Agenda

• IBM DS8880 General info
• Flash
• Easy Tier
  - Automatic mode
  - Manual mode
  - Easy Tier Control
  - Easy Tier Application
  - Release 8.1.1/8.2 News
• Performance enhancements with System Z
• Performance simulations
  - HDS VSP to IBM DS8886
  - Flash/SSD with Easy Tier
  - Metro Mirror
    o Different distances
    o Two PPRC targets

A match made in heaven!
DS8880 family: bulletproof hybrid data systems made for the future of business

- **2x** improved acceleration for mission-critical with next-generation design and enterprise-class flash
- **7-9’s** availability for 24x7 access to data and applications with bulletproof data systems and industry-leading capabilities
- Enable your data center for **systems of insight and cloud** with unparalleled integration with IBM® z Systems™ and IBM Power® servers
- **Streamline operations and reduce TCO** with next-generation data systems in a wide range of configurations, delivering 30% less footprint and 20% better energy efficiency

*3 seconds of downtime per year!*
High Performance Flash Enclosure

- Flash offers higher IOPS than SSD (small difference in latency)
- Direct connected to Power servers (do not share Disk Adapters with SSD/SAS drives)
- 16 or 14 flash cards per enclosure (Gen 1)
- Up to 4 enclosures in DS8884
  120 flash cards
- Up to 8 enclosures in DS8886
  240 flash cards
IBM DS8880 High Performance Flash Enclosure Gen2

**Enables faster decision making** with up to **2x performance** improvement per enclosure on real-time analytics, cognitive computing and traditional I/O intensive workloads

**Manages business data growth** with up to **6 times more capacity** per enclosure for storage consolidation and high-data-volume workloads

**Improves data protection** for superior business continuity where integrity is critical by using **RAID 6** as default

<table>
<thead>
<tr>
<th>HPFE Gen1</th>
<th>HPFE Gen2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash card options</td>
<td>400 / 800 GB</td>
</tr>
<tr>
<td>Maximum raw capacity per enclosure</td>
<td>24 TB</td>
</tr>
<tr>
<td>RAID protection</td>
<td>RAID 5 and 10</td>
</tr>
<tr>
<td>Performance</td>
<td></td>
</tr>
<tr>
<td>Read</td>
<td>340,000</td>
</tr>
<tr>
<td>Write</td>
<td>200,000</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DS8880 Available Drive Technology

- **Flash – 1.8” in High Performance Flash Enclosure**
  - 400/800 GB card (Gen2 – 400/800/1600/3200GB)

- **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 drives

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

- **3.5” Nearline – 7200 RPM Native SAS**
  - Extremely high density, direct SAS interface
  - 4TB and 6TB drives

All drives support encryption at rest
DS8000 Easy Tier automated sub-LUN tiering

- Full 3/(4)-tier technology support
  Inter-tier movement to Tier 0,
  Intra-tier movement between Flash and SSDs.

- Higher performance for hot data with SSDs

- Sophisticated algorithms automatically optimize each pool continuously

- Easy Tier supports thick and thin provisioned volumes

- Moves on extent level (1GiB or 1113 cylinders). DS8870, DS8880 R.8.1

Remember to leave some free extents in each pool in order for Easy Tier to be able to move extents between tiers. Recommendation is approximately 10 extents per RAID rank.
Why focus on read miss?

(Write Miss is extremely rare)
Swedish mainframe client using DS8870 with Easy Tier.
4.7 TiB SSD
55 TiB SAS (600GB)
Easy Tier Intra-tier movement

- Enhanced auto intra-tier re-balancing to support homogeneous (single-tier) pools
- Also used together with inter-tier (Flash/SSD for example)
Easy Tier Manual mode

- **Migrate volumes between extent pools**
- **Re-distribute volumes in extent pool**
- **Merge extent pools**
- **De-populate ranks**
• **Easy Tier Application for System z**
  - Software defined storage API to help efficiently deploy storage
  - Enables application control for optimal placement of data
  - Implemented via z/OS DFSMS Media Manager and DB2

• **New Easy Tier end user controls**
  - Implemented via new DSCLI commands
  - Control Easy Tier learning and migration behavior
  - Provide additional volume placement controls
Use Case – z/OS DB2 Database Reorganization

Easy Tier used for System z

- Easy Tier has optimized blocks – hot on SSD, cold on HDD

Without Easy Tier Application for System z

- It takes time for ET to optimize the target datasets after re-org

With Easy Tier Application for System z

- Target datasets are already optimized before the re-org completes

Assignment hint
New in Easy Tier (Release 8.1.1/8.2)

Starting with DS8000 R8.1.1 firmware, **two different extent sizes** are supported for extent pools:

Large extent is 1 GiB for FB pools and 1113 cylinders for CKD pools.

Small extent is 16 MiB for FB pools and 21 cylinders for CKD pools.

**New concept “track group”** – large extent = one track group, small extent – 64 FB small extents = one track group (53 CKD small extents = one track group).

When a volume is initially created in a hybrid pool made of small extents, any track group will reside on a specific tier. However, over time, Easy Tier promotes or demotes extents in that track group based on IO activity.
DS8880 Caching Optimized for z Systems

- **Cache space efficiency with 4K segments**
  - Significantly improved cache utilization per GB

- **SARC (Sequential Prefetching in Adaptive Replacement Cache)**
  - Self-learning algorithms
  - Adaptively and dynamically learn what data should be stored in cache
  - Improves cache hits by up to 100% and improve I/O response time by 25%

- **AMP – Adaptive Multi-Stream Pre-fetching**
  - Dynamically decides what/when to pre-fetch
  - Two-fold increase in RAID-5 array sequential read

- **IWC - Intelligent Write Caching**
  - Better write cache management and de-stage order
  - Up to 2 x throughput for random write workloads

Experience has taught me
- Should I keep this data?
- What data is needed next by the Host?

![Graph showing Throughput (MB/sec) comparison before and after AMP]

**Throughput (MB/sec)**
- Before AMP
- With AMP

- **6+P Raid-5**
- **7+P Raid-5**
### DS8880 Cache Efficiency

**Store two Random 4k Data Blocks in Cache**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Slot Size</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DS8870</strong></td>
<td>4KB slots</td>
<td>Two 4K cache segments allocated (8K stored, 0K unused)</td>
</tr>
<tr>
<td><strong>VSP</strong></td>
<td>16KB slots</td>
<td>Two 4K cache segments allocated (8K stored, 24K unused)</td>
</tr>
<tr>
<td><strong>VMAX</strong></td>
<td>64KB slots</td>
<td>Two 4K cache segments allocated (8K stored, 120K unused)</td>
</tr>
</tbody>
</table>

For storing **16GB of random 4K blocks** it requires:

- **16GB on IBM DS8880**
- **64GB on HDS VSP/G1000**
- **256GB on EMC VMAX**
Support CKD I/O performance parameters specified by WLM

z/OS can specify metadata in an I/O command indicating the importance of the I/O operation and how well the storage system has done at achieving I/O performance goals for I/Os of the same importance.

DS8000 maps the importance and achievement combination to a DS8000 I/O Priority Manager performance group.

Allows multiple applications using the same CKD volume to have different priorities.

Users can assign a DS8000 I/O Priority Manager performance policy to each CKD volume that is used in the absence of WLM information (same way FB volumes are supported by I/O Priority Manager).

**Value**

- **Performance/Management** – Helps maintain high performance for highest priority I/Os; ties z/OS user-assigned job priorities to I/O activity.
Hyperswap/DS8880/DB2 = zHyperWrite

- Improved DB2 Log Write performance with DS8880 Metro Mirror
- Reduces latency overhead compared to normal storage based synchronous mirroring
- Reduce write latency and improved log throughput
- Up to 40% improvement in testing

Requires GDPS or TPC-R
Base – HDS VSP
Intervall kl. 04:00 – 49.000 IOPS
Response time for interval 04:00 – 49,000 IOPS

DS8886-16 core
512GB cache
600GB 10k SAS drives
+ 3 driveset 400GB Flash
16Gb FICON zHPF
PPRC over 20km
Performance simulations

Using 1.8TB 10k SAS drives (170TB)

Added 16 400GB Flash cards (4.4TB)

2.5% Flash capacity = response time lowered by 3ms!
Performance simulations

Metro Mirror inactive

Metro Mirror over 1km distance

Metro Mirror over 10km distance

Metro Mirror over 20km distance

Metro Mirror over 50km distance

Metro Mirror over 100km distance
Performance simulations

One PPRC target 20km

Two PPRC targets 20km

CPU (Internal DS8880) Utilization will increase with two targets.
Tillsammans med våra kunder antar vi dagens mest kritiska IT-utmaningar