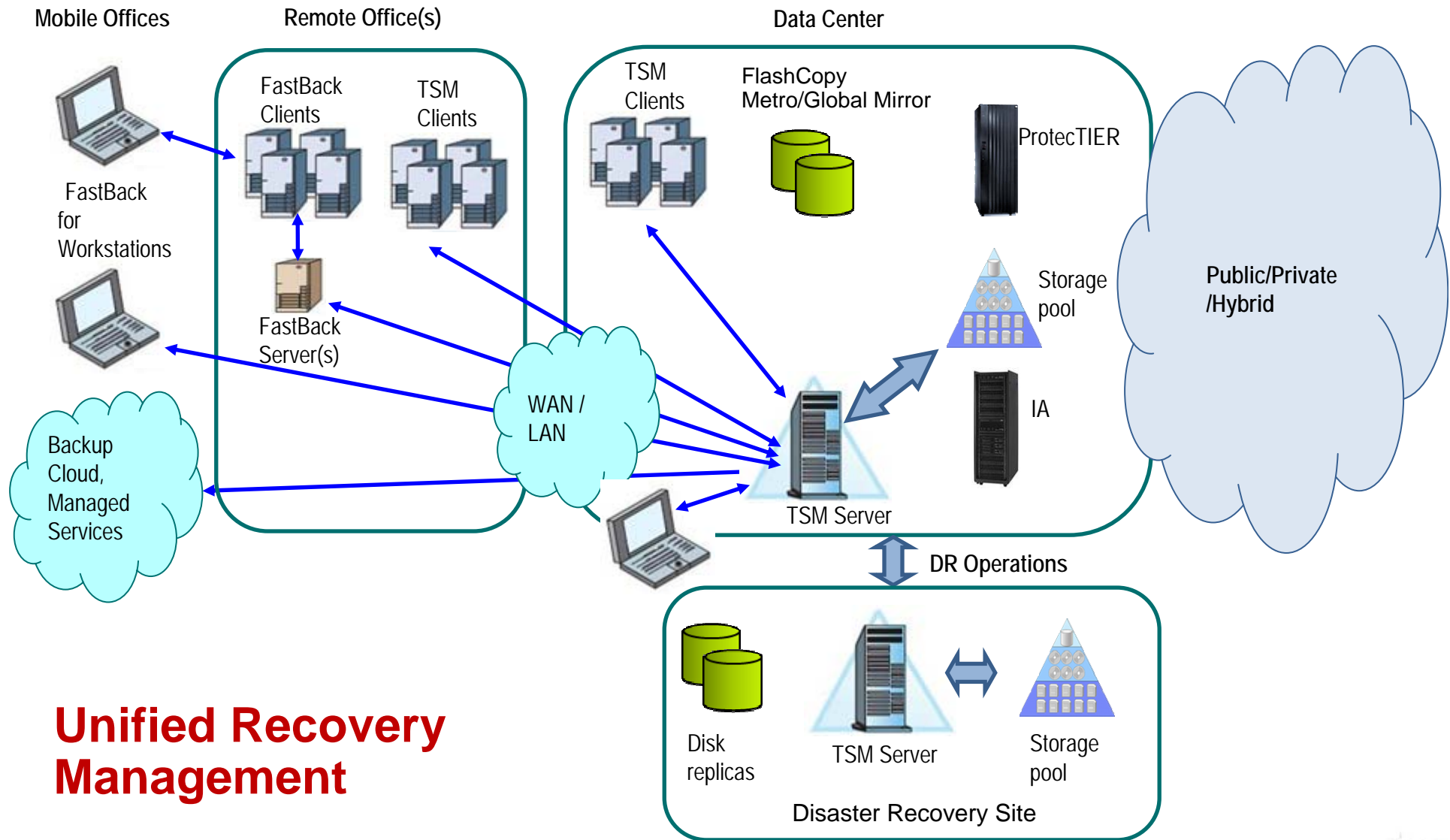
Unified Recovery Management

STORAGE SUBSYSTEM BASED REPLICATION

Types of IBM Storage Based Replication

FlashCopy
- Point in time copy
- Available on:
  - DS8000
  - XIV
  - SAN Volume Controller
  - v7000
  - DS5000
  - DS3500
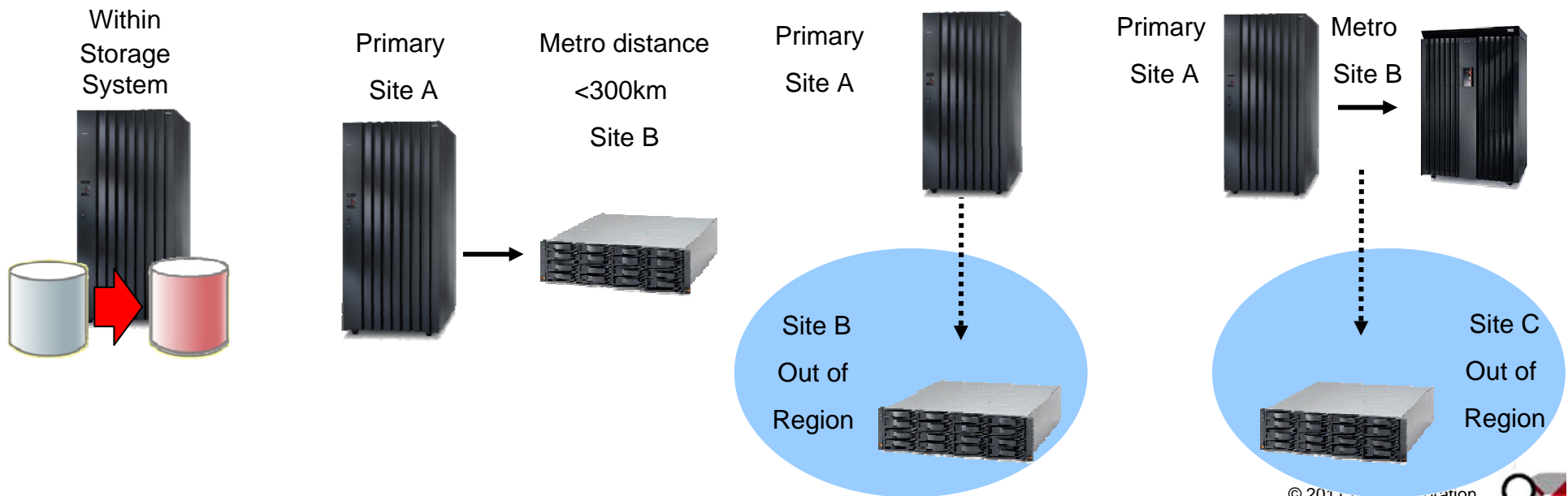 - N Series

Metro Mirror
- Synchronous mirroring
- Available on:
  - DS8000
  - SAN Volume Controller
  - DS5000
  - N Series

Global Mirror
- Asynchronous mirroring
- Available on:
  - DS8000
  - SAN Volume Controller
  - DS5000
  - N Series

Metro / Global Mirror
- Three site synchronous and asynchronous mirroring
- Available on:
  - DS8000
  - N Series

Within Storage System

Primary
Site A

Metro distance
<300km
Site B

Primary
Site A

Site B
Out of
Region

Primary
Site A

Metro
Site B

Site C
Out of
Region

Why are snapshots useful for backup?

- Faster backups without taking applications off-line
  - Minimize downtime
- Faster recovery time (RTO)
- Easier to realize more recovery points (RPO)
- Minimal down-time of applications

- What types of snapshots are there?
  - Split-Mirror
  - Copy on Write
  - Redirect on Write
  - Others

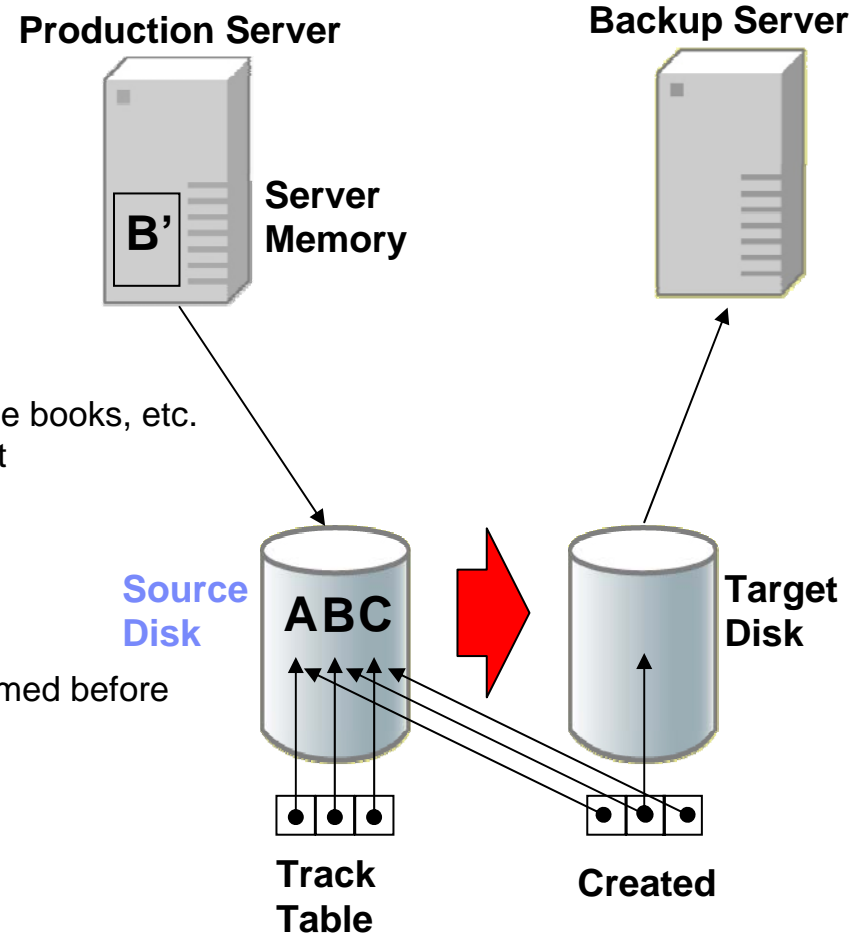For more info on snapshot technologies: http://www.ibm.com/developerworks/tivoli/library/t-snaptsm1/index.html

FlashCopy Technology

Production Server

Backup Server

- What is FlashCopy?
  - Provides an instantaneous copy of a set of data
  - Mostly performed at the Volume Level:
    - (Mainframe, NSeries at the file level)
  - Usually in the same Disk System (except SVC)

B' **Server Memory**

- What is FlashCopy typically used for?
  - The copy is used for backup programs
  - Performing data analysis, data-mining, auditing, closing the books, etc.
  - A clone of a production application for development or test
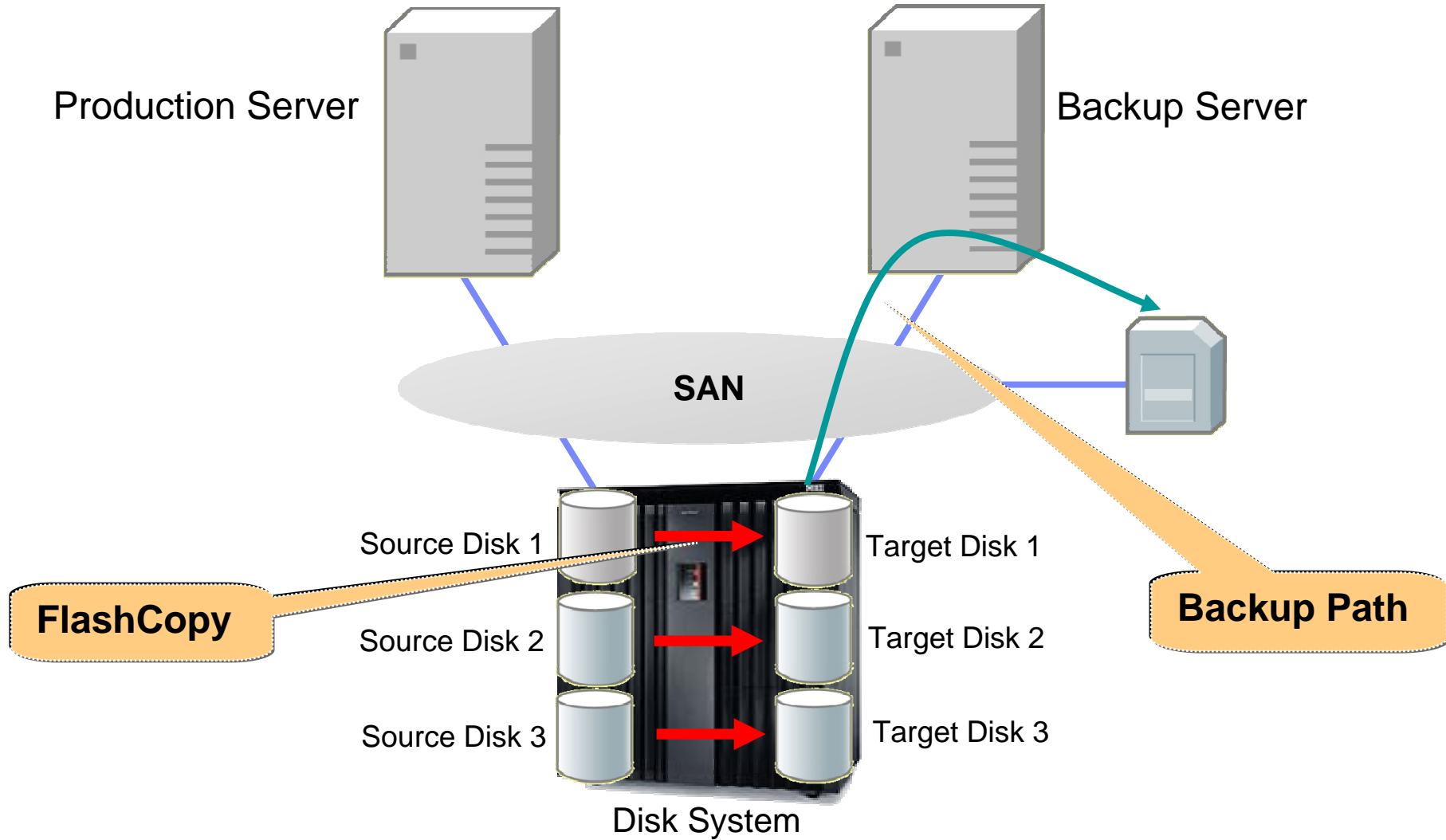 - Back-out position during major upgrades

- How does the copy have data integrity?
  - FlashCopy provides integrity on volume or file level
  - For database or application integrity 'quiesce' must performed before FlashCopy can take place

Source Disk **ABC** **Target Disk**

- FlashCopy Features
  - Start Background Copy Now
  - Incremental FlashCopy
  - Cross Cluster FlashCopy
  - Data Set Relocation
  - Multiple Copies (12 max)
  - Consistent FlashCopy
  - Inband FlashCopy
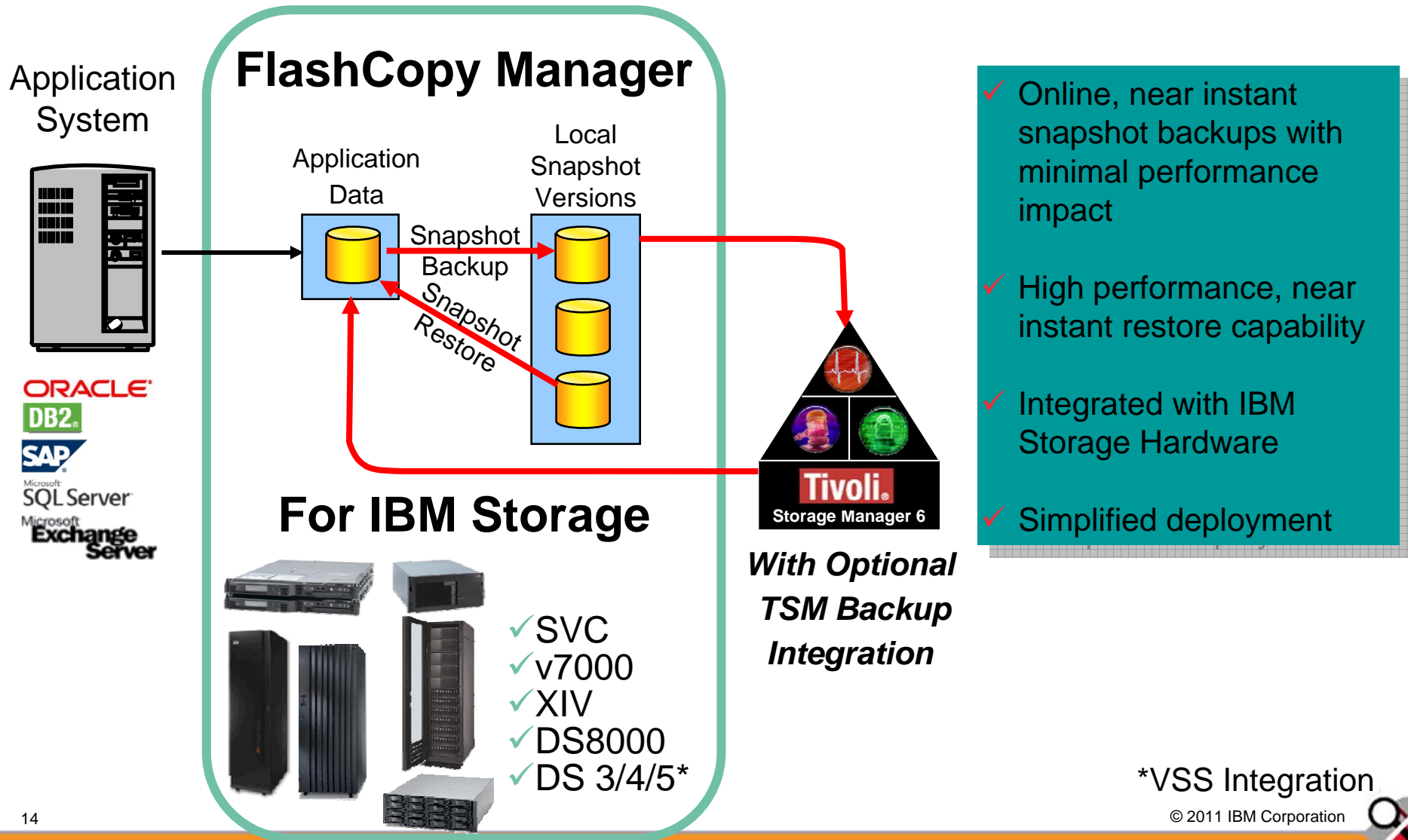 - FlashCopy to PPRC Primary
  - Reverse Restore

Track Table

Created

FlashCopy NOCOPY Complete

Leveraging FlashCopy

Production Server

Backup Server

SAN

Source Disk 1

Target Disk 1

FlashCopy

Source Disk 2

Target Disk 2

Backup Path

Source Disk 3

Target Disk 3

Disk System

FlashCopy Manager

FlashCopy Manager

Application System

Application Data

Local Snapshot Versions

Snapshot Backup

Snapshot Restore

For IBM Storage

- ✓ SVC
- ✓ v7000
- ✓ XIV
- ✓ DS8000
- ✓ DS 3/4/5*

Tivoli Storage Manager 6

With Optional TSM Backup Integration

- ✓ Online, near instant snapshot backups with minimal performance impact
- ✓ High performance, near instant restore capability
- ✓ Integrated with IBM Storage Hardware
- ✓ Simplified deployment

*VSS Integration

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Data Consistency and Consistency Groups

Source Volumes

Consistent secondary volumes

L

D

J

D

D

D

L

D

J

D

D

D

Mirroring Links

Database

Database Logs and Journals match Data Tables

L = Log   J = Journal   D = Data
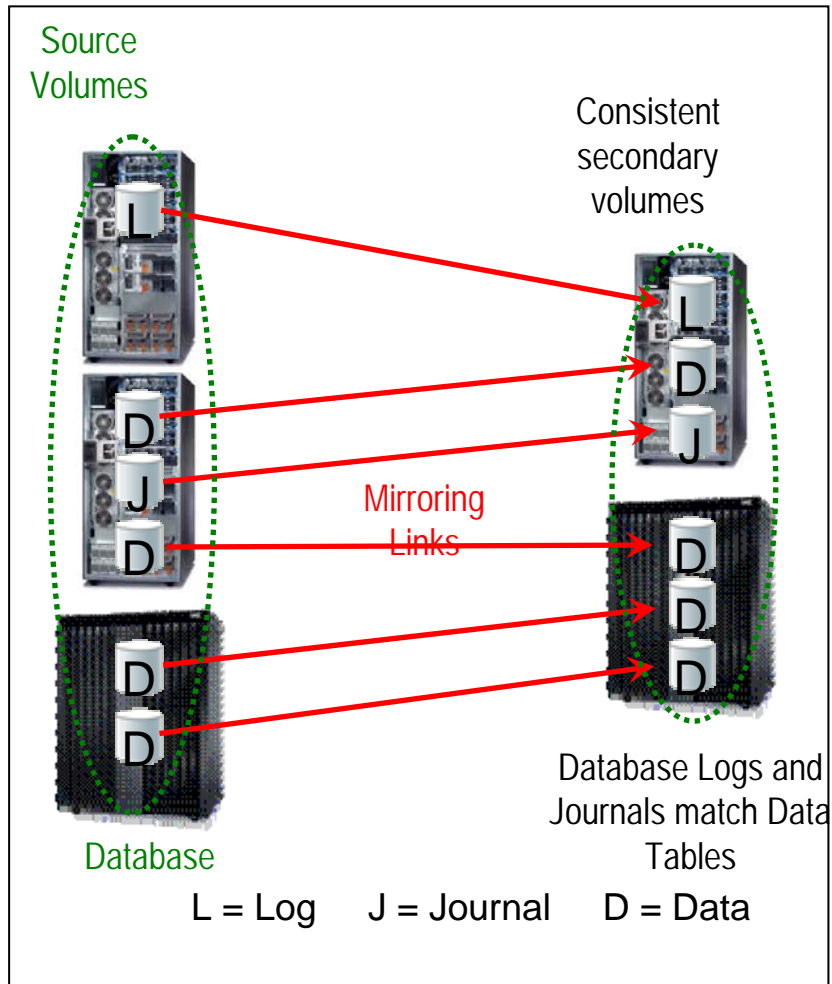
- **Consideration for any disk mirroring**
  - **Because databases are multi-LUN, multi-volume**
  - **We must have the concept of a *session*, into which multiple volumes/LUNs can be managed as a group**
  - **This disk replication function is known as "Consistency Group"**

- **A disk platform selection consideration is:**
  - **Maximum number of LUNs supported in Consistency Group**

IBM Metro Mirror

1. Application sends a write request

2. Data written to remote disk cache

4. Write complete signal to the application

SAN   SAN

3. Receipt confirmation from remote disk system
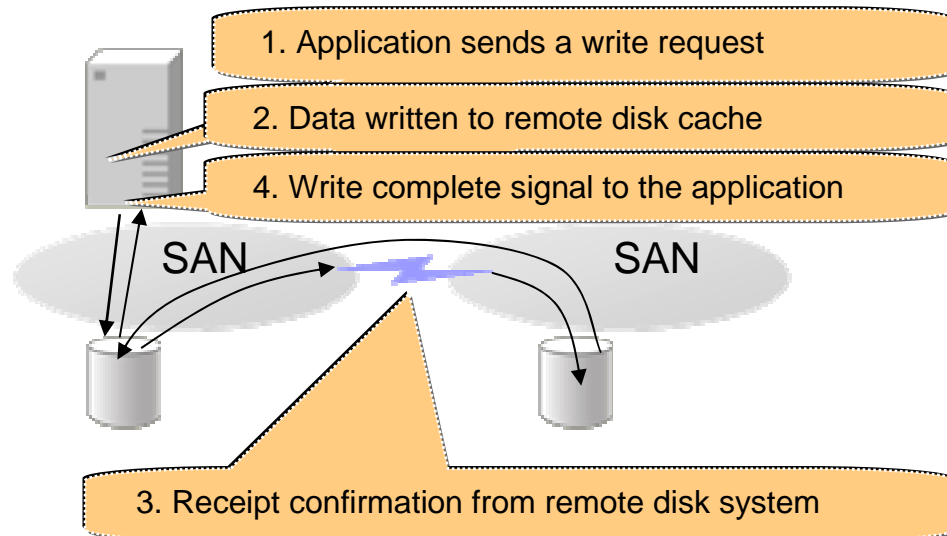
Remote disk is exactly in "lock step"
at the record write level

- What is Metro Mirror?
  - **Originally known on ESS as Peer to Peer Remote Copy (PPRC)**
  - **Synchronous mirror of data volumes to a metro distance location**
  - **Available on:**
    - **DS8000, DS6000**
    - **SAN Volume Controller**
    - **N series**
    - **DS5000**

- What is Metro Mirror used for?
  - **For applications that need zero data loss, Metro Mirror provides the tightest Recovery Point Objective**
  - **Overhead: Range of 1 to 2 ms delay per 100km**
  - **Maximum distance and overhead depends on platform:**
    - **DS8000, DS6000 = 303 KM**
    - **SAN Volume Controller = 303 KM**
    - **DS5000 and N series = 50-100 KM estimated**

Global Copy

- ## What is Global Copy?
  - ### Non-synchronous volume level disk mirror to remote location
    - Data is not sent in data consistent manner

  - ### Data integrity only at the end of the copy with quiesce
    - Can change state from Global Copy to Metro Mirror (synchronous)
    - When synch completes, FlashCopy creates a consistent recovery copy

  - ### Available on:
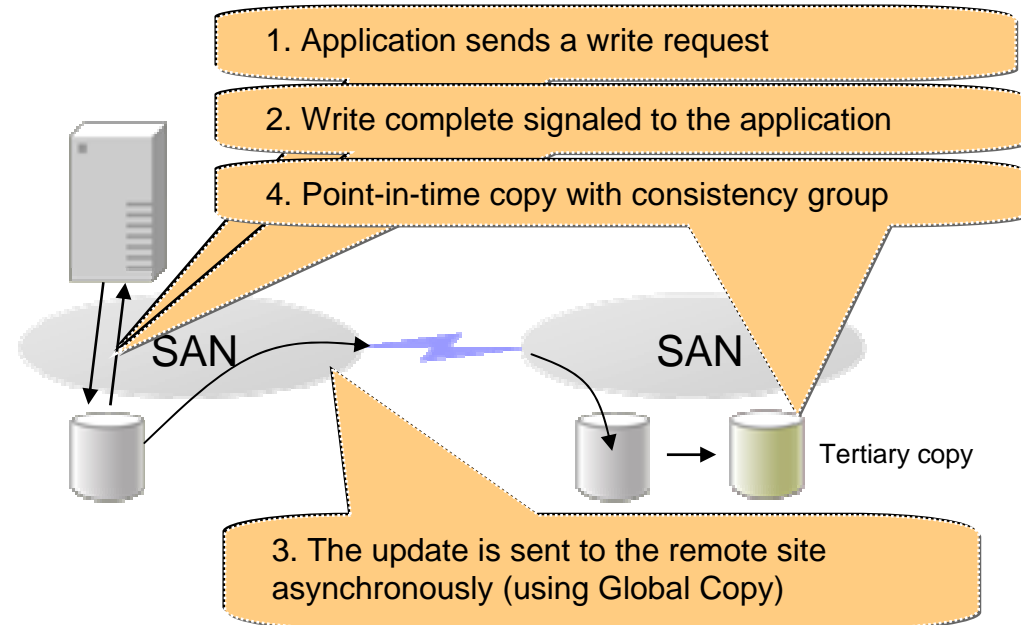   - ESS 800, DS6000, DS8000
    - DS4000, DS5000

SAN   SAN

Data is copied to the remote site asynchronously – and without regard for order.
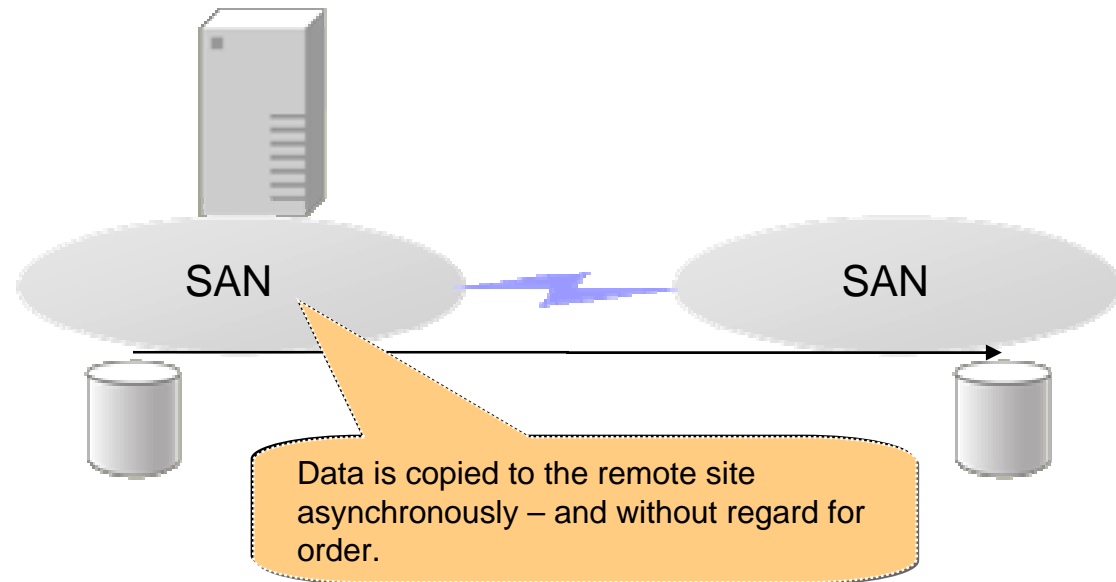
- ## What is Global Copy used for?
  - ### Data migration
    - Data center or application moves
  - ### Data broadcast
    - For example, transmitting database log files
  - ### Typically *not* for D/R by itself

IBM Global Mirror

- ## What is Global Mirror?
  - Asynchronous disk mirror with continuous data integrity
  - Performed at a volume level
  - Built by combining:
    - FlashCopy
    - Global Copy
    - FREEZE

- ## What is Global Mirror used for?
  - For asynchronous mirror with data consistency, at any distance
  - Creates tertiary (data consistent) copy every 3-5 seconds using incremental FlashCopy

1. Application sends a write request

2. Write complete signaled to the application

4. Point-in-time copy with consistency group

SAN

SAN

Tertiary copy

3. The update is sent to the remote site asynchronously (using Global Copy)

IBM Metro / Global Mirror

production
systems

Hyperswap

Metro Mirror

Continuous Availability

Production

Global Mirror

Disaster Recovery
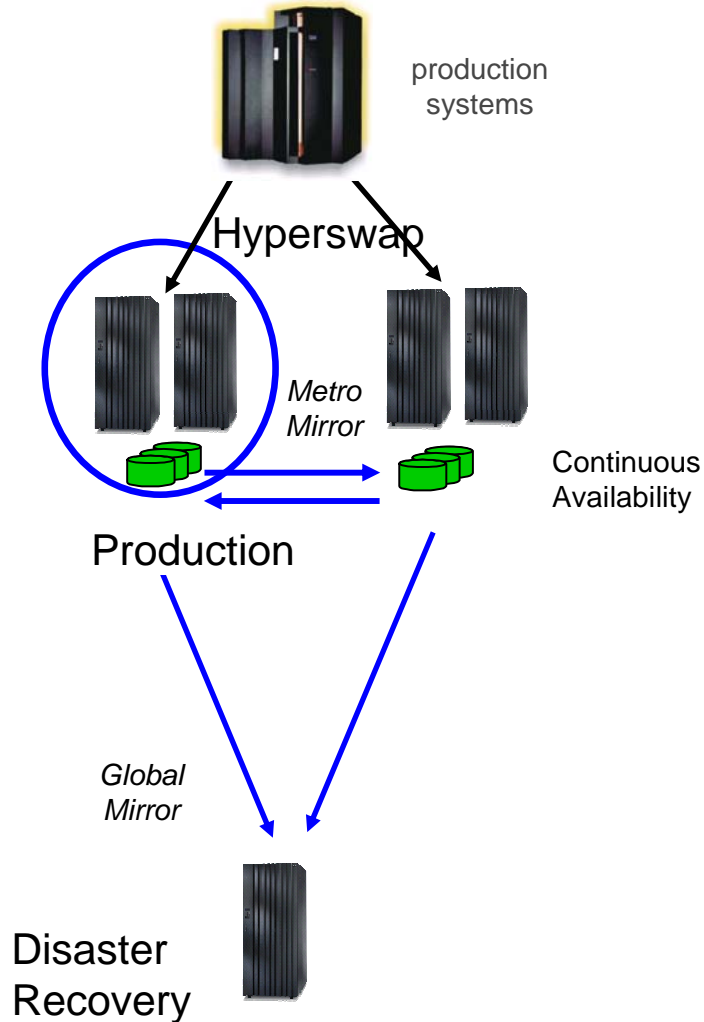
- **Cascaded configuration**
  - Metro Mirror and Global Mirror from the same z/OS volume
  - Fully supported by TPC-R and GDPS
  - MGM with Hyperswap provides near continuous availability switch between sites A and B
  - Global Mirror provides regional Disaster Recovery at site C
  - In event of Planned or Unplanned swap site A to B
    - No change to recovery to site C
  - Proven large scalability
  - Load on controller A is reduced compared to Multi-Target

Managed by TPC for Replication

- Volume level Copy Service Management
  - Manages Data Consistency across a set of volumes with logical dependencies

- Coordinates Copy Service Functionalities
  - Flash Copy
  - Metro Mirror
  - Global Mirror
  - Metro Global Mirror

- Ease of Use
  - Single common point of control
  - Web browser based GUI and CLI
  - Persistent Store Data Base
  - Source / Target volume matching
  - SNMP Alerts
  - Wizard based configuration
  - Practice Volumes

- Business Continuity
  - Site Awareness
  - High Availability Configuration – active and standby management server
  - No Single point of Failure
  - Disaster Recovery Testing
  - Disaster Recovery Management
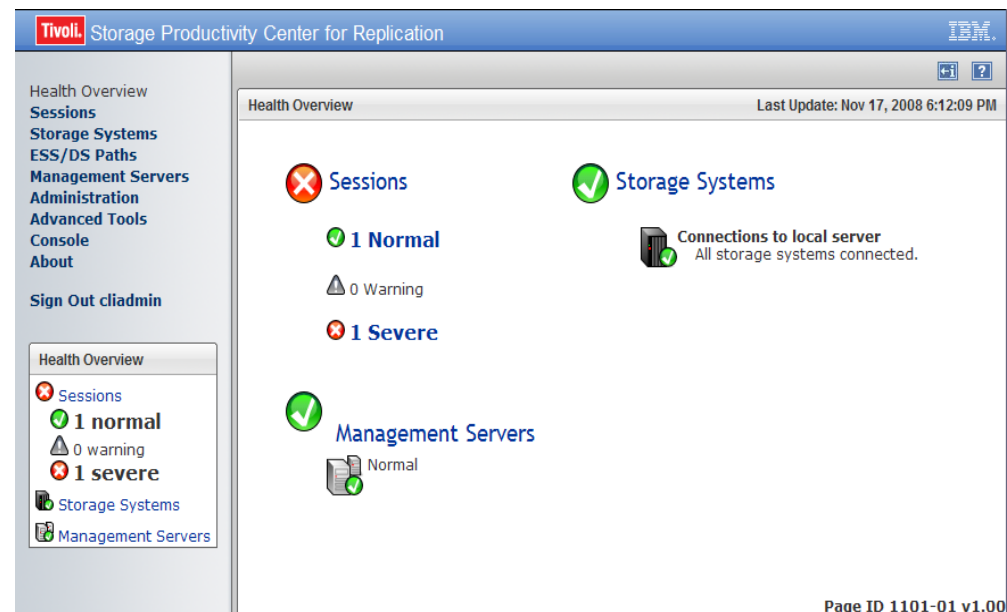
Comparing TPC for Replication and Tivoli Storage FlashCopy Manager

- The IBM Tivoli Storage Productivity Center (TPC) for Replication family helps to manage the advanced copy services provided by the IBM System Storage DS8000®, IBM System Storage SAN Volume Controller (SVC), IBM® Storwize® V7000 and the IBM Enterprise Storage Server® (ESS) Model 800

- IBM Tivoli® Storage FlashCopy® Manager software provides fast application-aware backups and restores leveraging advanced snapshot technologies in IBM storage systems. Performs near-instant application-aware snapshot backups, with minimal performance impact for IBM DB2, Oracle, SAP, Microsoft SQL Server and Exchange.

TPC for Replication and Tivoli Storage FlashCopy Manager

	TPC for Replication	FlashCopy Manager
Purpose	Disk and File Replication Mgt	Application Backup/DB Cloning
Hardware Copy Function used	FlashCopy, Metro Mirror, Global Mirror, Metro Global Mirror	FlashCopy
Hardware Supported	DS8000, SVC, Storwize V7000	Unix – DS8000, XIV, SVC and Storwize V7000 Windows – VSS supported disk (only IBM disks have been tested)
Data Supported	All data on supported hardware	Unix – DB2, Oracle, SAP Windows – VSS supported Apps (i.e. Exchange)
Servers Supported	Windows, AIX, Linux, z/OS	Windows, AIX, Linux, Solaris

VIRTUALIZATION BASED REPLICATION

IBM SAN Volume Controller Characteristics

- Virtualization Engine – resides on SAN between hosts and storage
- Adds functionality to storage that device may not have on it's own
  - FlashCopy and Metro/Global Mirror
  - *Online data migration!*
  - Cache
  - Tier of solid-state disk
- Hardware/Vendor Agnostic
- Extremely scalable

# SVC Delivers Flexibility to the Storage Infrastructure

Flexibility to auto or manually migrate full volumes to meet needs

Make changes to the storage without disrupting host applications

Virtual Disk   Virtual Disk   Virtual Disk   Virtual Disk

SAN

SAN Volume Controller

Advanced Copy Services

Manage the storage pool from a central point

Apply common copy services across the storage pool

Storage Pool

DS8000   HDS   DS4000   EMC   HP

Combine the capacity from multiple arrays into a single pool of storage

IBM SAN Volume Controller Replication Options

SVC supports:

- FlashCopy
  - FlashCopy can have up to 256 Targets for distribution
  - Incremental FlashCopy
  - Cascaded FlashCopy can create "copies of copies"
  - Space-Efficient FlashCopy
- Metro Mirror
  - Up to 300 KM
  - Popular; 35% of SVC customers use
- Global Mirror
  - Around the world!

IBM.
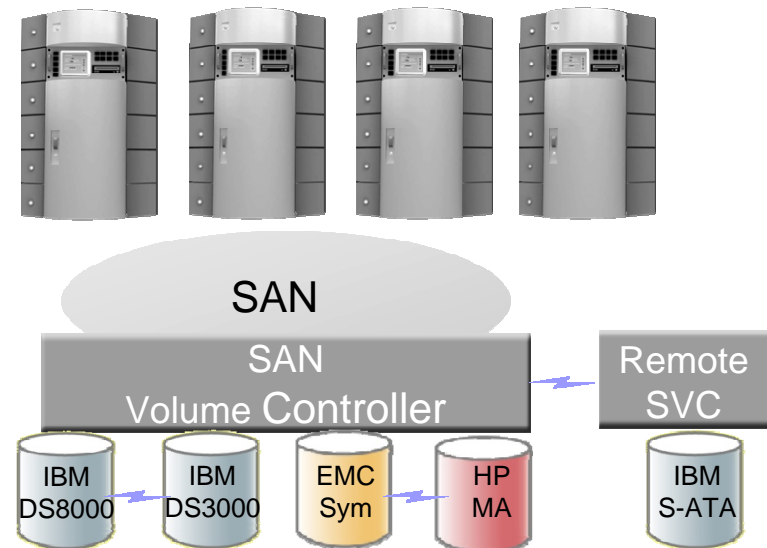
SVC Supported Environments*
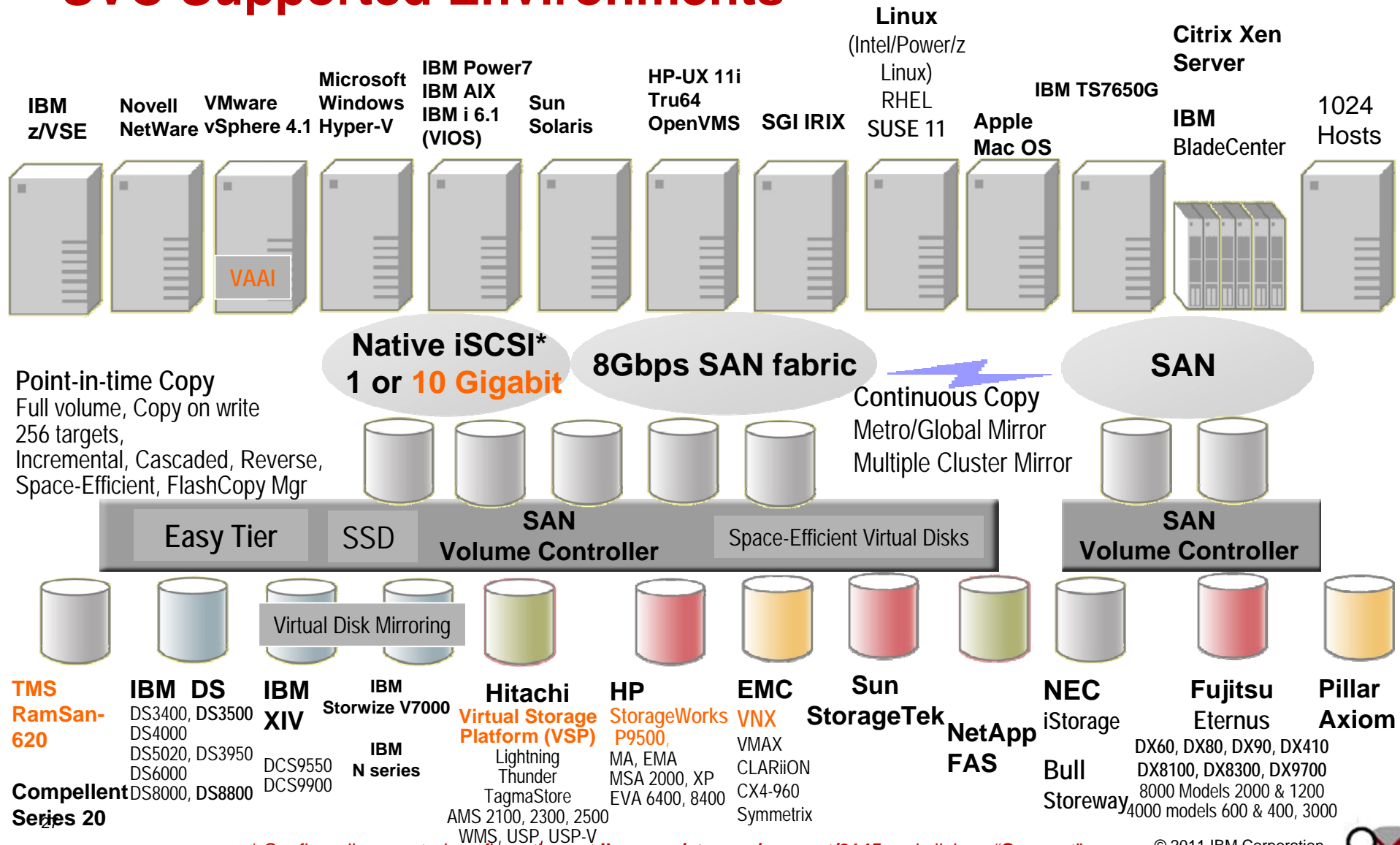
* Confirm all supported configurations at **ibm.com/storage/support/2145** and click on "**Support**"

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SVC Copy Services – FC / MM / GM

SAN Volume Controller

SAN Volume Controller

LUN 1	LUN 2	LUN 3	LUN 4

RAID controller 1

RAID controller 2

RAID controller 3

RAID controller 4

SAN Metro/Global Mirror "outside the box"

SAN FlashCopy "outside the box"
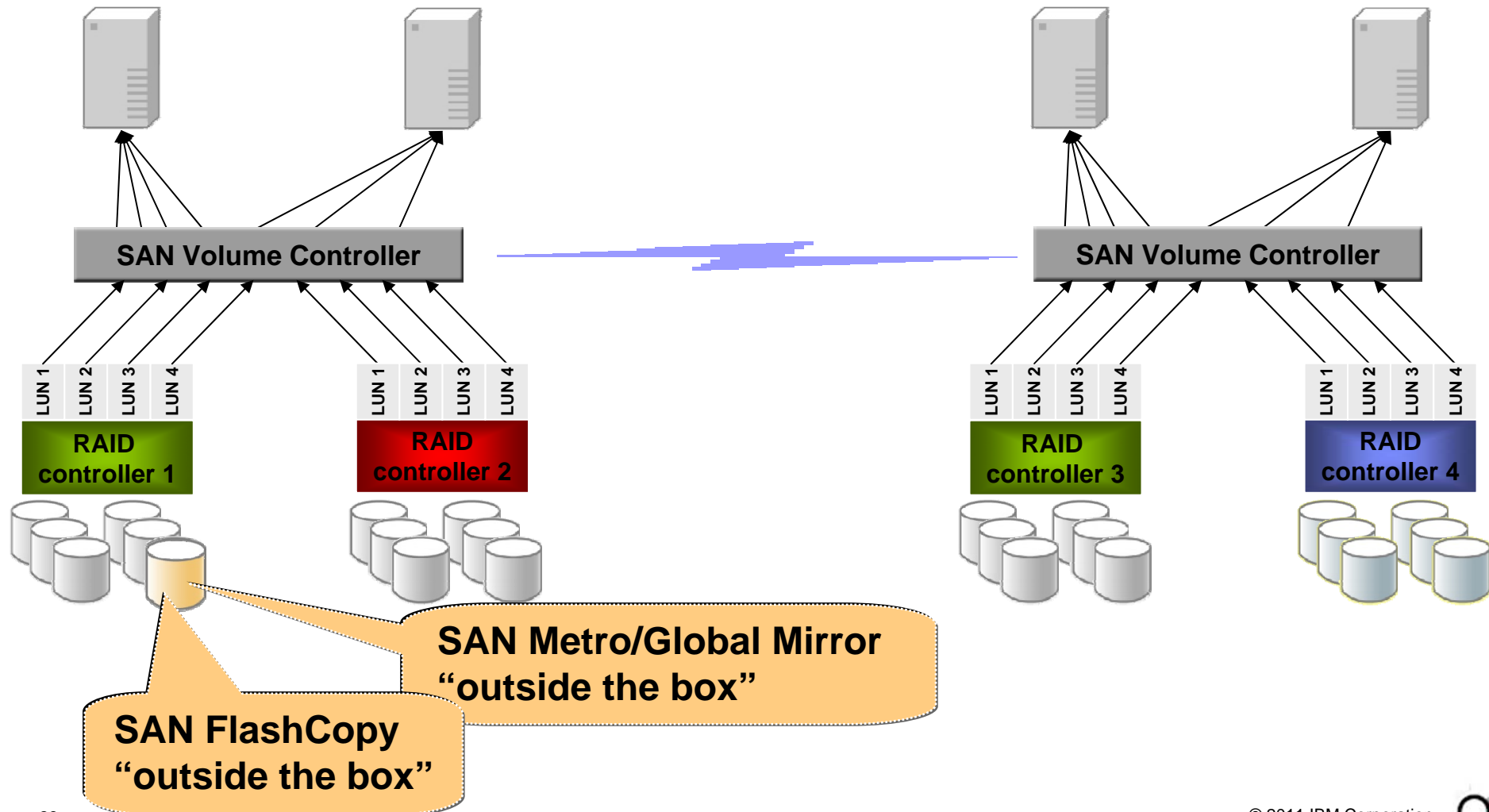
SVC Copy Services – Consistency Groups

Cross-device consistency groups
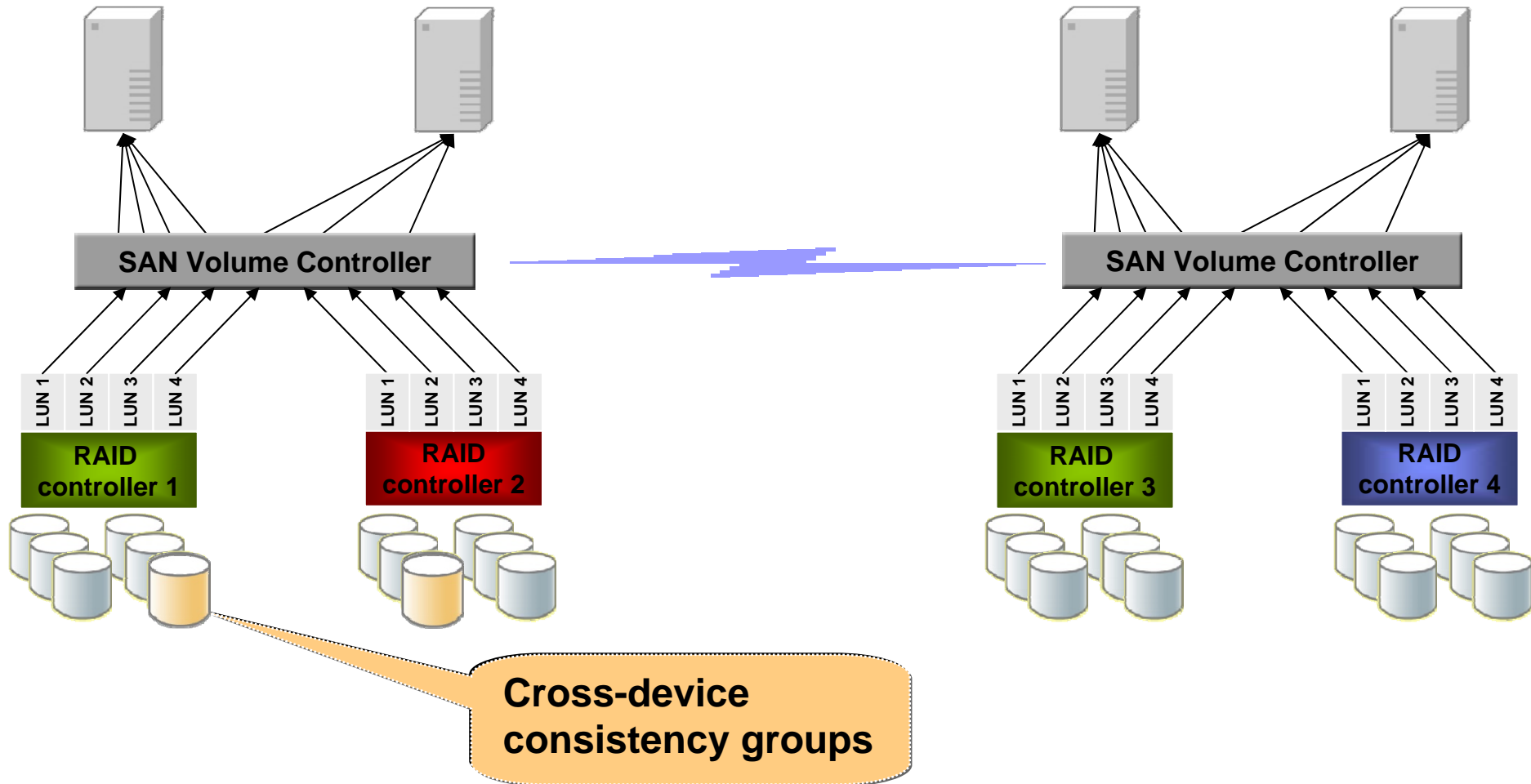
Near Zero Impact Backup with SVC

Production Server

Backup Server

SAN

SAN Volume Controller

SVC Flash Copy

SVC Flash Copy

Backup Path

DS8000

DS4000

HP

EMC

- SVC Flashcopy
- Flash Copy inside Disk System
- Flash Copy outside Disk System
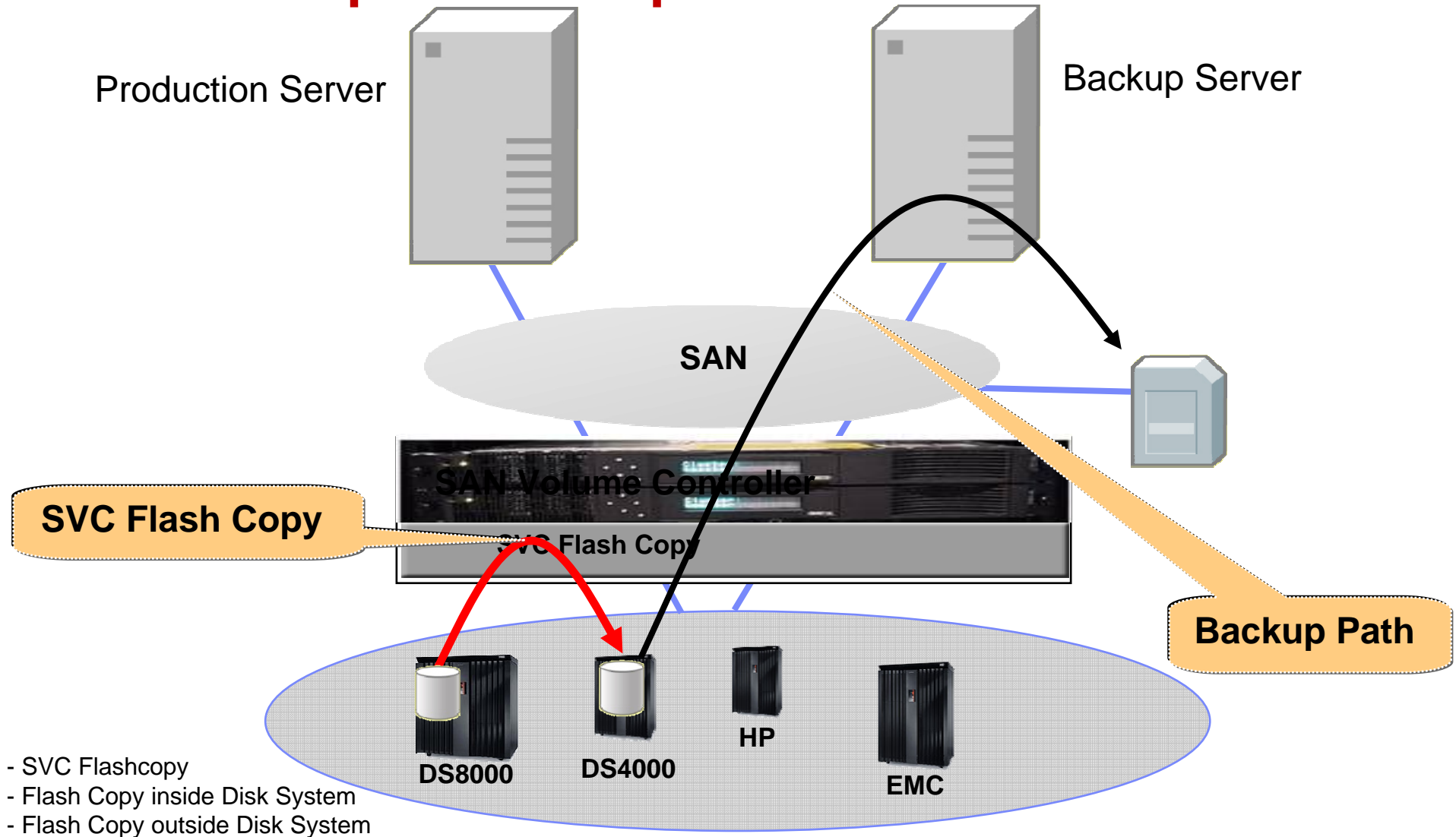
SOFTWARE BASED REPLICATION/PROTECTION

TSM FastBack

- Continuous Data Protection at a block level.

- Works well in ROBO (remote-office/branch-office) environments.

- Adds rapid recovery and restoration points to Windows and Linux application environments

Introducing Tivoli Storage Manager FastBack

- Block-level, incremental-forever, continuous or scheduled backup for Windows and Linux servers

- Near-instant restore of any type / amount of Windows and Linux application data

- Integrated target-side and WAN data deduplication

- Built-in 'selective replication'

- Comprehensive reporting, leverages Tivoli Common Reporting

- Tight integration with Tivoli Storage Manager

- TSM FastBack for Workstations: optional protection for laptops & desktops

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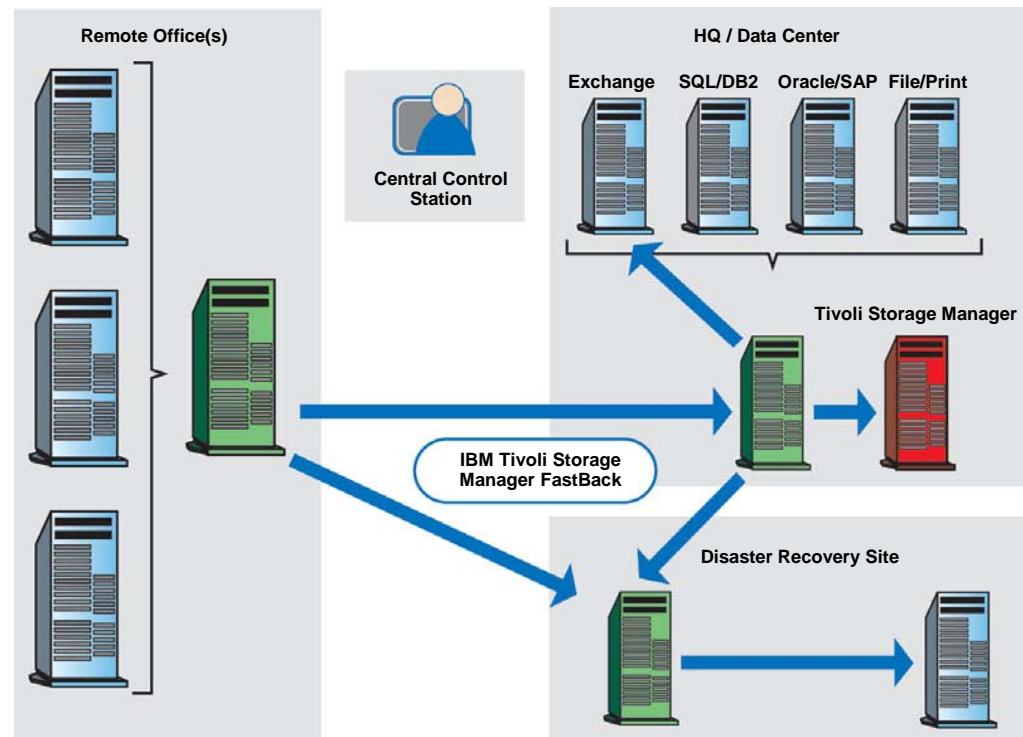
TSM FastBack helps reduce your storage footprint

- IBM offers a broad range of choices for reducing storage requirements throughout the data creation and management lifecycle – including TSM FastBack

- TSM FastBack's block-level, incremental-forever backup model can reduce backup repository requirements by 70%*

- Built-in data deduplication can reduce the FastBack repository by another 40%**, and reduce remote office WAN bandwidth requirements
  - Target-side deduplication is performed as a post-process with no impact on backup operations
  - WAN deduplication eliminates redundant blocks of data from being sent to a consolidation/DR site ***
  - Automatically reclaims deduplicated capacity
  - Provided at no extra charge
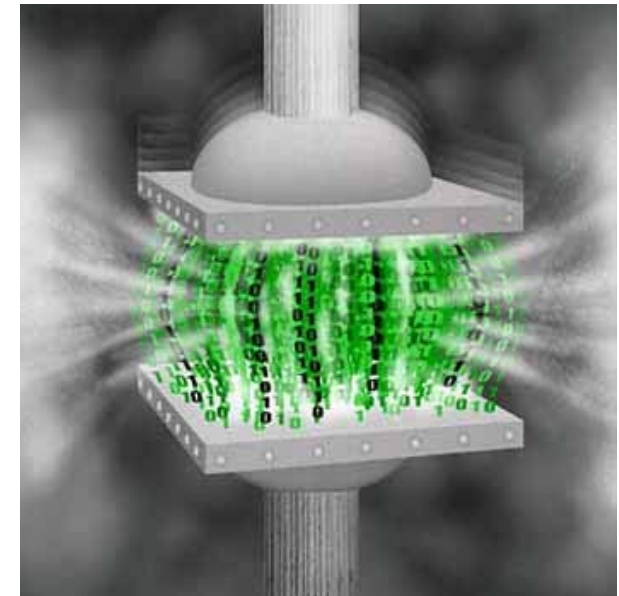
* Compared to FULL + Differential backup models
** Depending on amount of data, # of servers, etc.
*** When used in conjunction with Tivoli Storage Manager

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TSM FastBack helps you restore your data - *FAST*

- **FastBack Mount**

- Recovers individual files and folders, from any point-in-time

- Opens an Explorer-like view into the FastBack repository

- Simple 'drag-and-drop' operation

- **Virtual Recovery**

- Mounts an entire volume to be recovered

- Select any previous point-in-time
    o (Recovery Point Obective)

- New volume becomes available within seconds

- Read-write requests serviced by FastBack

- Data is restored in the background to target disk

TSM FastBack for Workstations

- Continuous Data Protection at a *file* level!

- Protects desktop and laptop class machines which are typically *unprotected*!

- Protects from hardware failure, software outage, and *user-error*

- Adds version recovery capability to software developers, media creation/editorial environments, etc. when working stand-alone

- Policy based
  - Selective protection

TSM FastBack for Workstations

Continuous data protection (CDP) for desktops and laptops

- Backs up files the instant they are saved to local disk
- Choice of locations to send an off-machine copy of the backup data:
    - File server (which can then be backed up by FastBack*), TSM server via API, WebDAV host, USB attached device
    - Resilient to network disconnections
- Keeps multiple versions of the files
- Central management for 1000s of clients

Benefits

- Continuously protects important files
    - Drag-and-drop, point-in-time recovery
- Easy Configuration, no scheduling, no hassles
- Encryption & compression
- Can then be protected by TSM and FastBack

Replication – LAN/WAN

Replication – LAN/WAN

File Server

TSM or FastBack servers

Replication

Primary:
- Disk
- Partition
- Directory

Local Repository:
- Disk
- Partition
- Directory

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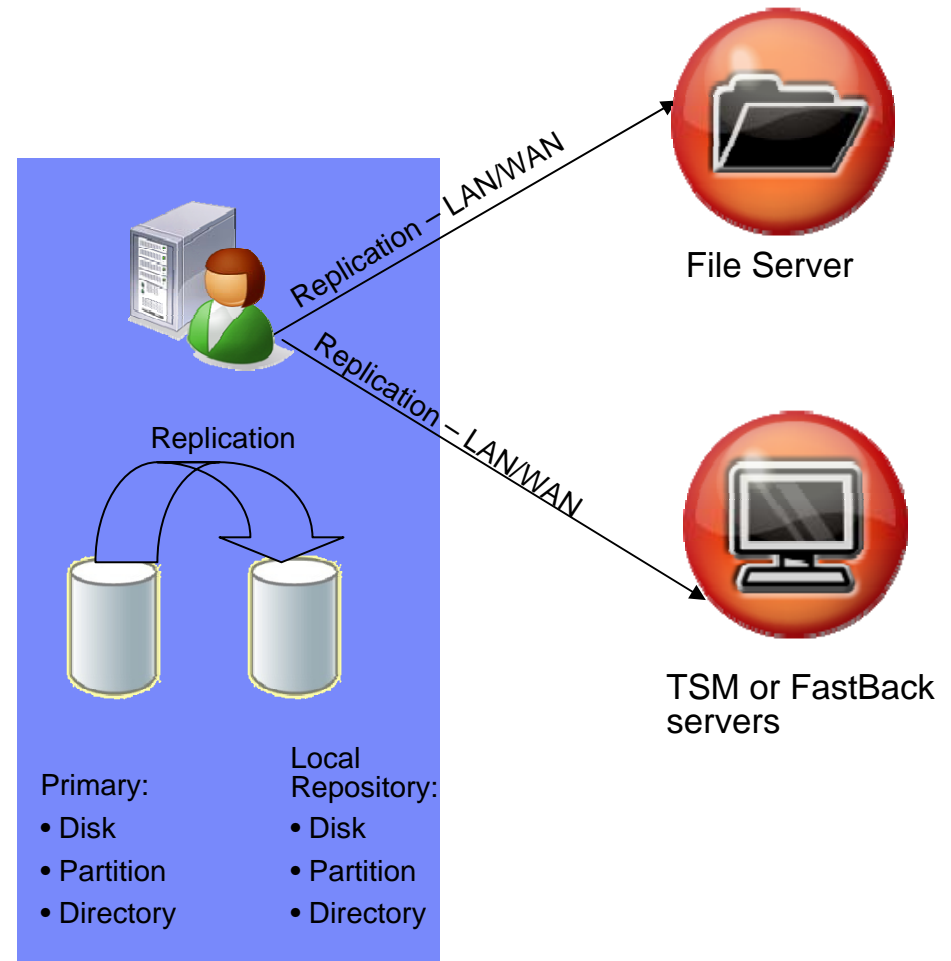
TSM FastBack for Workstations includes central administration of 1000's of desktop and laptop computers

FastBack for Workstations central administration can be combined with TSM and FastBack in one instance of the Tivoli Integrated Solutions Console
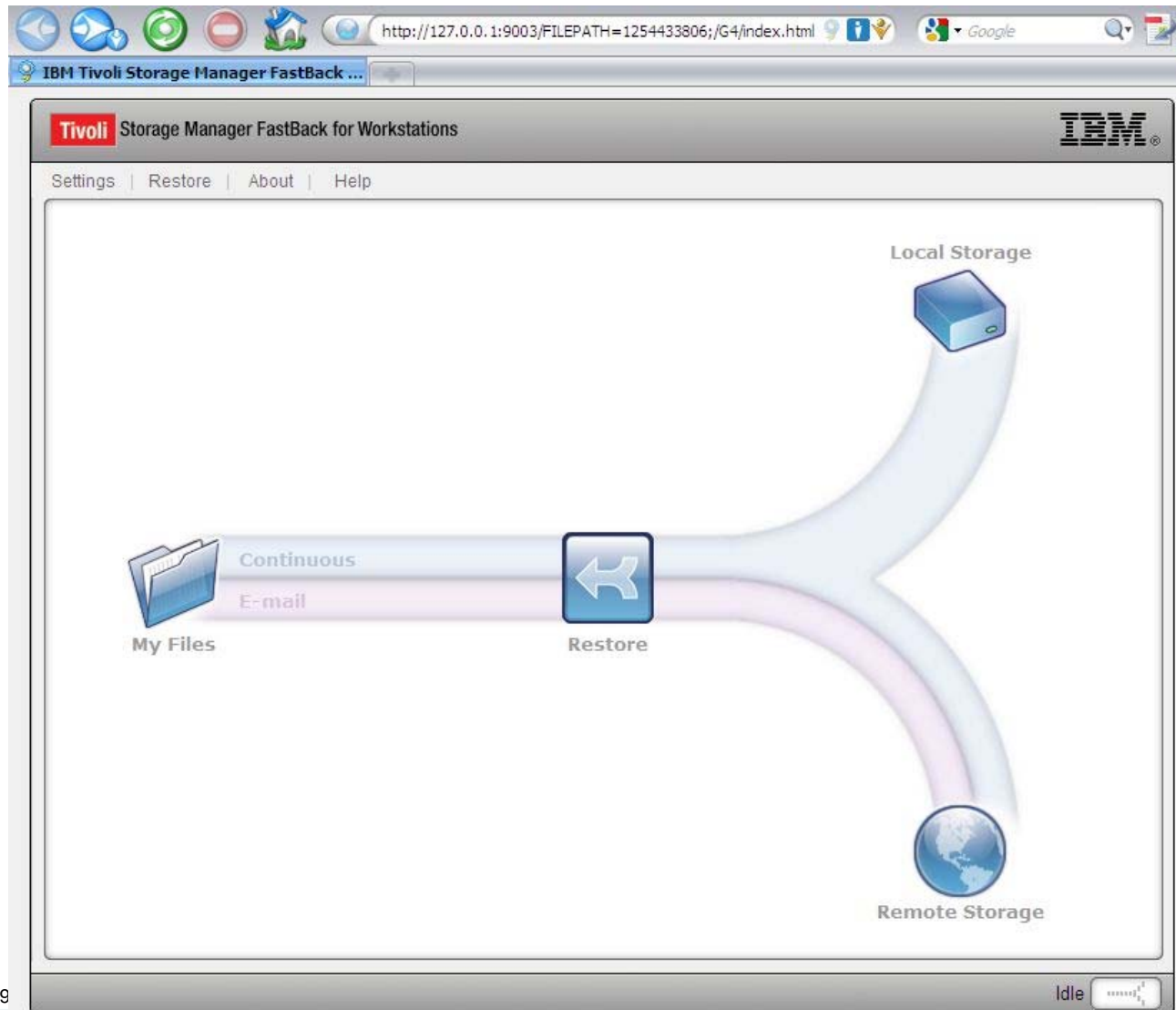
View Client Information:
- Amount of storage being used
- Amount of client activity
- Current configuration
- Clients storage target

Take Client Actions:
- Force an incremental backup
- Push a configuration
- View log files
- View Alerts
- Admin can lock client configuration so it can not be changed

TSM FastBack for Workstations - Client Home Page

Easy to set up:
- Select the files and mailboxes (Outlook & Notes) that you want to protect
- Select the amount of local disk to allocate for backups
- Select the target(s) for off-machine copies of data

Easy to manage:
- Drop down status windows for reports on last backup, capacity usage, network connectivity, etc.

Easy to restore:
- Simple drag-and-drop from the point-in-time and location that you select

TSM FastBack for Workstations – Features, Advantages, Benefits

Features	Advantages	Benefits
Continuous Data Protection	Real-time data protection	Simplified storage management may save IT and end user labor
Restore to point-in-time	Multiple versions of the files retained	Continuous data protection provides data integrity when viruses and corruption attack systems
Backups up on periodic basis to a remote file server	Faster backup	Reduces or eliminates backup windows and optimizes integration to network and enterprise data protection solutions
Backs up only changed files	Less data is transferred	Optimizes bandwidth and network transfer of data
Backs up your files the moment they change	Real-time data protection	Continuously protects versions of the files to allow customers choice of recovery points
Backs up files to local cache	Stand-alone protection	Ability to write protect data locally even when not connected in case of virus, corruptions, logical error or user error.
Remote and local disk support	Choice of backup devices	Ability to send data to mixture of backup devices – Disk, NAS, USB, local partition, LUN from SAN

DIFFERENTIATING NEEDS

Which mechanism and when?

- Disk subsystem based replication when storage hardware is compatible
  - Use FlashCopy Manager and/or TPC for Replication where appropriate
- SAN Volume Controller when disk-level replication is required, but storage HW may limit
  - Use FlashCopy Manager and/or TPC for Replication where appropriate
- FastBack for SW level replication
- FastBack for Workstations for desktop/laptop

Khop Khun Mak

Cheers

Sukran

Tack

Diolch

Merci

Gracias

Arigato

Kamsa hamaida

Danke

Salamat

kiitos

Efharisto

Thank You

Dankie

Grazie

Hvala

Xie xie

Kam ouen

Shukria

Tesekkurler

Köszönöm

Toda

Takk

Spasiba

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