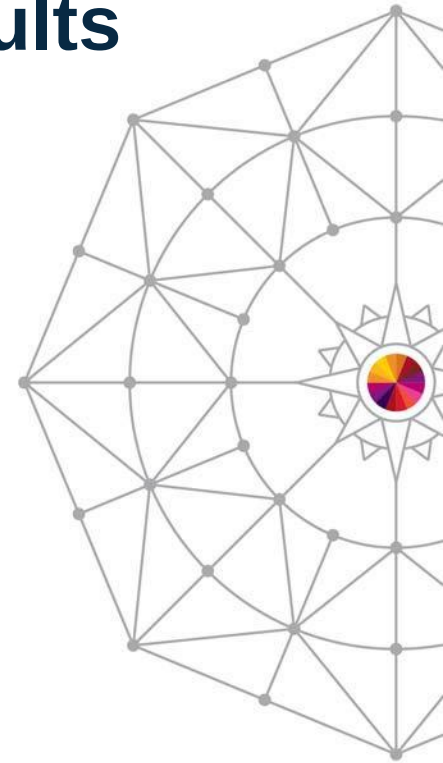


VMAX: Achieving dramatic performance and efficiency results with EMC FAST VP

Tony Negro
EMC Corporation

Vendor Sponsored Session



Insert
Custom
Session
QR if
Desired.

#SHAREorg



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AGENDA

- The Symmetrix VMAX Family
 - Enginuity and Mainframe Software Technology
 - Advanced Replication and DR features
 - Virtual Provisioning
 - Fully Automated Storage Technology
 - Basis for FAST VP
 - Scoring and data movement
 - FAST VP adoption
 - Business motivation
 - Deployment strategy
 - Efficiencies and performance improvements
 - FAST VP Management and Reporting
 - Summary

World's Most Trusted Mainframe Storage

Over 20 Years Running the World's Most Critical Applications

1990 - 1995

1995 - 2008

2009 - 2011

2012



Symmetrix
4000



Symmetrix
5500



Symmetrix
3000/5000



Symmetrix
8000



Symmetrix
DMX-1, -2



Symmetrix
DMX-3, -4



Symmetrix VMAX 20K



Symmetrix VMAX 40K

1990
Mainframe
Attach,
ICDA,
RAID, NDU

1994
SRDF/S

1997
TimeFinder
1998
Consistency
Groups

2003
SRDF/A
2004
SRDF/STAR
AutoSwap

2005
EzSM
2007
GDDR

2008
Flash Drives
2009
8 Gb/S FICON
FAST

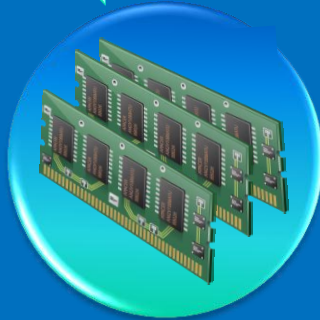
2010
z/OS Migrator
2011
z/VM AutoSwap
RSA Encryption

2012
3X Performance
2X Scale
Dense Configuration
System Bay Dispersion
VP and FAST VP

VMAX 40K Highlights



Performance Triple Play



2X More Global Memory

Increased performance
and cache efficiency

Additional FAST
optimization



2X More Bandwidth

Increased throughput for
cache miss IOPS

Improved resiliency and
serviceability

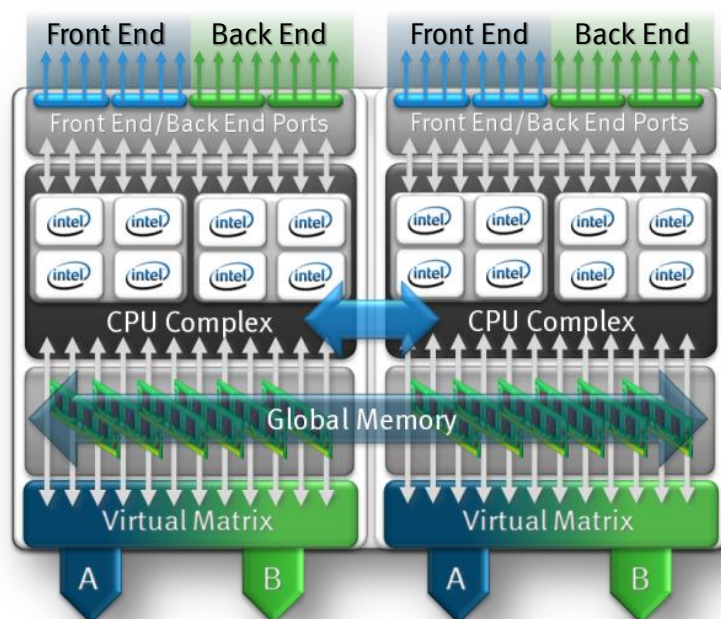


2X More Scalability

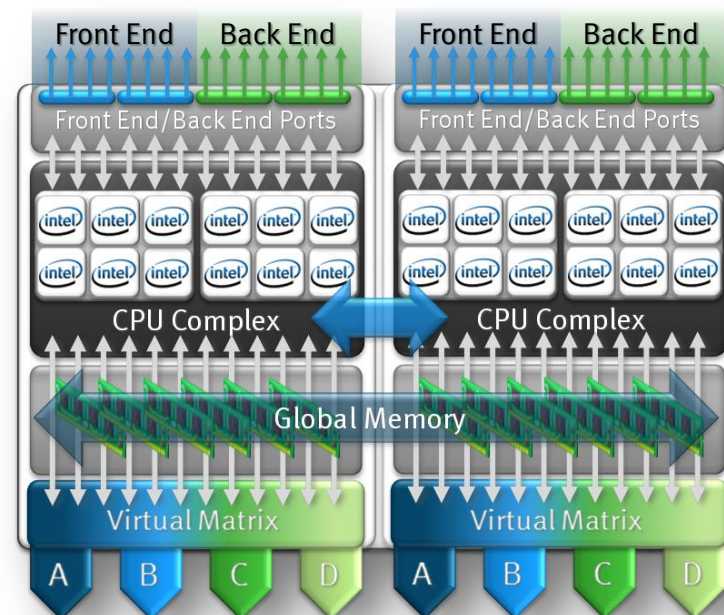
Up to 4 PB with High
Capacity 3.5" drives

3,200 2.5" drives & High
Density Bays

Engine Comparison

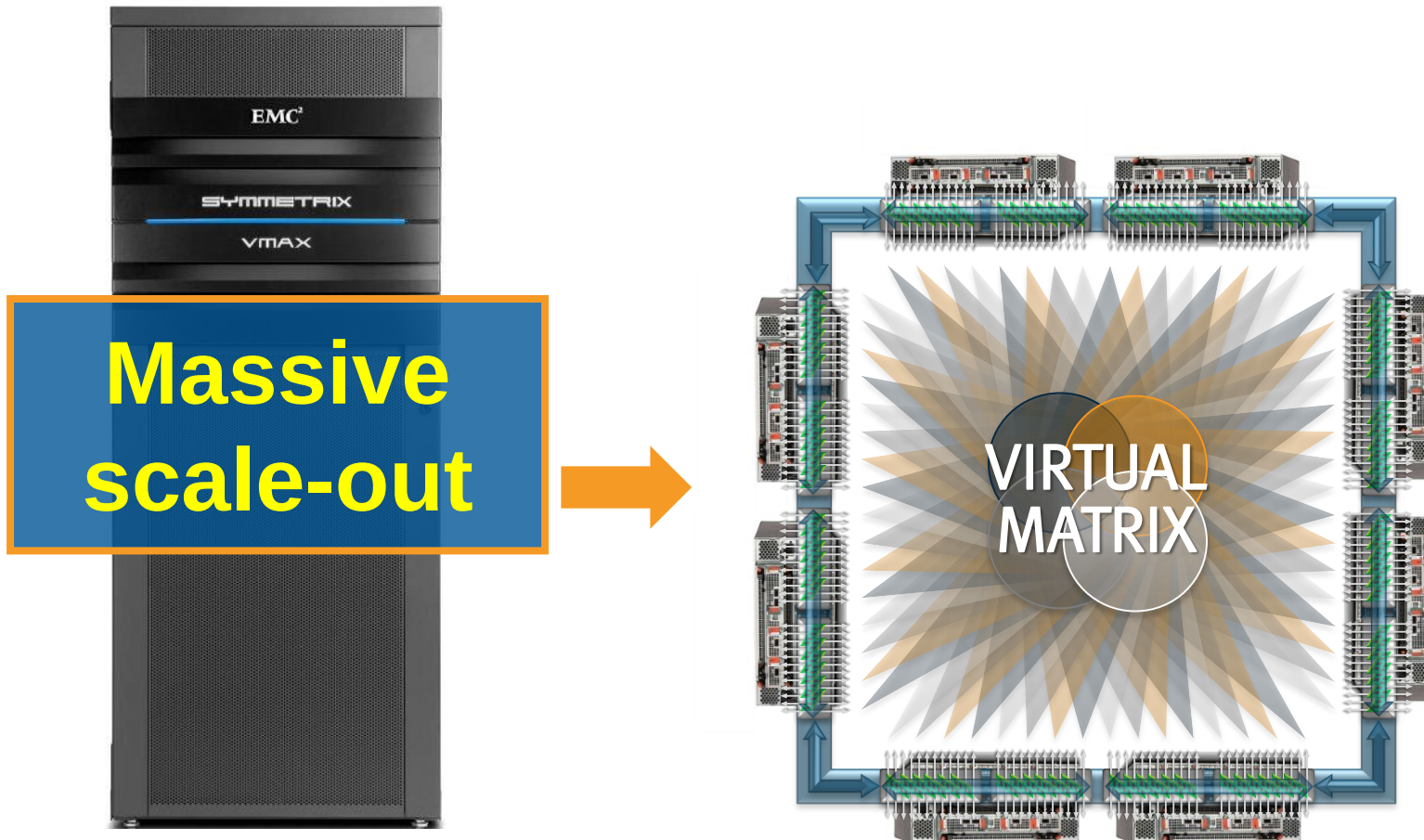


- 2.3 GHz Xeon Harperton
- 16 CPU cores per Engine
- Up to 128 GB Global Memory
- Dual Virtual Matrix Interface
- PCIe Gen1 Interconnects

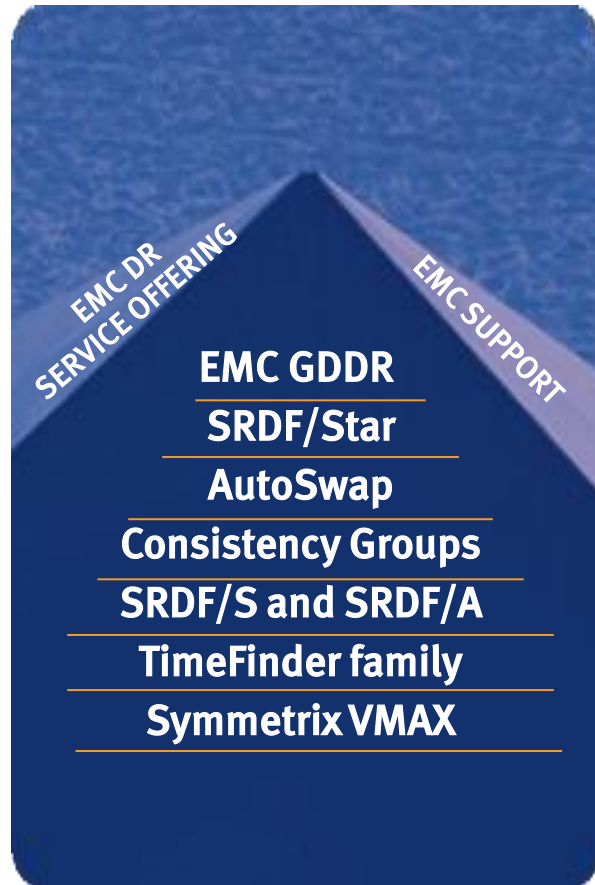


- 2.8 GHz Xeon Westmere
- 24 CPU cores per Engine
- Up to 256 GB Global Memory
- Quad Virtual Matrix Interface
- PCIe Gen2 Interconnects

Powerful Scale and Consolidation



Trusted for Mission Critical Applications



Built on EMC's industry-leading technology

EMC Geographically Dispersed Disaster Restart (GDDR)

Automation of restart processes

EMC SRDF/Star

Advanced disaster restart protection for multi-site SRDF configurations

EMC AutoSwap

Transparently moves workloads between storage subsystems

EMC Consistency Groups technology

Ensures information consistency

EMC SRDF/S and SRDF/A

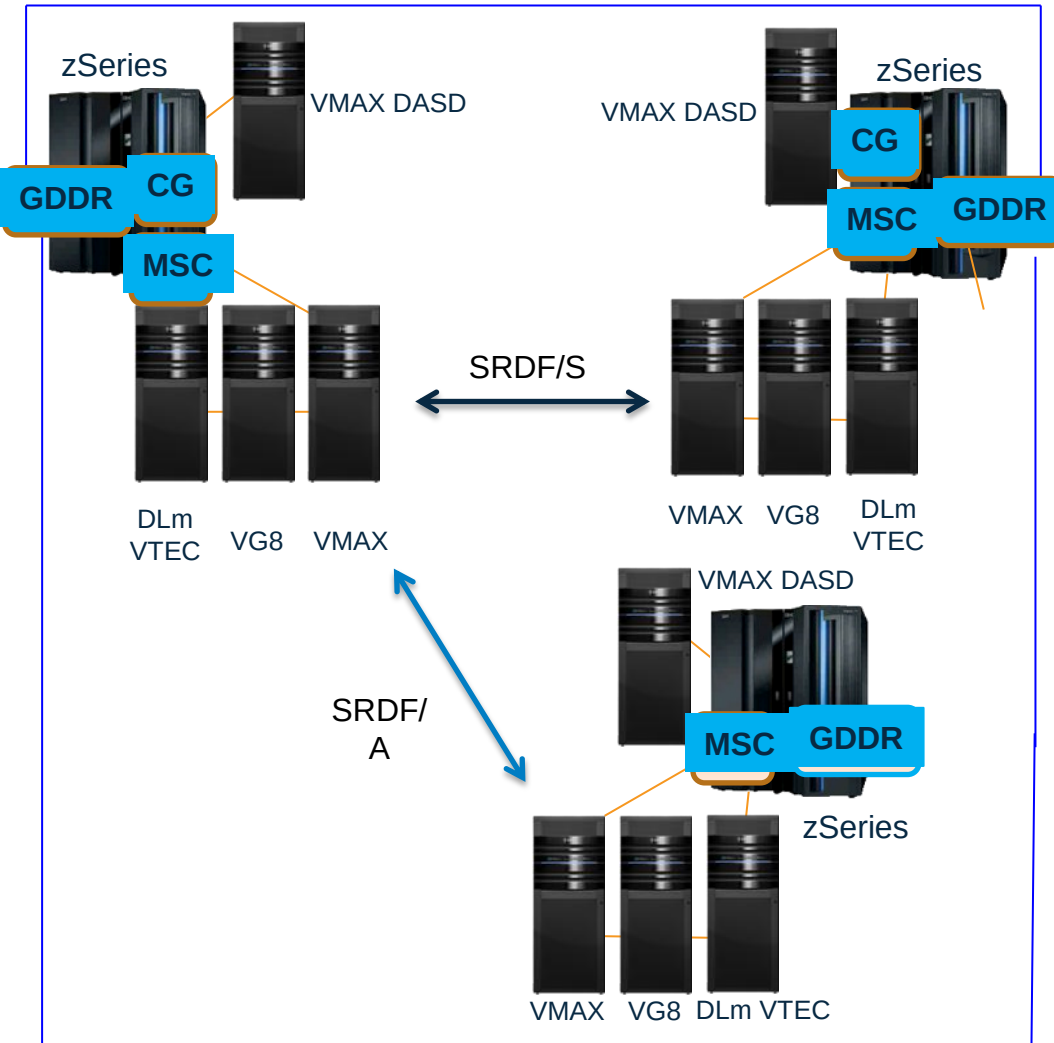
From the number one remote replication product family

EMC TimeFinder family

Local array-based replication for backups and application testing

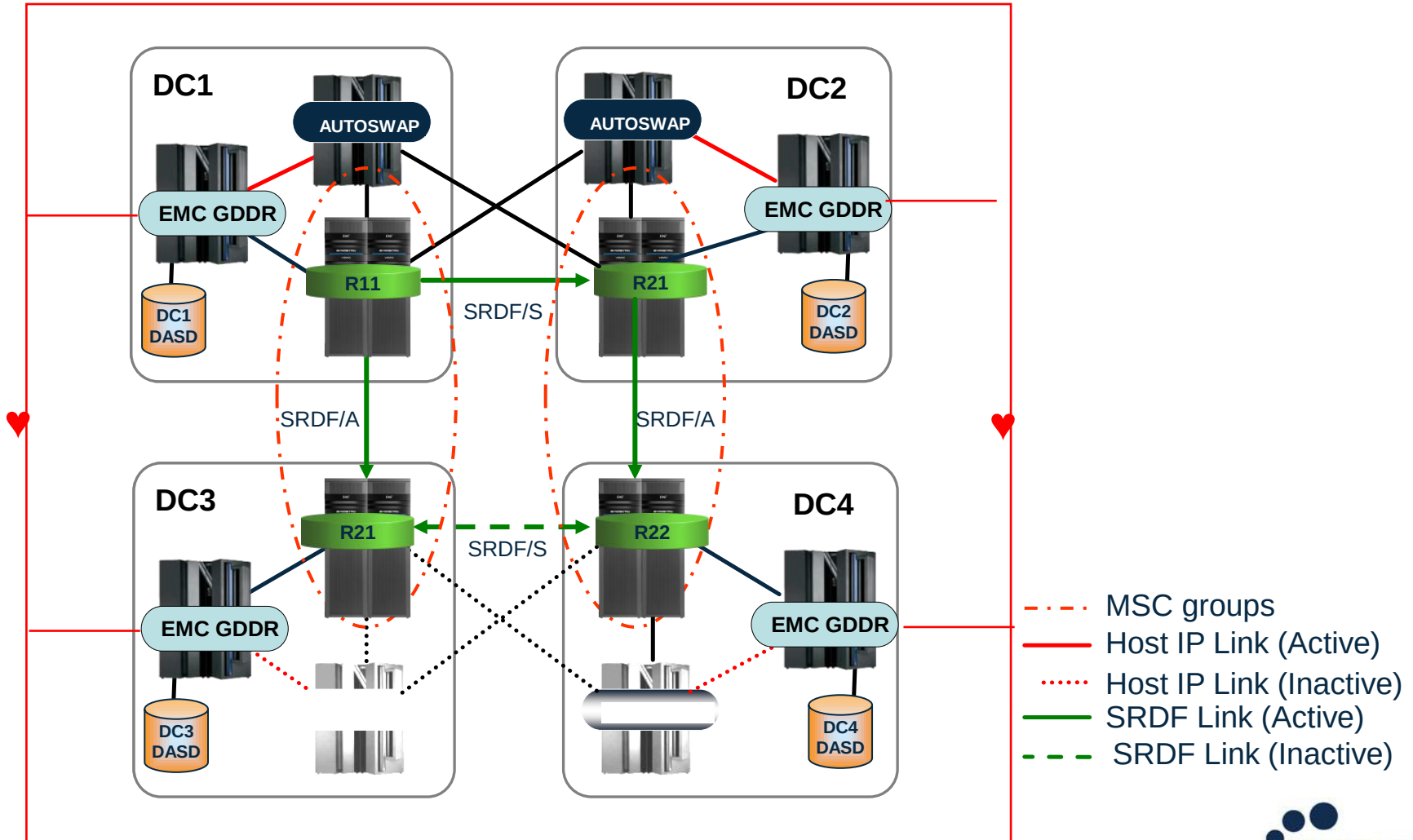
DLm8000

SRDF, GDDR, Universal Consistency

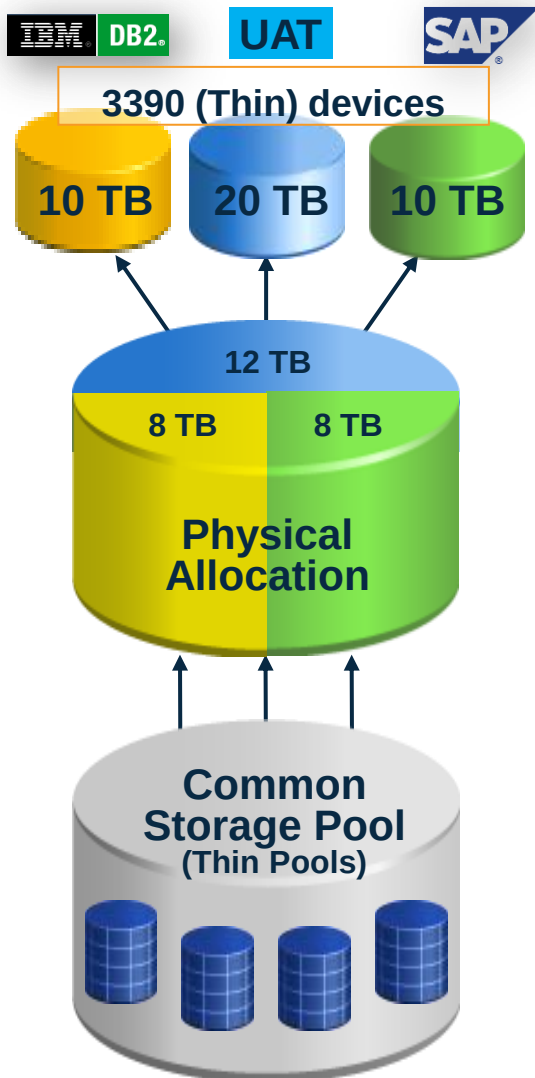


- Ultra-high data resiliency for both DASD and tape
- DASD and tape data consistent with each other to the last I/O
- 2 site and 3 site (STAR) configuration support
- Synchronous replication for local sites
- Asynchronous to out-of-region data center
- GDDR support
- Offering phased-in over several releases

GDDR – SRDF/SQAR with AutoSwap



Virtual Provisioning (VP) for System z



Improves Performance

- Device allocations are striped across drives in storage pools

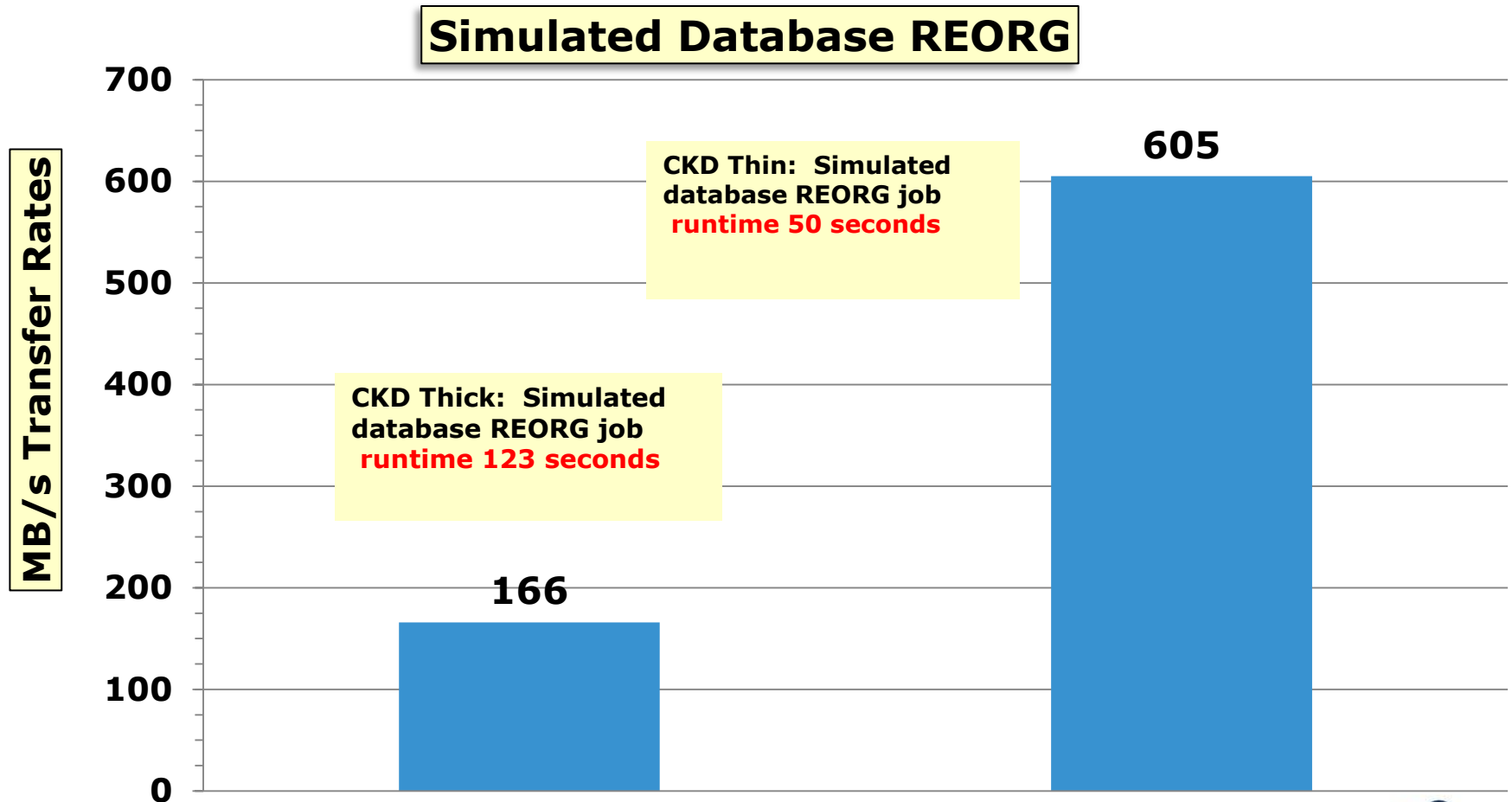
Improves Capacity Utilization

- Consume space on demand
- Deleted space reclamation utilities

Ease-of-Management

- Expand, shrink and rebalance pools without disruption to the z/OS device access

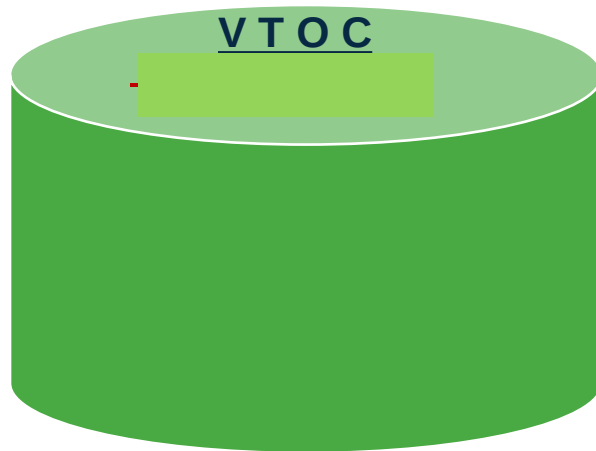
CKD Thin Technology Offers Improved Job Runtime and I/O Throughput



Thin Reclaim Utility (TRU) - Review

[1] TRU discovers and monitors thin devices that are not bound with PREALLOCATION /PERSIST attribute

DEV 02F



SCRATCH DSN=x.y.x

[2] EMC z/OS SCRATCH exit (or TRU SCAN utility) identifies the tracks that are eligible to be reclaimed

DEV 02F

F	F	F	F	F	F	F	F
F	F	F	F	F	F	F	F

SDDF

E	E	E	E
---	---	---	---

F=Free A=Allocated E=Eligible

[3] TRU RECLAIM Utility periodically marks eligible tracks as “empty” by updating STD rec. 0 (also can be done by batch job)

[4] Enginuity Zero Space Reclaim background process reclaims tracks with no user records (only STD 0)

New INI parm for OFFLINE device handling

- SCF.TRU.OFFLINE=PROCESS | NOPROCESS
- Prevents TRU from monitoring volumes OFFLINE to TRU system
 - Eliminates SCAN / RECLAIM execution and the impact their SYSVTOC RESERVE would have on systems that have volumes ONLINE
 - No monitoring → No SDDF session data → No SCAN / RECLAIM → No RESERVE
- PTF SF76049
 - Fixes OPT 434365

Options for RECLAIM processing



Implementation of the z/OS RECLAIM process can be done in one of two methods:

- A. Continuous Reclaim – Reclaim run on-demand via TRU+Scratch Exit
- B. Reclaim by Batch – Reclaim scheduled on periodic basis via “TRU,ENABLE” and “TRU,SCAN,XXXX-XXXX” commands



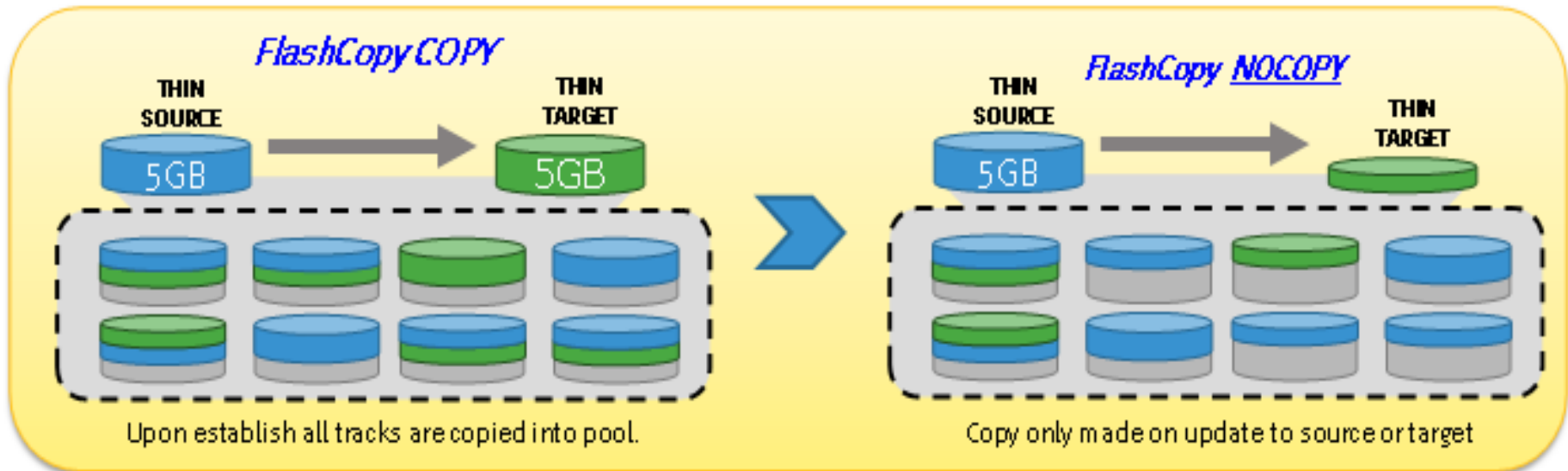
Command to **ENABLE** | **DISABLE** TRU

- F scfname,TRU,ENABLE | DISABLE
- Allows activation of TRU monitoring via command
 - Useful if SCF INI has TRU.ENABLE=NO
- ENABLE activates TRU Monitoring and refreshes device tables
- DISABLE suspends TRU monitoring
- PTF SF76049
 - Fixes OPT 434390

FlashCopy and Virtual Provisioning

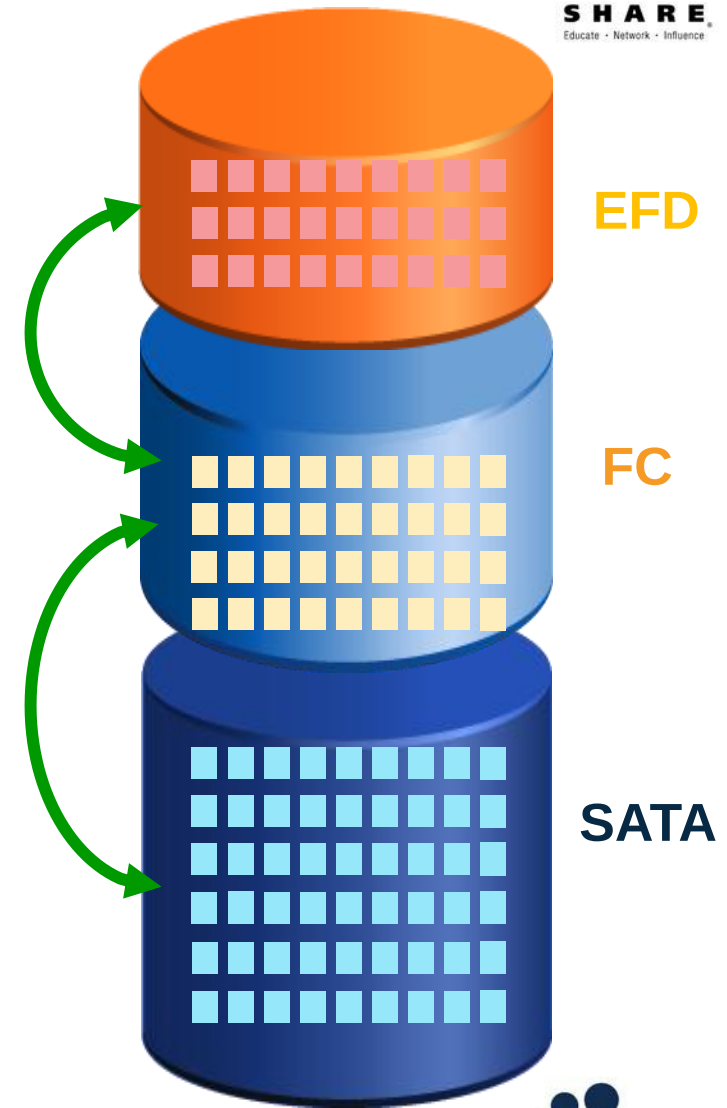
Copy vs NoCopy

- FlashCopy NOCOPY to THIN target results in space efficient copy
- Target can be in shared or dedicated VP pool (repository-like) that can be over-provisioned



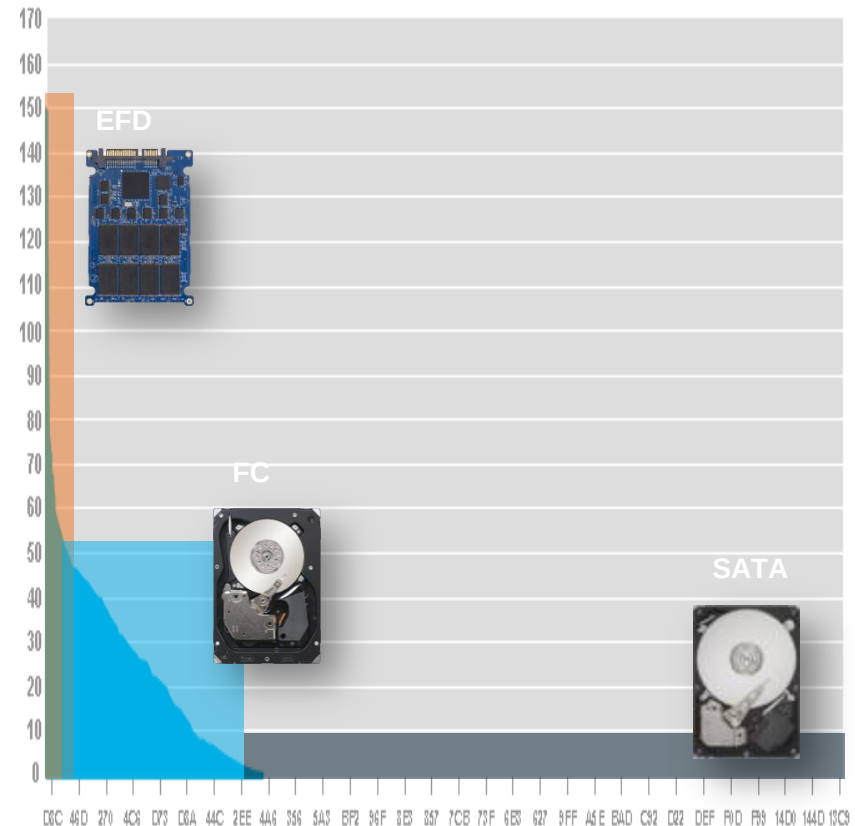
FAST VP – Fully Automated Storage Tiering for Virtual Pools

- Policy-based system that automatically optimizes application performance
- Promotes and demotes sub-LUN level data across storage tiers to achieve performance service levels and/or cost targets



Basis for FAST

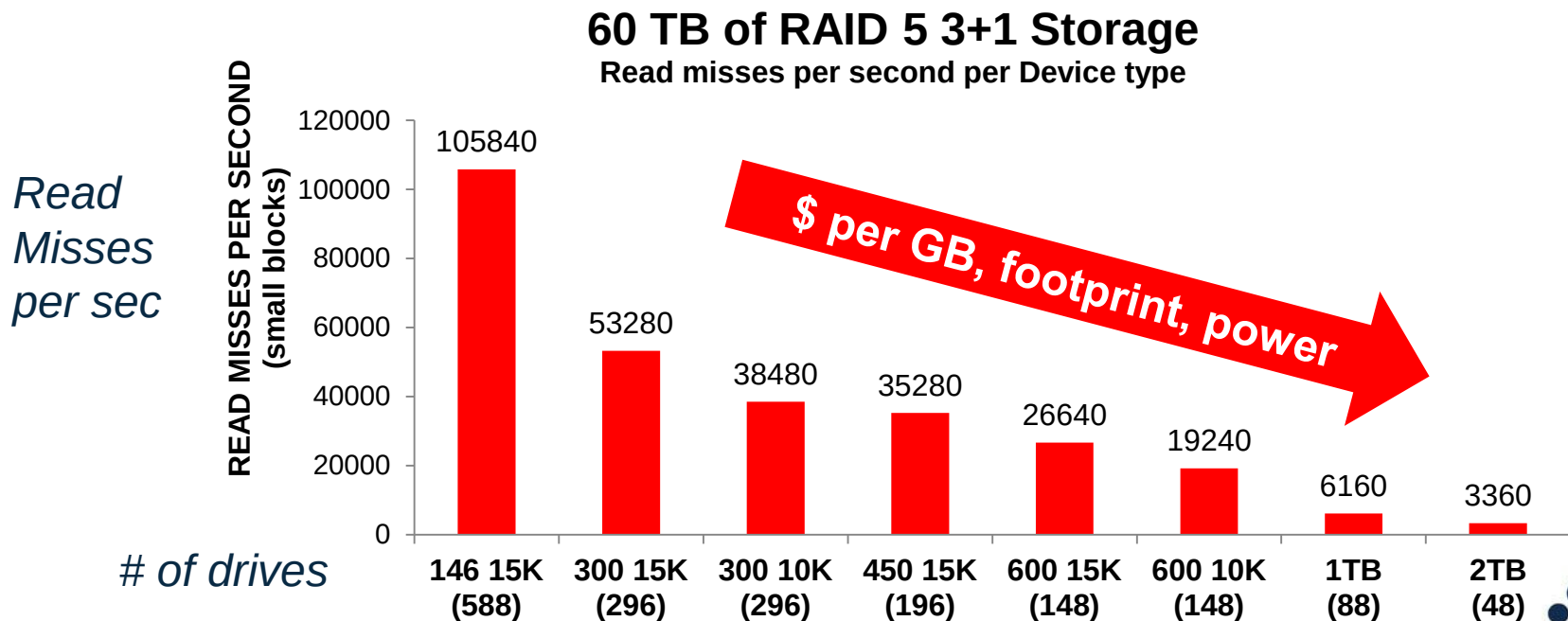
- With information growth trends, an ALL Fibre Channel configuration will:
 - Cost too much
 - Consume too much energy and space
- FAST VP helps by leveraging disk drive technologies
- What makes FAST work in real-world environments?
 - **Skew:** At any given time, only a small address range is active – the smaller the range, the better



80% of IO's on 20% of capacity

Wide striping and short stroking are common practice

- The vast majority of online workloads enjoy high cache-hit percentages, but **service levels are dictated by read-misses during transitional periods** like market open



Flash is Good for Everything

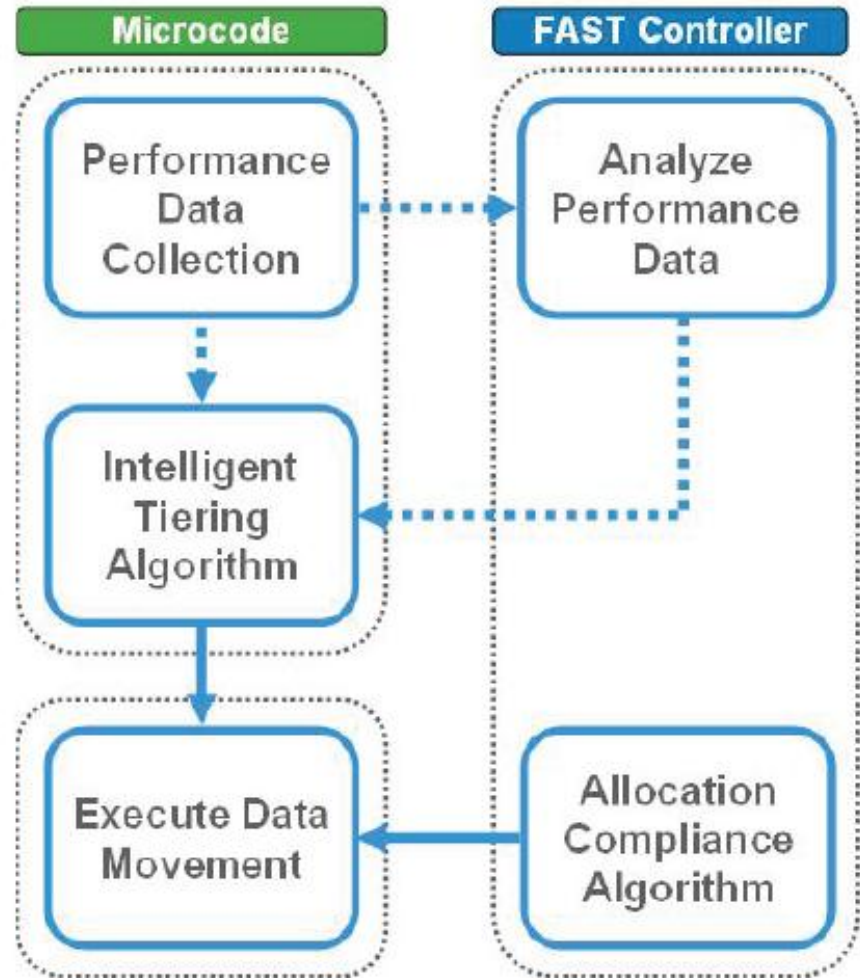
	FC 15K rpm	EFDs
One Sequence	80-100 MB/s	140 MB/s
Two Sequences	35 MB/s	140 MB/s
Random Reads 64 KB	16 MB/s	140 MB/s

What does this mean to the customers?

- More predictable sequential performance
- Batch processing is faster
- You can reorganize your data less frequently

FAST VP Implementation

- FAST VP tasks split between microcode and FAST controller
- Performance data collected by microcode
- Intelligent Tiering algorithm generates movement requests based on performance data
 - Uses supporting analysis performed by FAST controller
- Allocation Compliance algorithm generates movement requests based on capacity utilization
- Data movements executed by VLUN VP data movement engine



FAST VP Hierarchy



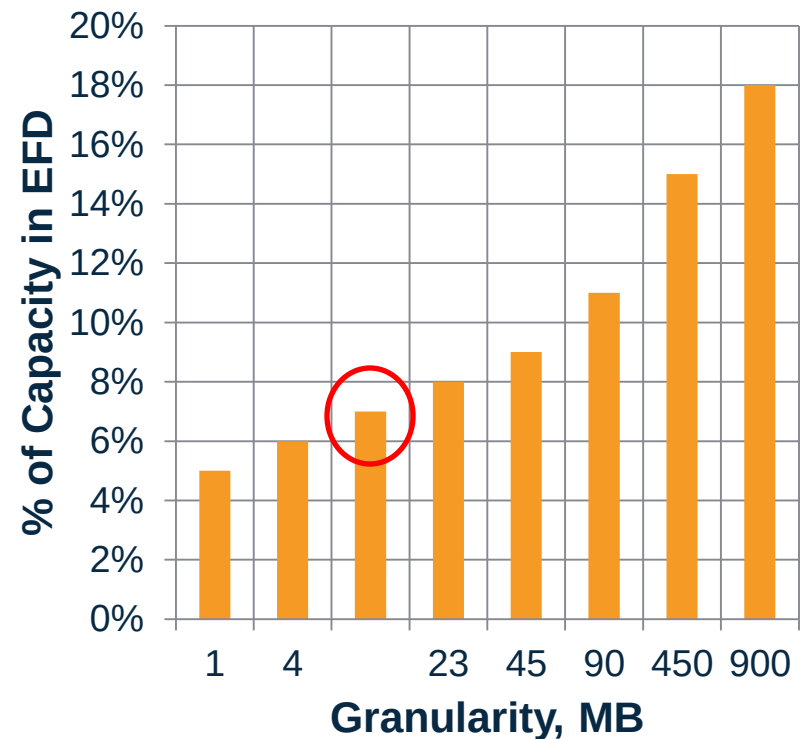
- **Extent Group**
 - 10 Track Groups (thin device extents)
 - 7.5 MB FBA / 6.8 MB CKD
 - **Data movement unit**
- **Track Group (Thin Device Extent)**
 - 768 KB FBA / 680 KB CKD
 - **VP allocation unit**

- I/O **rates** are collected during the “open” performance time window
 - Read Miss (RM)
 - Write (W)
 - Prefetch (P)
- Rates are updated every 10 minutes changing the ‘score’ of the Extent Group Set

Data Movement Granularity Trade-offs

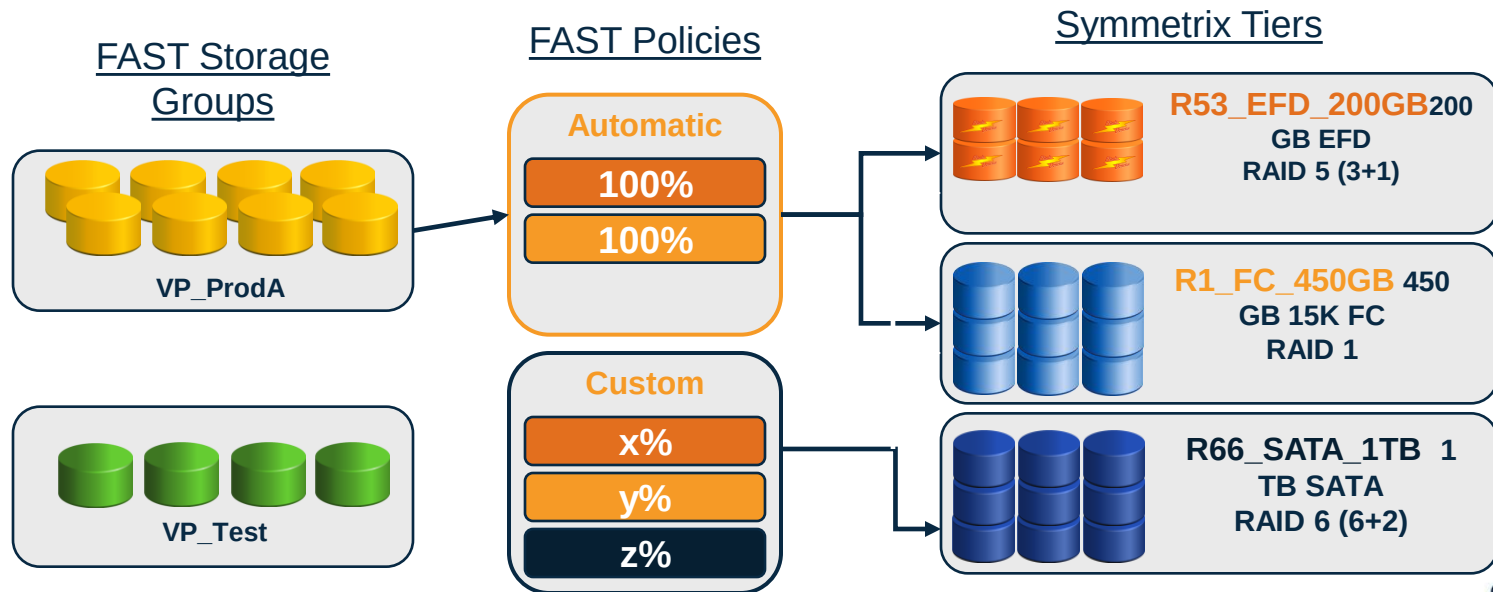
- Larger granularity
 - Uses EFD ineffectively
- Smaller granularity
 - Uses EFD effectively
 - Requires more system resources to maintain statistics
- There is a sweet spot that maximizes the benefits through better use of EFD and reasonable system resource use

% of EFD capacity needed to capture majority of I/Os in the system



FAST Storage Elements

- Symmetrix Tier – a shared storage resource with common technologies (Disk Groups or Thin Pools)
- FAST Policy – manage Symmetrix Tiers to achieve service levels for one or more Storage Groups
- FAST Storage Group – logical grouping of devices for common management



Why FAST VP Adoption



Financial Services

56% LOWER
COST per ARRAY

Investment Banking

25% FASTER
RESPONSE TIME

Health Care
Provider **1.5X**
MORE
UTILIZATION

Insurance
40%
LOWER
ENVIRONMENTAL COST

Migration Options



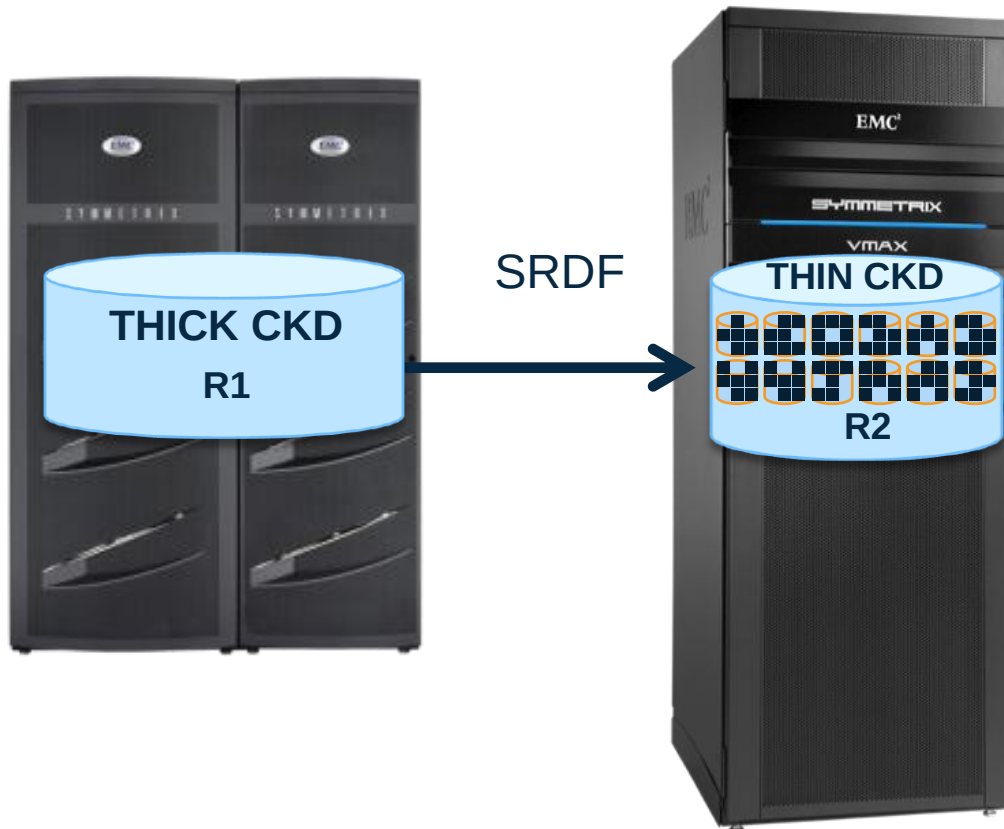
Host based:

- Logical copy
- Non-disruptive option
- Channel resources must taken into consideration

Array based:

- SRDF/Adcopy
- No host resources
- AutoSwap could be used for a non-disruptive approach

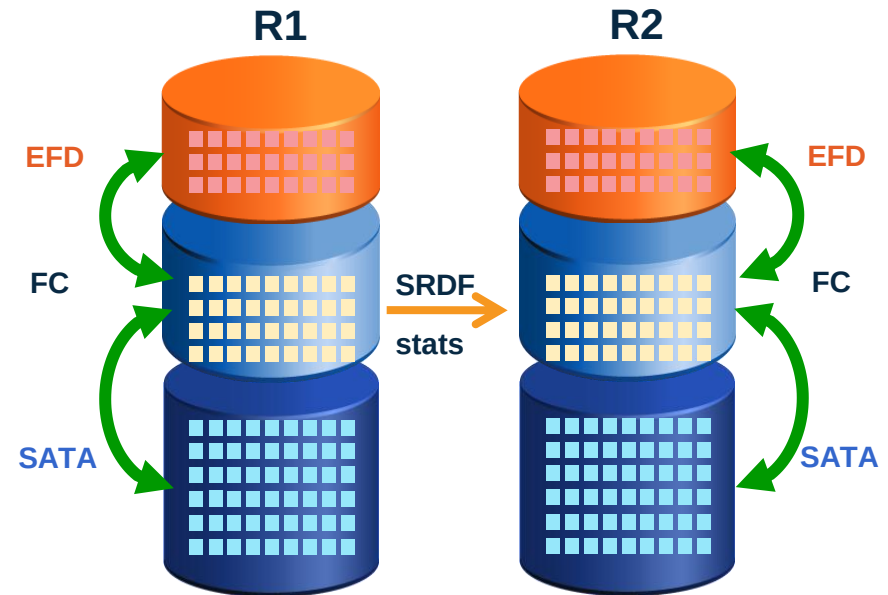
SRDF Thick to Thin support - MF



- **Support SRDF Thick to Thin (and thin to thick) for MF CKD**
 - Refer to SRDF Product Guide for supported Engenuity levels and topologies
- **Thin Reclaim Utility support for Thick R1→Thin R2**

FAST VP SRDF Support

- SRDF Integration enables predictable performance during failover
 - Full RDF Awareness to FAST VP
 - R2 system reflects promotion and demotion decisions of the R1 system
- Support includes 3 and 4 site solutions



FAST VP R2 statistics are merged with the R1 to reflect the R1 Read Miss ratio

Enabled per Storage Group
Requires R2 devices to also be under FAST VP control

Tiered vs. Standard Configuration Example



VMAX 40K Standard configuration

3.5" 300GB/15K disks

Total Drives: 1062

Raw: 319 TB, Usable: 136 TB

27.67 kVA, 88,500 Btu/hr

Annualized Energy Cost \$49,933

Power Drops Required: 14



VMAX 40K Tiered configuration

2.5" 200GB/EFD, 300GB/15K, 1TB/7.2K disks

Total Drives: 1015

Raw: 320 TB, Usable: 143 TB

15.59 kVA, 48,100 Btu/hr

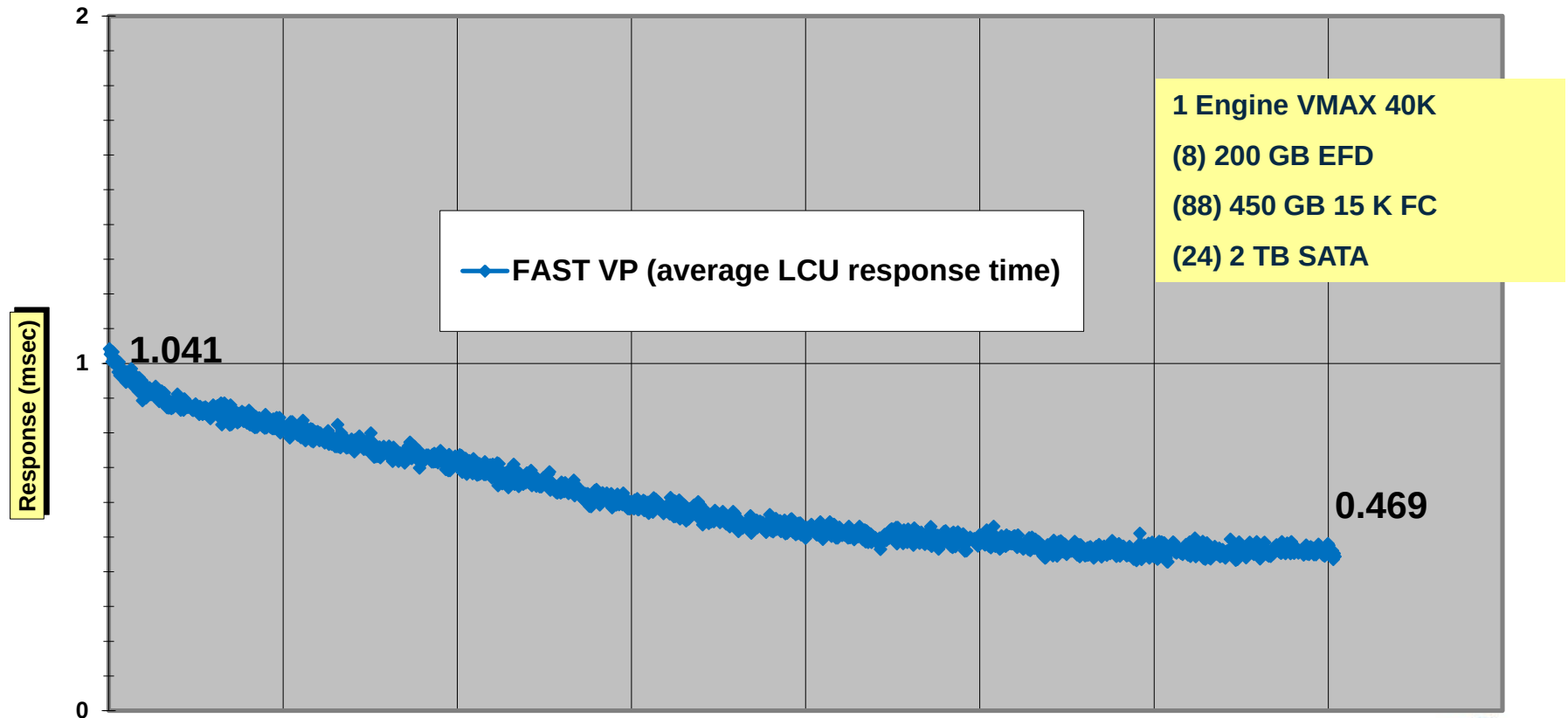
Annualized Energy Cost \$27,157

Power Drops Required: 8

Cache Friendly Transactional Workload Response Time Improvements

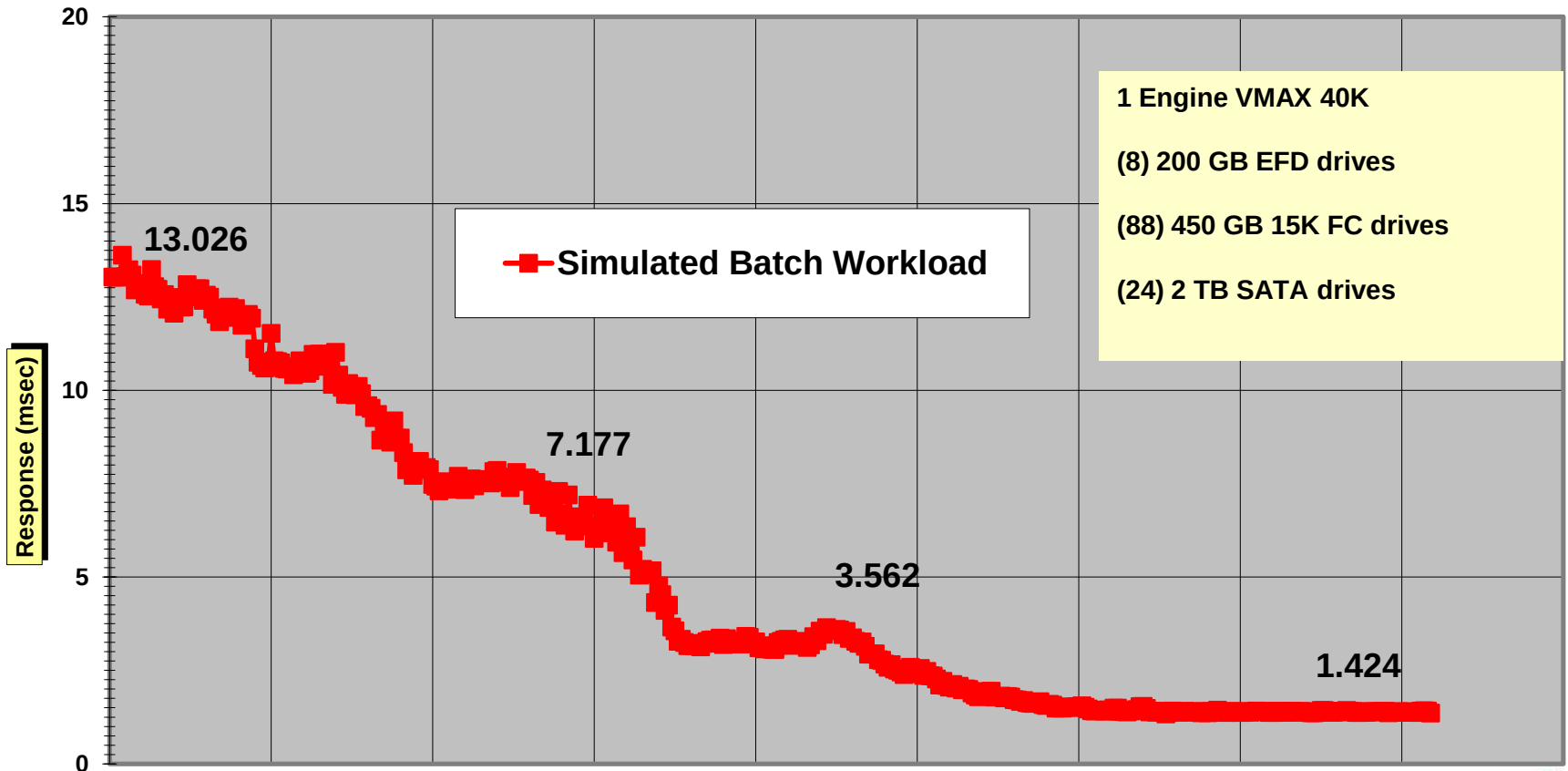
Simulated Transactional Workload

4 KB Blocks, 25% Write, 88% Cache Hit



Batch Workload Response Time Improvements

FAST VP - Simulated Batch Workload



Quick reaction time to changes in workload patterns



Symmetrix ID 000195701437

Virtual Pool Tier

EDU3_EFD_T

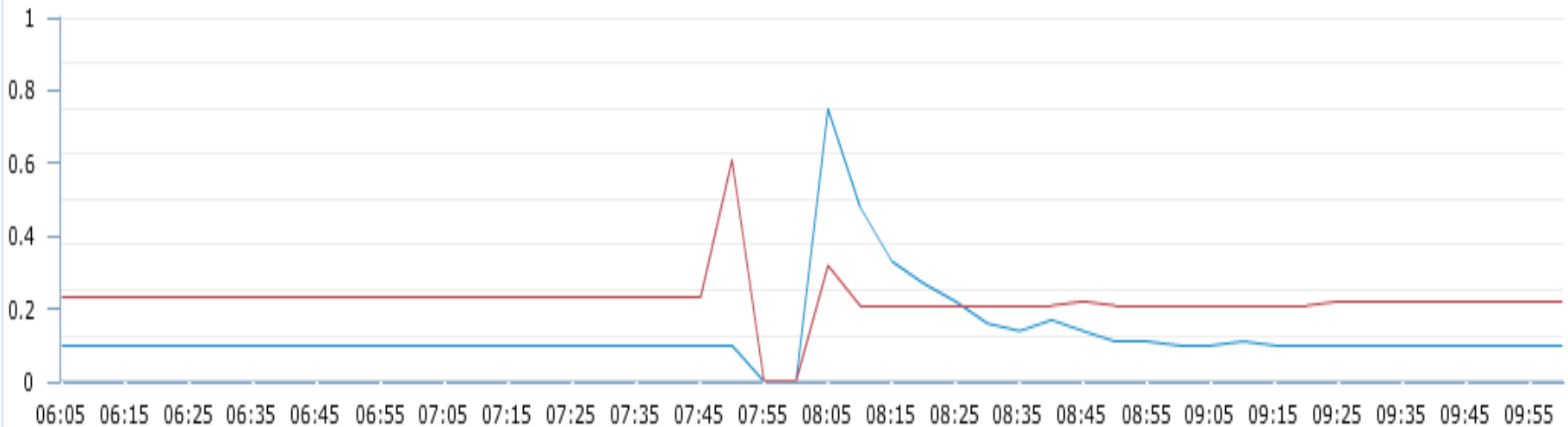
FAST by Tier

Feb 10, 2014 6:00 AM - Feb 10, 2014 10:00 AM

Read and Write Response Times



Read and Write Response Times



Read Response Time (ms) Write Response Time (ms)

FAST VP Management



EMC Unisphere for VMAX

000195700398 > Home

000195700398 > Storage

Storage Groups
View and manage storage groups. Includes expand, delete and set FAST associations.

FAST
View FAST Dashboard. Includes create FAST policies and place storage groups under FAST control.

Thin Pools
View and manage thin pools. Includes create, bind, write balancing and related objects.

Tiers
View and manage storage tiers. Includes create, delete, tier usage and related objects.

Volumes
View and manage volumes. Includes volume create, convert set attributes and volume distribution.

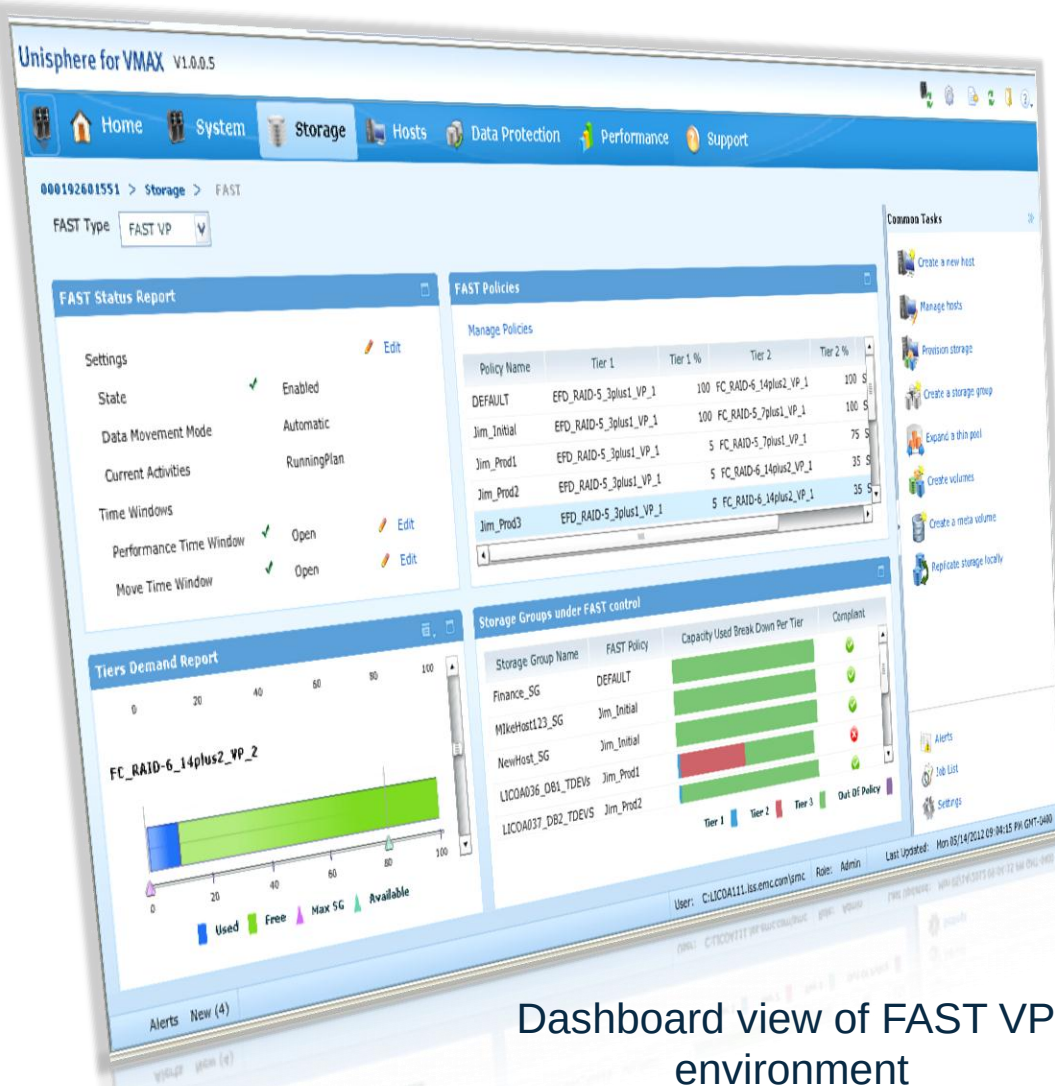
Storage Templates
View and manage storage templates. Includes create, import and export.

External Storage
View and manage Federated Tiered Storage (FTS).

Disk Groups
View and manage disk groups. Includes usage, related

**You can do everything using SYMCLI, too.
But the screenshots are not as pretty!**

Simplified FAST Management



Quick Access to

FAST Status

View and Manage Policies

Virtual Pool (Tiers) Demand

Tier Usage by Storage Group

Dashboard view of FAST VP
environment

Unisphere for VMAX Performance



- Unisphere provides real-time, diagnostic, and historical performance monitoring for FAST VP environments
- Monitor view provides system and user-defined dashboards to collate multiple performance indicators into a single view
- Three pre-configured FAST VP dashboards provide views into FAST VP for all primary storage elements
 - FAST VP By Storage Group
 - FAST VP By Tier
 - FAST VP By Policy



Dashboard for FAST VP by Storage Group

EMC Unisphere for VMAX

Home System Performance Support

000195700398 > Performance > Monitor

Toggle between Diagnostic and Historical data

Select viewing date range

Select dashboard

Create custom dashboard

Generate PDF report

Maximize chart size

FAST by Storage Group

Symmetrix ID: 000195700398 Storage Group: VP_ProdApp1

Mar 28, 2013 10:00 AM - Mar 29, 2013 10:00 AM

Read and Write Response Times

Host I/Os/sec and BE Reqs

BE MBs/sec by Tier

BE Requests/sec by Tier

IO Density by Tier

Allocation by Tier

New Folder Create Dashboard Save as Template Run Report Now Schedule Report Edit Save Copy Delete Navigate to Details View

Alerts New (9) User: C:\Lico117\smc Role: Admin Last Updated: Mon 04/01/2013 09:20:54 AM GMT-0400

Summary

- FAST VP is a policy-based system that promotes and demotes data at the sub-volume level, which makes it responsive to the workload and efficient in its use of control unit resources
- FAST VP exploits Virtual Provisioning basis enables efficient utilization of available backend resources
- FAST VP introduces active performance management, a revolutionary step forward in storage management
- FAST VP delivers all these benefits without using any host resources

VMAX: Achieving dramatic performance and efficiency results with EMC FAST VP

Tony Negro

EMC Corporation

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Insert
Custom
Session
QR if
Desired.

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