Washington Systems Center - Storage

z14 and IO Infrastructure Modernization

Tim Jeka – Brocade Solution Architect
Brian Sherman – IBM Distinguished Engineer
Bob Sommer – IBM Tape Specialist
Accelerate with IBM Storage Webinars

The Free IBM Storage Technical Webinar Series Continues...

*Washington Systems Center – Storage* experts cover a variety of technical topics

**Audience:** Clients who have or are considering acquiring IBM Storage solutions. Business Partners and IBMers are also welcome.

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**Information, schedules, and archives:**

Located in the Accelerate with IBM Storage Blog:


**Upcoming Webinars**

**Oct 10th**  z14 IO Infrastructure Modernization

**Recent Webinars**

**Sept 14th**  DS8000 R8.3 Update  
**Sept 7th**  Utilizing the BVIR VEHSTATS Reports to Monitor Your TS7700 Environment

**Recent Webinars (cont)**

**Aug 10th**  Tape - What’s New  
**Jul 24th**  Advanced uses of IBM Storage for storage immutability, building air gapped storage and recovery from RansomWare attacks  
**Jul 20th**  Spectrum Virtualize Encryption  
**Jun 29th**  DS8880 Thin Provisioning  
**Jun 22nd**  FlashSystem A9000 Update
• Customer demonstrations, Proof of Concepts, performance benchmarks

• Customer Workshops
  ➢ FlashSystem A9000/A9000R, XIV & Spectrum Accelerate Customer Workshop
    (Phoenix, AZ November 29-30)
  ➢ DS8000 Advanced Functions Customer Seminar
    (Seattle, WA November 01-02)

• Customers interested in participating in the workshops should contact their IBM Marketing Representative.
Agenda

- DS8000 and IBM z14 Connectivity Update
- TS7700 Updates
- Brocade Gen 6 and FOS8.1
IBM DS8880, Brocade and IBM Z – Continuing to Integrate by Design

• Highlights of what’s new with R8.3:
  • IBM zHyperLink
    • Designed to deliver less than 20usec response times
    • All DS8880’s support zHyperLink technology
  • Up to 3.8x more Flash capacity with 3.8TB High Capacity Flash cards
  • New processor in the DS8888 delivers increased performance
  • Automated tiering to the Cloud
    • DFSMS policy control for DFSMSHsm tiering to the cloud
    • Amazon S3 support for Transparent Cloud Tiering (TCT)
    • Volumes in a two site Metro Mirror copy services relationship supported
  • Cascading FlashCopy
    • Allows target volume/dataset in one mapping to be the source volume/dataset in another mapping creating a cascade of copied data
  • Miscellaneous
    • GUI, Easy Tier, CSM, Thin Provisioning controls and more

Years of research and collaboration between the IBM storage, Brocade and IBM Z teams, working together to transform businesses with trust as a growth engine for the digital economy
IBM DS8880, Brocade and IBM Z: Integration by Design

**Performance**
- zHPF Enhancements (now includes all z/OS DB2 I/O, BxAM/QSAM), DB2 Castout Accelerator
- Extended Distance FICON
- Caching Algorithms – AMP, ARC, WOW, 4K Cache Blocking
- Cognitive Tiering - Easy Tier Application, Heat Map Transfer and DB2 integration with Reorgs
- z/OS GM Multiple Reader support and WLM integration
- Flash + DFSMS + zHPF + HyperPAV/SuperPAV + DB2
- zWLM + DS8000 I/O Priority Manager
- zHyperWrite + DS8000 Metro Mirror
- zHyperLink
- FICON Dynamic Routing

**Availability**
- Forward Error Correction (FEC) code
- HyperPAV/SuperPAV
- GDPS and Copy Services Manager (CSM) Automation
- GDPS Active/Standby/Query/Active
- HyperSwap technology improvements
- Remote Pair FlashCopy and Incremental FlashCopy Enhancements
- zCDP for DB2, zCDP for IMS – Eliminating Backup windows
- Cognitive Tiering - Easy Tier Heat map transfer

**Management / Growth**
- Hybrid Cloud – Transparent Cloud Tiering (TCT)
- Quick Init for CKD Volumes
- Dynamic Volume Expansion
- Extent Space Efficient (ESE) for all volume types
- z/OS Distributed Data Backup
- z/OS Discovery and Automatic Configuration (zDAC)
- Alternate Subchannel exploitation
- Disk Encryption
- Automation with CSM, GDPS
Having the right infrastructure is essential: IBM DS8000 is ranked #1 storage for the IBM Z

Global market acceptance
#1 with 55% market share

Clear leadership position
90% greater revenue than next closest competitor

19 of the top 20 world largest banks use DS8000 for core banking data

Source: Calculations based on data from IDC Worldwide Quarterly Disk Storage Systems Tracker, 2017Q2(Worldwide vendor revenue for external storage attached to z/OS hosts)
## DS8880 Family of All-Flash Arrays (AFA)

Efficiently designed to meet a wide range of business needs, from midrange to large enterprises

<table>
<thead>
<tr>
<th>Model</th>
<th>DS8884F</th>
<th>DS8886F</th>
<th>DS8888F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>984 (Single Phase)</td>
<td>985 (Single Phase) / 986 (Three Phase)</td>
<td>988 (Three Phase)</td>
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<tr>
<td>Max Cache</td>
<td>256GB</td>
<td>2TB</td>
<td>2TB</td>
</tr>
<tr>
<td>Max FC/FICON ports</td>
<td>32</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>Media</td>
<td>192 Flash cards</td>
<td>384 Flash cards</td>
<td>768 Flash cards</td>
</tr>
<tr>
<td>Max raw capacity</td>
<td>729.6TB</td>
<td>1.459PB</td>
<td>2.918PB</td>
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<tr>
<td>Max IOPs</td>
<td>550,000</td>
<td>1.8M</td>
<td>3.0M</td>
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<tr>
<td>Minimum latency</td>
<td>120usec</td>
<td>120usec</td>
<td>120usec</td>
</tr>
</tbody>
</table>
DS8880 Media Options – All Encryption Capable

- **Flash – 2.5” High Performance Flash**
  - 400/800/1600/3200GB Flash cards

- **Flash – 2.5” High Capacity Flash**
  - 3.8TB Flash cards
  - SOD for 7.6/15TB Flash cards

- **SSD – 2.5” Small Form Factor**
  - Latest generation with higher sequential bandwidth
  - 200/400/800/1600GB SSD

- **2.5” Enterprise Class 15K RPM**
  - Drive selection traditionally used for OLTP
  - 300/600GB HDD

- **2.5” Enterprise Class 10K RPM**
  - Large capacity, much faster than Nearline
  - 600GB, 1.2/1.8TB HDD

- **3.5” Nearline – 7200RPM Native SAS**
  - Extremely high density, direct SAS interface
  - 4/6TB HDD
DS8888 AFA Performance - Open OLTP (DB Open – 70/30/50)

Open OLTP (DB Open – 70/30/50)
DS8888 48 Core (new processor/DDR4 memory)
IBM DS8000 Recommendation - RAID 6 for mission-critical protection

Drive media is rapidly increasing in capacity to 10TB and more. The greater density provides real cost advantages but requires changes in the types of RAID protection used.

Traditionally RAID 5 has been used over RAID 6 for Enterprise and Flash media because:

- Performs better than RAID 6
- Provides more usable capacity

However as the drive capacity increases, RAID 5 exposes enterprises to increased risks, since higher capacity drives are more vulnerable to storage media errors during array rebuild:

- Data will be lost, if a second drive fails while the first failed drive is being rebuilt
- Media errors experienced on a drive during rebuild result in a portion of the data being non-recoverable
I/O Latency Improvement Technologies for z/OS

Components of I/O Latency*

* Not drawn to scale
**I/O driver benchmark**

- **I/Os per second**
- **4k block size**
- **Channel 100% utilized**

---

*This performance data was measured in a controlled environment running an I/O driver program under z/OS. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.*

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**I/O driver benchmark**

- **MegaBytes per second**
- **Full-duplex**
- **Large sequential read/write mix**

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What is IBM zHyperLink™?

- zHyperLink Express is a direct connect short distance IBM Z I/O feature designed to work in conjunction with a FICON or High Performance FICON SAN infrastructure.

- IBM zHyperLink dramatically reduces latency by interconnecting the z14 CPC directly to the I/O Bay of the DS8880.

- zHyperLink improves application response time, cutting I/O sensitive workload response time in half without significant application changes.
How does IBM zHyperLink™ change the game?

• zHyperLink™ is FAST enough the CPU can just wait for the data
  • No Un-dispatch of the running task
  • No CPU Queueing Delays to resume it
  • No host CPU cache disruption
  • Very small I/O service time

• Operating System and Middleware (e.g. DB2) are changed to keep running over an I/O

• Transparently gives DB2 apps fundamentally better latency than applications on platforms without zHyperLink
zHyperLink Infrastructure at a Glance

• **z14 zHyperLink Express Adapter**
  - Two ports per adapter
  - Maximum of 16 adapters (32 ports)
  - Function ID Type = HYL
  - Up to 127 Virtual Functions (VFs) per PCHID
  - Point to point connection using PCIe Gen3
  - Maximum distance: 150 meters

• **DS8880 zHyperLink Adapter**
  - Two ports adapter
  - Maximum adapters
  - Up to 8 adapters (16 ports) on DS8888
  - Up to 6 adapters (12 ports) on DS8886
  - Point to point connection using PCIe Gen3
I/O Performance – Evolution to zHyperLink with DS8886

- Number of IOOPs (4K block size)
  - IBM DS8886
  - IOOPs per CHN
  - Single channel BW (GB/s)
  - Average latency (μsec)

- IOOPs per CHN: 315K, 106K, 62K, 0.75, 1.6, 2.5, 3.2, 8.0
- Single channel BW (GB/s): 2.2M, 2.4M, 3.2M, 5.3M
- Average latency (μsec): 155, 148, 132, 20
zBenefit Estimator - what can a IBM Z / DS8880 infrastructure do for you

IBM Z and DS8880 unique performance enhancers

- zHyperLink
  - Read
  - Write
  - Improved Cache hit
- z14 FICON 16Gbs Express+
- SuperPAV
- DB2 Castout Accelerator
- Easy Tier / DB2 Reorg
- Metro Mirror Bypass Extent

IBM Z and other vendor storage

MSU Savings per month

Response Time improvements
Easy Tier – Support for High Capacity Flash

- High capacity flash is considered a unique tier within Easy Tier
  - Separate tier from high performance flash tier
  - High performance flash are 400, 800 1600 and 3200 GB
  - High capacity flash are 3800 GB (and higher)

- Easy Tier is a three tier architecture
  - Tier 0 is a high performance tier and will contain as much workload as possible
  - Tier 2 is a quiet capacity tier intended to contain idle or near idle workload
  - Tier 1 contains the rest of the workload

- DSGUI and DSCLI both have the option to assign a logical volume to a tier
  - Both have been enhanced to distinguish between High Performance Flash and High Capacity Flash
Easy Tier Reporting is now integrated into DSGUI

• Monitor Easy Tier directly from DSGUI using the workload categorization report and migration report
• Directly offload the 3 CSV files and the Excel tool from both DSGUI and DSCLI. This will enable you to:
  • Get the skew curve CSV file for DiskMagic modeling
  • View the detailed data for Easy Tier planning, monitoring and debugging

• As of R8.3, you are no longer able to offload the binary heat data and use STAT to parse it
  • Can still parse the heat data from prior R8.3 release use the R8.2 version STAT tool
Transparent Cloud Tiering (TCT) - Hybrid cloud storage tier for IBM Z

Transparent Cloud Tiering improves business efficiency and flexibility while reducing capital and operating expenses with direct data transfer from DS8880 to hybrid cloud environments for simplified data archiving operations on IBM Z.

1 Migration based on age of data via DFSMS Management Class policies
2 Amazon S3 is part of R8.3
3 For development and testing environments on this first release
Client DFSMSShsm Production Environment – Projected Improvement

Based on projections, approximations and internal IBM data measurements. Results will vary by customer based on particular workloads, configurations and software levels applied.
Transparent Cloud Tiering (TCT) - CPU Efficiency Estimator

IBM has created a tool to estimate CPU savings

• HSM writes various statistics to SMF record specified by SETSYS SMF(smfid)
  • Recommended smfid is 240

• FSR records are written to smfid+1 (241)
  • FSRCPU records CPU time
  • Fields include dataset size and amount of data written

• NEW: Tool is now publically available:

With a few days worth of SMF data, the estimator can determine:
1. Size of datasets to target for greatest cost savings
2. Estimated amount of CPU cycles saved by using Transparent Cloud Tiering

• WSC Storage team can process the data and generate the analysis.
Cascading FlashCopy®

- Cascading FlashCopy allows a target volume/dataset in one mapping to be the source volume/dataset in another mapping and so on, creating what is called a cascade of copied data.

- Cascading FlashCopy provides the flexibility to obtain point in time copies of data from different places within the cascade without removing all other copies.

With cascading FlashCopy®

- Any Target can become Source
- Any Source can become Target
- Up to 12 relationships are supported
Cascading FlashCopy Use Cases

- Restore a Full Volume FlashCopy while maintaining other FlashCopies
- Dataset FlashCopy combined with Full Volume FlashCopy
  - Including Remote Pair FlashCopy with Metro Mirror
- Recover Global Mirror environment while maintaining a DR test copy
- Improve DEFRAG with FlashCopy
- Improved dataset FlashCopy flexibility
  - Perform another FlashCopy immediately from a FlashCopy target
Improved IBM Z Support – Create Volumes

Current behavior

Step 1. In “Volumes by LSS”, Create LSSs

Step 2. In “Volumes”, Create Volumes

Step 3. In “Volumes by LSS”, Create Aliases

New behavior
User Interface Improvement of IBM i Provisioning

Create separate action for IBM i

Create fixed size IBM i volumes

Create variable size IBM i volumes
TS7700 updates
Brocade Update

16 Gbps FC Fabric

- DCX-8510-4
- DCX-8510-8
- FC16-32 Blade
- FC16-48 Blade
- 6510

32/128 Gbps FC Fabric

- X6-4
- X6-8
- FC32-48 Blade
- G620

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Questions
• IBM TS7700 System z Virtualization Engine

• TS7700 Overview
  • Bob Sommer, Certified Tape Specialist, Washington System Center
Leveraging IBM Technology

- **System p server with IBM Power8**
  - Two 10 core 64 bit engines
- **IBM RAID DASD**
  - High performance AES 256 bit encryption disks
- **AIX**
  - Reliable, robust, tools suites and support
- **Spectrum Scale (GPFS)**
  - High performance, high capacity, highly scalable
- **DB/2**
  - Highly scalable, highly available database
- **WebSphere Message Queues**
  - Highly available messaging architecture
- **FICON host adapters**
  - Common adapter hardware to the DS8K family
- **Host Perform Library Function (PLF) zSeries Commands Interface**
  - True synergy with z/OS without any dependency on MTL support
- **IBM Tape and Automation Technology**
  - 3592/TS1150 → 10TB on a tape
  - TS3500/TS4500 modular, scalable, highly available automation
TS7700 Leadership and Progression – 20 Years!

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Feature/Update</th>
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<tbody>
<tr>
<td>R1.0</td>
<td>09/29/06</td>
<td>2-way grid&lt;br&gt;TS3500 Support&lt;br&gt;163592 J1A drives</td>
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<tr>
<td>R1.1</td>
<td>01/26/07</td>
<td>AOTM&lt;br&gt;TS1120 Drive Support&lt;br&gt;Larger Disk Cache&lt;br&gt;SW 1Gb Fibre Grid&lt;br&gt;256 virtual devices</td>
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<tr>
<td>R1.2</td>
<td>03/09/07</td>
<td>Tape AES256 Encryption&lt;br&gt;Broadband call home</td>
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<td>R1.3</td>
<td>08/31/07</td>
<td>3-way grid&lt;br&gt;LI REQ Support&lt;br&gt;Copy export (standalone)&lt;br&gt;1M logical volumes&lt;br&gt;Secure data erase&lt;br&gt;ROR Recovery</td>
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<td>R1.4</td>
<td>11/23/07</td>
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<td>R1.5</td>
<td>12/05/08</td>
<td>TS7720&lt;br&gt;Disk Cache Refresh&lt;br&gt;TS1130 support&lt;br&gt;TS3500 support&lt;br&gt;TS3500 HD support</td>
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<td>R1.6</td>
<td>12/04/09</td>
<td>4-way grid&lt;br&gt;TS7720/TS7740 Hybrid&lt;br&gt;Logical WORM&lt;br&gt;Network Load balancing&lt;br&gt;Cluster Families&lt;br&gt;SNMP</td>
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<td>R1.7</td>
<td>06/04/10</td>
<td>Disk Cache Refresh&lt;br&gt;Selective Write Protect&lt;br&gt;Additional Memory FC&lt;br&gt;6000MB logical volumes&lt;br&gt;LDAP Support</td>
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<td>09/29/06</td>
<td>2-way grid&lt;br&gt;TS3500 Support&lt;br&gt;163592 J1A drives</td>
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<td>R1.9</td>
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<td>AOTM&lt;br&gt;TS1120 Drive Support&lt;br&gt;Larger Disk Cache&lt;br&gt;SW 1Gb Fibre Grid&lt;br&gt;256 virtual devices</td>
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<tr>
<td>R2.0</td>
<td>03/09/07</td>
<td>Tape AES256 Encryption&lt;br&gt;Broadband call home</td>
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<td>R2.1</td>
<td>08/31/07</td>
<td>3-way grid&lt;br&gt;LI REQ Support&lt;br&gt;Copy export (standalone)&lt;br&gt;1M logical volumes&lt;br&gt;Secure data erase&lt;br&gt;ROR Recovery</td>
</tr>
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<td></td>
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<td>Copy export (grid)</td>
</tr>
</tbody>
</table>

R3.0 12/7/12<br>Disk Cache Refresh<br>Disk AES256 Encryption<br>Unified GUI<br>4 Million Logical Volumes<br>Native LDAP<br>Limited IPv6 support

R3.1 12/6/13<br>1PB TS7720<br>8x8Gb FICON<br>512 paths per port<br>Flash Copy for DR<br>Testing<br>Time Delayed<br>Replication

R3.2 Dec 2014<br>Tape Attach TS7720<br>25GB Volume Support<br>496 UCB/Devices<br>RACF LDAP Support<br>LDAP SSR Bypass<br>LI REQ in MI

R3.3 Sept 2015<br>TS1150 Support<br>ISKLM for Disk<br>Grid to Grid Migration<br>TVC Preferencing<br>z/OS Device Data Changes

R4.0 2Q16<br>TS4500 Support<br>Power8 Server Refresh<br>4x10Gb Grid links<br>Distributed RAID6 Rebuilds

R4.1 1Q17<br>7/8 Way Grid

R4.1 2Q17<br>2.45 PB Cache / 8 TB<br>DS8K Offload to TS7700
IBM TS7760 At A Glance

- All previous TS7700 features continue to apply
- 100 to 2500 MB/sec on demand performance
- Up to 2.45 PB disk cache per system.
- 7.35 PB with 3:1 compression
- Up to 100PB Tape attach support
  - 300 PB with 3:1 compression
  - TS1150, TS1140, TS1130 Tape drives
  - TS4500 and TS3500 Automation
- Data protected at all levels
  - No performance impact
  - AES 256Bit Strong Encryption
- Dynamic Disk Pools
  - Distributed Raid
  - 8-Way Grid Cloud replication
Model TS7760 Components (slide 1 of 2)

• The frame – maximum 2.45 PB
  • Up to 36u of rack space dedicated to TS7760 components
    – A TS7760 system -3957-VEC
    – One TS7760 cache controller (3956-CSA) – 61.5TB (1.8X capacity)
    – Up to nine TS7760 cache drawers (3956-XSA) – 61.5TB each
    – 2nd and 3rd Frame – one cache controller, 15 cache drawers each (984TB)
    – Redundant power supplies for improved availability
    – Two power feeds for improved availability

• The “Cluster”
  • High performance IBM Power8 server
    – Two 10-way processor card
    – Over 2 GBps of data throughput
    – Redundant I/O drawers for improved availability
  • Performance enablement features
    – Up to 25 100MBps increments
  • Hardware for continuous availability
    – 2x1Gb, 4x1Gb (SW optical or Copper) or 4x10Gb LW Optical Grid Ports
    – Up to 8-way grid configurations
Model TS7760 Components (slide 2 of 2)

- Each TS7760 cache drawer
  - High performance **Dynamic Disk Pool**
    - Includes 8TB SAS HDDs
  - Supports high availability
    - Dual power
    - Automatic rebuild leveraging reserved capacity
    - Redundant hot-swap components

- TS7760T
  - Physical tape support
  - Copy Export
  - **16Gb Fibre Channel connectivity**
  - Minimum of 4 and a maximum of 16 tape drives
  - Supports
    - TS1150, TS1140, TS1130 tape drives
    - **TS4500** and TS3500 tape libraries
    - High Availability
      - Dual power
      - Dual active accessors
  - AES 256 bit encryption
  - Would solve Airgap issues
Dynamic Disk Pool Basics

- **Traditional RAID-6 Rebuild after a drive failure (TS7720)**
  - All drives in the array are read, parity recomputed and result written to the **spare drive**
  - Process takes several days because the spare drive is the bottleneck (all writes go to this single drive)
  - When the failed drive is replaced with a new drive the data is **copied-back** from the spare to the new replacement drive. This typically takes 1 day

- **New Dynamic Disk Pool after a drive failure (TS7760)**
  - There are no global spare drives, instead all pool members have spare space reserved
  - The pool will read all its drive members recompute parity and the result will be stored in the reserved space anywhere in the pool
  - No single drive will be used for the writes since data is distributed everywhere
  - This speeds up the process because there are parallel reads and parallel writes (no more bottleneck)
  - When the failed drive is replaced the pool is rebalanced again
    - There is no copy-back!
TS7760 Value Based Enhancements (vs TS7720)

Up to 60% Cache Throughput Improvement
- Reduced drawer count for the same performance
- Minimal host throughput improvements expected until 16Gb FICON is supported (Expected December, 2017)

Up to 27% faster replication with 4 10Gb links
2X higher Redundancy in 10Gb grid connectivity
Up to 2X higher bandwidth to Physical tape with 16Gb switches
- Reduce data retrieval times

2.4X More Disk Storage Capacity

Up to 68% Faster Cache Rebuild Times
- Reduced impact to performance

Reduce disk firmware updates times
- Concurrent Disk Firmware updates eliminate impacts to operations
IBM TS7700 System Z Virtualization Engine

Leveraging Grid as Cloud Tape Storage for System z

Grid Cloud

8-way consisting of any generation of TS7700
- R3.3 or later on all V07/VEB clusters
- R4.1.1 or later on VECs
- Supports indefinite use
- Some limitations when R4.0 or older code levels exist.

Cumulative FICON throughput of over 3.6GB/s * 8

System z hosts view up to 496 * 8 equivalent devices

Grid access to all data independent of where it exists.
Network Considerations

• The network infrastructure should not add packet metadata (increase its size) to the default 1500-byte maximum transmission unit (MTU).
• Jumbo Frames are not supported
• The TS7700 uses TCP/IP for moving data between each cluster. Bandwidth is a key factor that affects throughput for the TS7700.
• The following key factors can also affect throughput:
  • Latency between the TS7700 tape drives
  • Network efficiency (packet loss, packet sequencing, and bit error rates)
  • Network switch capabilities
  • Flow control to pace the data from the TS7700 tape drives
  • Inter-switch link capabilities (flow control, buffering, and performance)
Network Considerations (Cont’d)

• To maximize throughput, ensure that the underlying network meets these requirements:
  • Has sufficient bandwidth to account for all network traffic that is expected to be driven through the system to eliminate network contention.
  • Can support the **flow control** between the TS7700 tape drives and the switches, which enables the switch to pace the TS7700 tape drives with the WAN capability.
  • **Flow control** between the switches is also a potential factor to ensure that the switches can pace their rates to one another. The performance of the switch can handle the data rates expected from all of the network traffic.
Current DR Solutions for IP Storage

- Widespread replication throughput challenges over distance
- Unprotected traffic between data centers
- Competing demands for bandwidth and priority
  - Regular users affected by high-bandwidth replication or backup traffic
  - Storage team sees RTO and RPO impacts from high-bandwidth events in the user community
- No proactive warnings or insight to identify network problems and ownership
- Cannot efficiently adapt to changes in WAN bandwidth
- No guarantee of high availability
What is SAN42B-5 IPEX?

IPEX is short for IP Extension

IPEX is IP Storage WAN-Security-Availability-Operations Optimization

IBM SAN42B-R IPEX solves what problem?
Business Resiliency and Replication Issues

Who are the customers trying to solve this problem?
Storage and Mainframe Administrators
IBM SAN42B-R Extension Switch

Purpose-built for IP storage replication

- Increase performance and scalability with more than 30 Gbps application throughput per platform
- Provide dramatically higher throughput than native IP storage replication
- Secure data flows over distance with 256-bit IPsec encryption without a performance penalty
- Improve load balancing and network resilience with Extension Trunking, Adaptive Rate Limiting, and Fabric Vision technology
- Extend proactive monitoring between data centers to automatically detect WAN anomalies and avoid unplanned downtime
- Pre-validate and troubleshoot the physical infrastructure with a built-in traffic generator and WAN Test Tool to accelerate deployment
### IPEX TCP Acceleration

The results (IBM TS7700 Grid)

<table>
<thead>
<tr>
<th>Latency (ms) RTT</th>
<th>No packet drop</th>
<th>1% packet drop</th>
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<tbody>
<tr>
<td></td>
<td>Native</td>
<td>IPEX</td>
</tr>
<tr>
<td>2</td>
<td>590</td>
<td>590</td>
</tr>
<tr>
<td>20</td>
<td>590</td>
<td>590</td>
</tr>
<tr>
<td>100</td>
<td>65</td>
<td>560</td>
</tr>
<tr>
<td>250 (Brocade IPsec enabled)</td>
<td>25</td>
<td>540</td>
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</tbody>
</table>

- Results in MB/s

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IBM SAN42B-R TS7700 Solution.. IPEX Deployment

- No re-cabling
- No IP address changes
- No new subnets
- No new VLANs

Only the gateway IP address changes

Only for routes to remote subnets

Default or local subnet gateways remain the same

Remote Flows now go here

IPEX TS7700 Storage End devices
TS7700 8Gb LW FICON Ports

TS7700 10 Gb Ports

Data Center LAN switches (Supports 10Gbps)
LAN side LAGS provide redundant links with redundant cables and optics.
Ingress LAN Traffic to SAN42B-IPEX Gateway

SAN42B-R IPEX Gateway
Tunnels send traffic to the desired DC
VE ports/Circuits

Remote Flows now go here

Two 10Gb WAN Pipes

IP Router
Original Gateway
Local flows continue to go here

WAN to remote Data Centers
Replicate same solution remotely
TS7700 z/OS Policy Management

- Integrated DFSMS support
  - Automatic Class Selection (ACS) Routines
  - Storage construct names assigned to logical volumes
  - Construct names passed to TS7700 during mount request
- Volume granular policy management
  - Replication can occur synchronously, immediately or asynchronously or any mixture of the three
  - No dependency on Tape Management System pools
- Dynamic policy updates
  - Simply redefine the name or rules and a simple mount/demount enforces it
- Most TS7700 features are policy managed
  - Volume capacities, media types, replication policies, physical tape pooling, allocation assistance, tier to tape behavior and many others
True Sync Mode Copy

- **Volume End Guaranteed/Immediate mode copy does not provide a Zero RPO**
  - Applications which stack datasets to tape such as DFSMSHsm ML2 migrations can remove previously stacked datasets from DASD prior to end of volume processing
  - Content not yet replicated up to that point on tape is exposed to a single datacenter copy on tape

- **TS7700 provides the first Zero RPO synchronous copy method**
  - Up to two sites will be kept consistent after each implicit or explicit tape SYNC operation
  - Provides applications, such as DFSMSHsm, dataset level replication (Zero RPO!)
  - Additional Deferred and/or Immediate copies can occur once RUN is received processes the need to run host duplexing for equivalent RPO
  - Eliminates the need to run host duplexing for equivalent RPO

---

[Diagram showing real-time host writes and sync points]
4-way HA/DR Partitioned Configuration

- **Two production clusters at local or metro distances**
  - Host workload balanced across both clusters
  - Content written to particular mounting cluster is only replicated to one remote cluster
- **Two remote clusters at metro or DR distances**
  - Each remote cluster replicates content from one of the two production clusters
- **High availability at both locations without four copies of the data**
  - Same capacity as two 2-way configurations, with the high availability of a 4-way configuration
  - A true high available and disaster recoverable business continuous configuration!

Up to 2.4GB/s (6.4GB/s @ 2.66:1)

(7.8PB @ 3:1 comp)
Data Center Migrations Made Easy

- **Data Center Migration**
  1. Introduce two new clusters at 2nd data center (DC2)
  2. New workload targets DC2. DC1 is used for reads only.
     - Reads from DC1 host or through Grid WAN from DC2
  3. Use VESYNC and COPYRFSH to move existing content to new data center DC2.
  4. Eliminate DC1 using cluster removal ending up with a 3-way configuration.

![Diagram showing data center migrations](image)
Tape Partitions

- **Custom define up to seven tape attached partitions**
  - Each partition would utilize a customer defined fixed amount of capacity from the total configured
  - Each partition is independently hierarchical storage managed to back end tape
    - Contains its own PG0 and PG1 content.
    - Deferred Premigration (retain copy in disk cache only until time from creation/last-access expires)
      - Perfect for Archive!
  - Policy managed as to which partition a workload targets

- **One resident only partition**
  - What space remains after creating zero to seven tape managed partitions is viewed as the resident only partition
  - All data in the resident only data partition remains there indefinitely and doesn’t offload to tape
  - TS7700 grid removal policies apply to this partition when it becomes full

---

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Flash Copy for DR Testing

• **Full support of concurrent testing**
  - DR test host can run while production continues
  - Production data continues to replicate during the entire test
  - Mount volumes at both production and DR at the same time.
  - Data contained within any TS7720 DR cluster is accessible for DR testing and the content at time zero is provided.
  - Through selective write protect, DR host can create new content to segregated volume ranges.

• **Production data protection**
  - Use TS7700 selective write protect to isolate DR test volumes by category for full read/write access while only allowing read access to production volumes
  - All access to write protected volumes will actually access a snapshot in time flash.
  - Access production volumes which have been returned to scratch as private volumes within DR location
  - No need to disable return to scratch processing

• **Enablement**
  - Configure “DR Families” via LI REQ
  - Enable Write Protect and/or Flash from the LI REQ command against all clusters in a DR Family
TS7700 Monitoring/Management

- Web-based Management Interface
  - Configuration/health/performance status/statistics
  - Unification between IBM solutions
- z/OS operator console
  - ‘Green Screen’
  - For operator monitoring of TS7700 status and changing of many settings
- Operational statistical data
  - Captured every 15 minutes, 90 rolling days kept outboard
  - IBM provided report formatting tools (VEHSTATS, MI Graphical Output)
### TS7760: TS4500 Attachment

- Next Generation Enterprise Automation
- Dual-Accesor for High Availability
- Integrated Service Bay
- Dynamic Partitioning
- Transparent Capacity on demand
- Virtual I/O (VIO)
- Up to 128 - TS1150 / TS1140
- Single Cartridge support up to 10 TB native
- **16Gb FC Switch support is required** for TS7760T attachment
- 100 PB native usable capacity when attached to TS7760T

- Improved Management
- Magazine I/O
- Native LDAP support
- Improved ease of use

<table>
<thead>
<tr>
<th>Media</th>
<th>TS1140</th>
<th>TS1150</th>
</tr>
</thead>
<tbody>
<tr>
<td>JA</td>
<td>Read</td>
<td></td>
</tr>
<tr>
<td>JJ</td>
<td>Read</td>
<td></td>
</tr>
</tbody>
</table>
| JB    | Read-E05  
1.0TB-E06*  
1.6TB-E07 |        |
| JC    | 4TB    | 4TB-E07*  
7TB-E08 |
| JK    | 500GB  | 500GB-E07**  
900GB-E08 |
| JD    |        | 10TB    |
| JL    |        | 2TB     |
DS8000 and TS7700 Object Offload via Transparent Cloud Tier

- Build upon DS8K TCT enhancements
- TS7700 Grid is streamlined target
- z/OS offloads data to your private Grid Cloud
  - DFSMSHsm Datasets
  - DFSMSHsm Backup
  - Full Volume Dumps
  - Others
- Benefit from TS7700 Functions
  - Full DFSMS policy management
  - Grid replication
  - Integration with physical tape
  - Analytics offloading, e.g. ISO 8583 for zSpark
  - Further tier to on prem or off prem cloud
Statement of Direction

• TS7700 Integration with Cloud-based storage

“IBM® plans to offer integration with cloud-based storage solutions as an extension of the existing advanced capabilities of TS7700 systems. Through policy management, IBM plans to enable the use of on-premise and off-premise, cloud-based storage for TS7700 content for uses such as data tiers, data archiving, data migration, and disaster recovery, and to transport data to other platforms, such as distributed systems applications.”
TS7700 Cloud Tier via Transparent Cloud Tier

- Leverage TCT for off load to public or private cloud
- Physical tape and cloud tier are both policy managed options
  - Move to neither, both or just one of the two
  - Timed movement from one to the other
- Store in standard format making it accessible to distributed systems
- Use for DR restore point when grid is not an option or as an additional level of redundancy
- Use for migration between grids
- Optionally encrypt all data that enters the cloud
Is your Storage Area Network Ready for Flash?

Tim Jeka
System Engineer
Brocade Communications
IBM z14, Gen6 SAN, and IBM DS88xx Systems

Designing, developing, and testing together is key to unlocking true value

Only IBM!

In-flight Encryption
IBM Health Checker for Z/OS
Faster Transaction Performance
Forward Error Correction
FICON Dynamic Routing
Read Diagnostic Parameters
Brocade CUP Diagnostics
Multi-Hop zHPF
“Fibre Channel will remain the data center protocol of choice for the next decade as performance bottlenecks move out of arrays and into the storage network”

“Storage networking investments are becoming a critical top priority due to the adoption of high-throughput, solid-state, and flash storage”

“IT leaders planning to upgrade their storage networking need to use 16Gbps FC today with a migration plan for moving to 32Gbps FC”
Modernize all aspects of your Data Center

What is missing?
The Data Path…

… is critical to ensure:
Performance
Security
Scalability
Visibility

If you do not plan for the network, then your solution will be at risk of performance bottlenecks, availability concerns, and other potential issues that could jeopardize your applications accessing their data.
Modernize all aspects of your Data Center
Why is All-Flash Array Growth Such A Game Changer?

Why 32Gb is important?

Relative performance

Servers

32GB is ready for all Flash Arrays
8/16/32/128 FC

Works in Nanoseconds
Some servers can do more than 1.5 million transactions per second each with many I/Os per transactions

Servers Adapters?

Intel FC SFP+ 1.3 Million
P series FC 780,000 IOPs
Z series 16S+ 320,000 IOPs
P Series PCIE3 PWR8 32GB

Works in Microseconds

Flash run at about 150 IOPS
or about 6,000 IOPS per Tray

Features
16GB IOPs 10s of Millions
16GB delivers 450 Million Frames per second!
Latency 700NS
32GB IOPs 100s of Millions
32GB delivers 1 Billion Frames/second
Latency 900 NS
NVMe Ready

Storage Network Fabric

HDD
SSD

IOPs will only Increase

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Fibre Channel the Next Generation

- Serial and Parallel Link Speeds... 32Gb, 16Gb, 8Gb

<table>
<thead>
<tr>
<th>Generation</th>
<th>6th Gen</th>
<th>7th Gen</th>
<th>8th Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical / Optical Module</td>
<td>32GFC and 128GFCp /SFP+ and QSFP28</td>
<td>64GFC and 256GFCp /SFP+ and QSFP56</td>
<td>128GFC and 512GFCp /SFP+ and QSFP112</td>
</tr>
<tr>
<td>Electrical Speeds (Gbps)</td>
<td>1 lane of 28.05</td>
<td>1 lanes of 56.1</td>
<td>1 lane of 112.2</td>
</tr>
<tr>
<td></td>
<td>4 lanes at 28.05</td>
<td>4 lanes at 56.1</td>
<td>4 lanes at 112.2</td>
</tr>
</tbody>
</table>

Best Practices
Cleaning Optics at 8G and above!
SM Cable w/oil or dust.
Z13/z13s...I/O Infrastructure has to Keep Pace!
Enhancing the value of the I/O Infrastructure

I/O Enhancements designed with Brocade Engineering

- This Big Beast needs to be fed a hearty diet of data:
  - FICON Express 16S (93,000 IOPS with zHPF)
  - Supports 160 FICON Express 16S cards
  - Supports 320 16Gbps CHPID channel ports @ 2800 MBps Full Duplex
  - IBM’s z13/z13s added new Intelligent I/O with the FICON Express 16S Chip Set..

Key Hardware Enhancements to the DS888X
- 16GFC FCP/FICON Host Adapter reduces latency
  - Minimum Latency <1ms

Key Function Enhancements to the DS888X
- Forward Error Correction
- FC Read Diagnostic Parameters
- FICON Dynamic Routing
- Fabric IO Priority
- zHPF Performance for distance

Looks Familiar…. Same I/O Enhancements
Same 16Gb chip set as z13/z13s

DS888X
2.5 IOPs

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I/O Enhancements designed with Brocade Engineering

- **FICON Express 16s+ Features**
  - FICON 16G S+ Chip Set
  - Faster Transaction Performance
  - Forward Error Correction Code
  - Multi-hop zHPF
  - FICON Dynamic Routing
  - Read Diagnostic Parameters
  - New CUP Facility
  - Port Decommission
  - IBM zHealth Checker Enhancements
  - NPIV Enhancements
  - FICON Fabric Priority

- FICON Express 16s+ designed to boost I/O rates and reduce latency!
  - FICON Express16S+ (320K IOPS with zHPF)
  - 3x performance improvement over the FICON Express 16s on z13!
  - Position the SAN for higher performance..16,8,4
  - IBM’s z14 added new Intelligent I/O with the FICON Express 16S+ Chip Set.

Key Hardware Enhancements to the DS888X
- 16GFC FCP/FICON Host Adapter reduces latency
  - Minimum Latency <1ms

Key Function Enhancements to the DS888X
- Forward Error Correction
- FC Read Diagnostic Parameters
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- Fabric IO Priority
- zHPF Performance for distance

**Looks Familiar…. Same I/O Enhancements**
Same 16Gb chip set as z13/z13s
**DS8880 will have 16s+ 2017**

**DS888X 2.5 IOPs**

TS7760 16Gb FICON Card
Supported 4.1.2 Microcode 12-17
I/O driver benchmark
I/Os per second
4k block size
Channel 100% utilized

+FICON Express8
20000
52000
FICON Express8S
20000
23000
FICON Express16S
FICON Express16S+S
92000
98000

FICON Express16S
300000
FICON Express16S+S
620
770
620
620
620
7196,7114

6% increase

*This performance data was measured in a controlled environment running an I/O driver program under z/OS. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, and the workload processed.
FCP Performance* for z14

I/Os per second
Read/writes/mix
4k block size, channel 100% utilized

FICON
Express4

FICON
Express8

FICON
Express8S

FICON
Express16S

FICON
Express16S+

380000
345% increase

MegaBytes per second (full-duplex)
Large sequential
Read/write mix

FICON
Express4

FICON
Express8

FICON
Express8S

FICON
Express16S

FICON
Express16S+

3200
25% increase

*This performance data was measured in a controlled environment running an I/O driver program under z/OS. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed.
Trust Z: Self Healing, Self Tuning, Self Diagnosing SAN Infrastructure

Brocade and IBM have released a series of features and functions specifically designed to address the needs and demands of the data center.

- **3-4x IOPS** increase for application acceleration
- **FICON Dynamic Routing** reduce traffic congestion, simplifies configuration and optimizes performance
- 66% I/O improvement writing data remotely with **zHPF Enhanced Write Protocol**
- Integration with IBM z/OS **Work Load Manager** SAN Priority
- Integrated **Read Diagnostic Parameters** to non-disruptive find trouble spots
- Insight into the network health and performance with **Fabric Vision** technology
- Maximizes scalability with **ICLs** without using up ports for ISLs and adding hops
- Security with **In-flight Encryption** between switches and sites.
- **Health Checker** (Z/OS) discovers single points of failure & analyze flow characteristics
- Increase reliability with automated **Port Decommission and Recommission**
- **Forward Error Correction** enables recovery from errors in links, enhancing transmission reliability and performance
Home of the IBM Qualification Letters

- IBM ResourceLink
  - Login
  - Select “Library” link
  - Select “Switches and Directors” qualified for directors and switches qualified for IBM Z FICON and FCP channels.
  - The qualifications letters are listed on the right hand side of the page
IBM Z® Qualification support for Brocade Fabric Operating System (FOS) 8.1.0c and Brocade Network Advisor (BNA) 14.2.1

International Business Machines Corporation and Brocade Communications Systems, Inc. have successfully completed qualification testing of z/VM (with performance FICON, FCP, and FCPP protocols, using the switches and directors in Table 1) with FOS 8.1.0c and BNA 14.2.1, in the configurations in Table 2, for the following IBM Z family hardware platforms: IBM z14™ (z14), IBM z13s® (z13s), IBM zEnterprise 114® (z114), IBM zEnterprise 196® (z196), and IBM zEnterprise 2100® (z2100), and for the following IBM LinuxONE™ platforms: LinuxOne Emperor™ and LinuxOne Rockhopper™.

### Table 1: Supported directors and switches

<table>
<thead>
<tr>
<th>Brocade Name</th>
<th>IBM Machine Type</th>
<th>Max. Logical Switches</th>
<th>Max. CUP Instances</th>
<th>FICON Base Switch (XCSL) Support</th>
<th>Supported Blades</th>
<th>Supported SFP Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>X8-4</td>
<td>SAN365B-4</td>
<td>20000-700</td>
<td>15</td>
<td>Yes</td>
<td>FC32-48, SXS</td>
<td>10 Gbps, 40 Gbps</td>
</tr>
<tr>
<td>G120</td>
<td>SAN565-6</td>
<td>5900-756</td>
<td>4</td>
<td>No</td>
<td>N/A</td>
<td>10 Gbps, 25 Gbps</td>
</tr>
<tr>
<td>B510-6</td>
<td>SAN765-6</td>
<td>2409-364</td>
<td>8</td>
<td>Yes</td>
<td>FC16-48, FC15-48</td>
<td>10 Gbps, 25 Gbps, 40 Gbps</td>
</tr>
<tr>
<td>B510-4</td>
<td>SAN-650-6</td>
<td>2409-364</td>
<td>8</td>
<td>No</td>
<td>N/A</td>
<td>10 Gbps, 25 Gbps, 40 Gbps</td>
</tr>
<tr>
<td>B510</td>
<td>SAN365B-5</td>
<td>2409-364</td>
<td>4</td>
<td>No</td>
<td>N/A</td>
<td>10 Gbps, 25 Gbps, 40 Gbps</td>
</tr>
</tbody>
</table>

Although the distances for the protocols supported for these switches, FICON, FCP, FCP, and ISLs, have been successfully tested to a distance of 300m, IBM requires an Extended Distance RPO for IBM Z to and LinuxOne to assure applications greater than 100km adhere to the bounds of our qualification.

The supported routing modes for FICON are:

- Exchanged Base Routing (EBR) with FICON Dynamic Routing on Gen6 and Gen5 Platforms (X8-4, X8-4, G620, B510, 7940, 7920, 7910, 7900)
- Device Base Routing (DBR)
- Port Based Routing (PBR)
• **Schedule**
  – August 29, 2017
  – We’re done!
  – IBM Qualification Start
    Refer to Director Qualification Library
  – IBM Announce – Aug 29, 2017
  – IBM G/A – Aug 29, 2017
• **Software Supported with z14**
  – FOS 8.1.0c
  – 8.0.2b
  – 8.0.1b
  – 7.4.2a
  – 7.4.1d
  – Network Advisor: 14.2.1
  – Qualified for All System z (FCP and FICON)
  – GEN4 Devices not supported
  – Including the SAN06B-R
IBM Storage Networking b-type Portfolio

Gen6 Technology provides 33% more IOPS than GEN 5

No plan to go to End-of-Sale

IBM Network Advisor end-to-end network management

Extension Products

Gen 5 Ext Blade
SAN06B-R

Gen 6 Ext Blade
SAN42B-R

IBM Network Advisor Enterprise & Prof. Plus 14.X (SAN only)

8 Gbps FC Entry Switch
SAN24B-4

16 Gbps FC Fabric

SAN384B-2
SAN96B-5
SAN48B-5
SAN24B-5

SAN768B-2

32/128 Gbps FC Fabric

SAN512B-6
SAN256B-6
SAN512B-6
SAN64B-6
SAN24B-6

NEW

All SANs Managers

Software And Dashboards

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b-type extension enables predictable, reliable, and secure network performance on premise, across metro or across regions.
The IBM SAN42B-R…GRID IPEX Solution

What is a Grid?
- Two to Eight TS7700s
- Worldwide access: as little as one physical instance of the data
- Automated failover
- Read / written at disk speeds, sent at network speeds
- Where do we play?

To the z Systems host, the GRID configuration looks like a single storage subsystem

With tape
TS7740 and TS7720T

Two or more TS7700 Clusters that are connected by using a customer supplied IP Network to form a highly available, resilient virtual storage tape architecture.

GRID SAN42B-R Value Proposition:
IP Extension for High Speed Replication
Extends Brocade Data Center-hardened, IP-based Advanced Extension Tunneling Technology to IP Storage Replication Traffic
IBM/Brocade
Driving New Opportunities

Transparent Cloud Tiering
IBM Cloud Object Storage (COS)
DS8K-SAN42B-r-IPEX-TS7700
IBM Transparent Cloud Tiering Solution

Find the Right Fit…Adapt to Partner Needs…Drive a Joint Plan

• IBM Goal:
  • Remove CPU cycles to migrate/move data from the disk arrays to less expensive storage (i.e. Tape)

• Transparent Cloud Tiering:
  • Leverages Object Storage S/W technology embedded in DS8K to move data directly between disk and tape via an IP connection

• Today's Offering:
  • Available June, 2017
  • New Release Sept, 2017
  • Replication using 1G Ethernet
  • Local/Campus support

Legend:
- 10G Enet
- FICON
IBM Enterprise Cloud Tiering Solution

Find the Right Fit...Adapt to Partner Needs...Drive a Joint Plan

- **Future Offering:**
  - Integrating 10G Enet
  - Adding additional Enet ports
  - Supporting distance solutions

- **Solution Validation:**
  - Phase 1:
    - Functional testing using IPEX with SAN42B-R
  - Phase 2:
    - Add distance and network impairment
    - Test IPEX value; Network compression, encryption, Trunking and Failover

- **IBM Unfair Advantage:**
  - IBM “ONLY” offering
  - Provides most flexibility for client deployment

Legend:

- 10G Enet
- FICON

Diagram illustrating network connections and components like DS8880, TS7700, SAN512B-6, and IP WAN.
IBM Enterprise Cloud Tiering Solution

Find the Right Fit…Adapt to Partner Needs…Drive a Joint Plan

- **Future Offering:**
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---

Legend:
- 10G Enet
- FICON

Diagram showing connectivity between Local Site and Remote Site, with various network components such as TS7700, DS8880, SAN512B, SAN512B-6, and All FICON, connected via IP WAN and 10G Enet.
New Multi-Hop Support

- Multi-Hop supports:
  - Cascading up to Four switches
  - Three Hops
  - Expanding the previous restrictions of two cascaded switches, one hop.
- Solution
  - Remove restrictions regarding hop counts between channel and control unit
  - Verify FICON architecture over broader scope of configurations
  - Establish best practice guidelines for FICON configurations
MultiHop FICON

• FOS 8.1 qualification
• Z13/Z14 servers using Multi-hop have advantages for simplifying configurations in a single site or across multiple sites with ISL and cascaded FICON directors:
  • Support multiple configurations for easy deployment of GDPS
  • Improve utilization of FICON Directors and switches
  • Simpler and easier to manage configurations for SAN availability

• IBM Technical White Paper co-authored by Brocade
• https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102704
FICON Multi-hop Supported Configurations

Native ISL Configurations
Two-Hop Array

- Three switches connected linearly
- Must adhere to the FICON timeout limitations… this means….
  - Longest distance a FICON packet can traverse is 300km
  - The maximum distance of AB + BC <= 300km
• Three switches connected in a triangle
• Must observe the 300km max distance for FICON links.
• Examine the worst case scenarios in the event of path loss, the traffic would have to traverse, to the 2 longer paths to reach its target. If we assume BC is the shortest, then AB + AC < 300kms
Three-Hop, Four Array Configuration

- Three switches connected linearly
- 300 km distance limit still applies
- \( AB + BC + CD < 300 \text{km} \).
The Square

- Four switches connected in a square configuration
- 300 km distance limit still applies
- Examine worst case scenario in event of path failure.
- If we assume BC is the shortest distance, then $AB + AD + CD < 300\text{km}$.
FCIP configurations

- Configurations use FCIP links to increase the distances for FICON links
- Primarily used for asynchronous replication applications
- Maximum distance supported over an FCIP connection for FICON=3000km
Two-Hop array with FCIP Bridge

- Two switches connected with native ISLs (300km)
- Third switch connected over FCIP (3000km)
Three Hop Four Switch with middle FCIP

The FCIP bridge is in the middle of the configuration. The maximum distance of the bridge is 3000kms. ISLs distance AB and CD = <300kms.
Three Hop array and leaf FCIP Bridge

FCIP is positioned at last hop.
Maximum distance 3000kms
Native ISLs AB + BC <300kms
FICON Multi-hop Design Considerations
Multi-hop Design Considerations

- Bandwidth planning
  - Consider having additional bandwidth available between all routes
  - Perform a bandwidth sizing study
- Potential adverse performance impact to applications in the event or rerouting traffic due to failure/loss of connectivity
  - Increased latency traversing a longer path
Bandwidth Sizing Study Considerations (Best Practices)

- What type of traffic is going across the cascaded FICON links (ISLs)? DASD, tape, CTC, all of the above?
- Do I have replication traffic going across the ISLs? If so, what type (synchronous, asynchronous, both)?
- Do I wish to isolate a particular traffic type to its own set of ISLs (by OS, storage type, replication type)?
- Am I using trunking/port channels in conjunction with Multi-Hop?
- Am I using virtual fabrics and how does that effect my ISL allocation?
- Do I have an SLA that must be met on a specific replication traffic?
- Does my environment include a GDPS or similar architecture? Will I be performing a HyperSwap?
Summary

• FICON Multihop provides
  • Potential consolidation and simpler management
  • Better availability for 3 and 4 site architectures
• FICON Multihop does introduce more complexity into configurations
• Increased complexity means more detailed planning is required
"The enterprise computing community represents that unique sector of the storage networking market that propels the most critical systems in the world – especially z System.

Brocade has released a series of features and functions to leverage the capabilities of Gen 5 and Gen 6 Fibre Channel and extend them into the heart of the applications that are driving the world’s most reliable and crucial systems.

These systems must operate cohesively and under extremely stringent conditions in order to provide the everyday services and operations enjoyed by billions."

Howard Johnson
Principal Software Engineer
FICON Engineering Architect
Brocade Communications, Inc.
Integrated by Design Roadshow 10-23-17

Integrated by Design
Brocade Gen 6 SAN, IBM Z Systems and IBM Storage Roadshow

Brocade Gen 6 SAN, IBM Z and IBM Storage are designed, developed, tested, and qualified together to enable the infrastructure required for the Cognitive Era. Register for this technical seminar, presented by Brocade and IBM subject matter experts, to learn how these solutions can optimize your business’s critical infrastructure.

DATE & TIME:
Monday, October 23, 2017 11:30am - 4:30pm

LOCATION:
IBM Corporation
590 W Madison Ave
Room 221A, 27th Floor
New York, NY 10022
Lunch will be served, networking event to follow.

AGENDA:
- Executive Opening Remarks
  - John Kelly, Vice President, System Technical Sales, North America
  - IBM Z Trends and Directions
  - Ray Newcom, IBM Z Product Management
  - Samir, TCCN, and the z/4
  - Howard Johnson, Technology Architect, TCCN
  - IBM Storage Update and Integration with z/4
  - Ely Aslam, IBM Client Technical Specialist - Storage
  - TCO7700 Update Physical and Virtual Tape Options and Integration with z/4
  - Bob Sommer, IBM Certified Tape Specialist

WHO SHOULD ATTEND:
Serial, Storage Administrators, Managers, IBM and Business Partner sales and technical teams
Registration to follow at Repliion directly following the event.
Repliion Sales and Bar
321 E 54th Street
New York, NY 10022

Questions About This Event
Please contact Tim.Jakes@brocade.com
- Find the latest version on Flight Deck
- Product pages contain key product information, IBM P/N translations, and hotlinks directly to relevant online information
- Automatically translate IBM P/N to Brocade P/N and vice versa
- Contains list of frequently asked questions and messaging
- External – can be shared with IBM & IBM BP
- E-mail ibm-sales@brocade.com will go to our WW Brocade IBM sales team
- E-mail ibm-sanse@brocade.com will go to our WW Brocade IBM technical team
Any Questions?

Thank You!