Abstract

This white paper discusses the new features and functionality introduced with the Enginuity™ 5876 code release for EMC® Symmetrix® VMAX™ subsystems in the IBM System z environment.

June 2012
Table of Contents

Executive Summary ........................................................................................................... 4
   Audience ......................................................................................................................... 4

Enginuity 5876 New Features .......................................................................................... 5
   Virtual Provisioning .......................................................................................................... 5
   Fully Automated Storage Tiering for Virtual Pools (FAST VP) ...................................... 7
   Increased number of Logical Control Units (LCU) per split ........................................... 8
   SRDF enhancements ........................................................................................................ 10
   SRDF device write pacing .............................................................................................. 10
   SRDF/A copy improvement ............................................................................................ 11
   Mixed mode SRDF .......................................................................................................... 11
   FAST VP support for SRDF ............................................................................................ 12
   Hardware compression for Fibre RA ............................................................................... 12

Mainframe Enablers 7.4 .................................................................................................. 12
   Virtual Provisioning support ........................................................................................... 13
      General Pool Management .......................................................................................... 13
      Thin Reclaim Utility .................................................................................................... 14
   Thin device monitor ....................................................................................................... 14
   Thin gatekeeper support ................................................................................................. 15
   SRDF/A Write Pacing monitor ........................................................................................ 15
   SRDF Host Component enhancements .......................................................................... 16
   TimeFinder/Clone Mainframe Snap Facility .................................................................... 16
   Quality of Service enhancements .................................................................................. 17
   AutoSwap enhancements ............................................................................................... 17
   DISKCOMPARE enhancement ........................................................................................ 18
   Electronic License Management enhancements ............................................................. 18

Conclusion ....................................................................................................................... 19
Executive Summary

VMAX 40K is the newest member of the Symmetrix VMAX Family. It is built on the foundation of the industry-leading Virtual Matrix architecture, and provides higher levels of scalability, performance, and consolidation for the most demanding virtual data center environments. The Symmetrix VMAX Family consists of VMAX 40K, VMAX 20K (formerly VMAX) and VMAX 10K (formerly VMAXe).

Enginuity version 5876 is the latest Enginuity release supporting Symmetrix VMAX 10K, VMAX 20K and VMAX 40K. The capabilities of Enginuity 5876 to network, share, and tier storage resources allows data centers to consolidate applications and deliver new levels of efficiency with increased utilization rates, improved mobility, reduced power and footprint requirements, and simplified storage management.

Enginuity 5876 includes significant enhancements for mainframe users of the Symmetrix VMAX Series array that rival in importance to the original introduction of the first Symmetrix Integrated Cached Disk Array in the early 1990s. After several years of successful deployment in open systems (FBA) environments, mainframe VMAX Series users now have the opportunity to deploy Virtual Provisioning™ and Fully Automated Storage Tiering for Virtual Pools (FAST VP) for count key data (CKD) volumes.

These two technologies deliver a much needed autonomic computing capability to the storage layer that was previously only available in the server layer of the mainframe platform.

In addition, more flexible configuration capabilities have been incorporated that provide a much larger single control unit image and allow users a single point of control for configuration change.

Accompanying Enginuity 5876 is a new release of Mainframe Enablers software, V7.4, which provides for management of virtual pools and automatic space reclamation in thin-provisioned environments, along with a number of new functions and usability enhancements in the SRDF® Host Component, QoS, TimeFinder®/Clone, and AutoSwap™ products.

Finally there are several noteworthy enhancements to the Symmetrix Remote Data Facility (SRDF) product that benefit mainframe users of this mission-critical Enginuity feature.

Audience

This white paper is intended for EMC technical consultants, mainframe system programmers, storage administrators, operations personnel, performance and capacity analysts, technical consultants, and other technology professionals who need to understand the features and functionality capabilities of the Symmetrix VMAX subsystem at a closer architectural level.

While this paper deals with the new features as stated, a comprehensive understanding of all of the mainframe features offered in Enginuity prior to this
release can be gained by reviewing the EMC Mainframe TechBook, *EMC Mainframe Technology Overview*.

The focus of this white paper is on the new Enginuity 5876 features for mainframe environments. For details of features for the open systems environments, see the white paper titled *New Features in EMC Enginuity 5876 Enhancements for Open Systems Environments*.

**Enginuity 5876 New Features**

This section describes the new features in Enginuity 5876 that are relevant to mainframe users of CKD volumes.

These features include:

- Virtual Provisioning
- Fully Automated Storage Tiering for Virtual Pools
- Increased number of Logical Control Units per split
- SRDF enhancements
  - SRDF/A write pacing (device level and reporting)
  - SRDF/A copy improvement
  - Mixed mode SRDF
- HW compression for Fibre RA (VMAX 40K only)

**Virtual Provisioning**

Virtual Provisioning is a new method of provisioning CKD volumes within the Symmetrix VMAX Series array. It is supported for 3390 device emulation only and is described in detail in the white paper titled *z/OS and Virtual Provisioning Best Practices*.

Standard provisioning, also known as thick provisioning, either mirrors an entire 3390 volume on Symmetrix hyper volumes (RAID1) or stripes the volume across the disks of one and only one RAID parity RAID rank (that is made up of hyper volumes on the physical disks in the Symmetrix array) in 2 or 4 track increments. This configuration is depicted in Figure 1.
Figure 1. Standard Thick Provisioning in Symmetrix VMAX Series arrays

A virtual provisioned volume, that is a thin volume, disperses a 3390 volume image across many physical RAID-protected devices using small (12 tracks) units called track groups. These devices are protected by the same RAID protection as provided for normal thick devices and are organized into virtual pools (thin pools) that support a given disk geometry (CKD3390 or FBA), drive technology, drive speed, and RAID protection type.

Thin devices are associated with virtual pools at creation time through a process called binding, and can either be fully pre-allocated in the pool, or allocated only on demand when a write occurs to the volume.

Figure 2. Virtual Provisioning in Symmetrix VMAX Series arrays
This dispersion of track groups across the disks in a pool is what gives rise to the term virtual provisioning, as the volume is not bound to a single RAID rank but exists on many RAID ranks in the virtual pool.

This mapping of the device image to a virtual pool through the track group abstraction layer enables a concept called thin provisioning, which allows a user, who chooses not to pre-allocate the entire volume image in the pool, the option to present more storage capacity by way of the thin volumes than is actually present in the thin pool. Presenting more capacity on the channel than is actually in the pool is called over provisioning, and the ratio the storage presented on the channel to the actual storage in the pool is called the over-subscription ratio.

Virtual Provisioning also provides these important benefits:

1. The data is effectively wide striped across all the disks in the pool, thereby eliminating hot spots and improving overall performance of the array.

2. The array is positioned for active performance management at both the sub-volume and sub-dataset level using FAST VP.

**Fully Automated Storage Tiering for Virtual Pools (FAST VP)**

Fully Automated Storage Tiering for Virtual Pools is an array-level performance management function that non-disruptively moves sets of 10 track groups (6.8MB) between storage tiers automatically at the sub-volume level in response to changing workloads. It is based on, and requires, virtually provisioned volumes in the VMAX.

FAST VP fills a long standing need in z/OS storage management: Active performance management of data at the array level. It does this very effectively by moving data in small units making it both responsive to the workload and efficient in its use of control unit resources.

Such sub-volume, and more importantly, sub-dataset, performance management has never been available before and represents a revolutionary step forward by providing truly autonomic storage management.

As a result of this innovative approach, compared to an all-fibre channel disk drive configuration, FAST VP can offer more performance at the same cost, or the same performance at a lower cost.

FAST VP also helps users reduce DASD costs by enabling exploitation of very high capacity SATA technology for low-access data, without requiring intensive performance management by storage administrators.

Most impressively, FAST VP delivers all these benefits without using any host resources whatsoever.

FAST VP uses three constructs to achieve this:

- **FAST tier**
  - A collection of up to four virtual pools with common drive technology and RAID protection. There are at most three tiers allowed in an array.
• FAST storage group
  ▪ A collection of thin volumes that represent an application or workload. These should be based on SMS storage group definitions in a z/OS environment.

• FAST policy
  ▪ Rules that govern how much capacity of a storage group (in percentage terms) is allowed to be moved into each tier. The percentages in a policy must total at least 100 percent but may exceed 100 percent. Each FAST storage group is associated with one FAST policy definition.

Figure 3 depicts the relationship between VP and FAST VP in the VMAX Series array.

More details on FAST VP can be found in the white paper Implementing Fully Automated Storage Tiering for Virtual Pools (FAST VP) for EMC Symmetrix VMAX Series Arrays.

Figure 3. Virtual Provisioning and FAST VP

Increased number of Logical Control Units (LCU) per split

Currently the Symmetrix subsystem supports a maximum of 64 Logical Control Unit images (of 256 devices each) on a FICON port yielding a maximum addressable device count of 16,384 per port.

If there are more than 16,384 host-addressable devices in a Symmetrix frame, then the Symmetrix subsystem is divided into splits, whereby a subset of FICON ports
address a subset of the defined host devices. Each split in the Symmetrix array presents a unique control unit serial number to the mainframe host, and there are a maximum of 16 splits allowed in a Symmetrix frame.

While the current configuration support has afforded users the ability to connect many LPARs, supporting 8,192 logical paths per FICON port, it has also resulted in a constraint on the number of LCUs per port and a requirement to split Symmetrix that has a large number (>16K) devices.

This can impact users of EMC Compatible Native Flash because FlashCopy is only supported within one control unit and the splits appear to the host as separate control units. This prevents FlashCopy between devices in the same physical control unit if they exist in different splits.

In addition, it makes configuration management less flexible as changes require consideration of the split Symmetrix configuration and cannot be made only at the host.

Beginning with Enginuity 5876, a configuration option can be set in the Symmetrix subsystem that allows up to 255 LCUs per split. This allows addressability to 64K devices in a single split. However, the maximum of 16 splits and 255 LCUs per frame remains.

This increase in device addressability reduces both the need to divide the Symmetrix subsystem into splits and the likelihood of encountering the FlashCopy cross-split conflict. It also increases configuration flexibility by allowing most configuration changes to involve only host definition changes.

As a result of allowing more LCUs per port, the number of logical paths, and consequently the number of LPARs supported per port, is reduced depending on the number of LCUs defined per port. The overall maximum number of logical paths is limited to 2,048 by the rule below:

\[
\text{#CU} \times \text{#LPARS} = \text{Constant 2,048 logical paths}
\]

This results in the maximum supported LPAR per port attachment based on the number of LCUs depicted in the Table 1.

Table 1. Maximum supported LPARs per port attachment
Enginuity 5876 includes several SRDF enhancements that are of interest to mainframe users. These include:

- SRDF/A device write pacing
- SRDF/A copy improvement
- Mixed mode SRDF
- FAST VP support
- HW compression for Fibre RA (VMAX 40K only)

A description of these features follows.

**SRDF device write pacing**

Enginuity 5874 introduced the concept of SRDF/A Group Write Pacing as a resiliency enhancement to SRDF/A, which complemented the previous features Transmit Idle and Delta Set Extension.

The objective of SRDF/A Group Write Pacing is to maintain SRDF/A operational status by preventing cache exhaustion due to a reduction in the ability of SRDF/A to service input/output (I/O) in a timely manner, either due to link bandwidth reduction or a heavy burst of incoming writes. It does this by monitoring SRDF/A’s I/O service rate in comparison to the incoming host’s I/O rate at the group level. Differences in the service rates are resolved by applying slight delays (across the SRDF group) in the servicing of host I/O by the FICON adapters. In this way SRDF/A suspensions, and subsequent recovery operations, are prevented and SRDF/A remains operational. Mainframe Enablers provides controls for group write pacing using the GPACE option of the SRDF Host Component SC SRDFA_WP command.
Enginuity 5875 added support for TimeFinder/Snap off SRDF/A R2 devices by enabling pacing of an individual R1 device if its corresponding SRDF/A R2 device was the source of a TimeFinder/SNAP operation or a TimeFinder/Clone operation that did not specify the pre-copy option. This specific case of pacing at the device level on behalf of TimeFinder operations is sometimes referred to as TimeFinder pacing, but it is controlled by the DPACE option in the SC SRDFA_WP command. Again, its objective is to prevent SRDF/A cache exhaustion on the R1 side due to R2 restore delays that may be caused by TimeFinder operations.

Enginuity 5876 has extended the functionality within group write pacing to add a device-level, in addition to group-level, pacing function based on SRDF/A restore delays. If a restore operation is elongating beyond the minimum cycle time due to write pending considerations on R2 devices, then Enginuity may apply pacing delays on the corresponding R1 device. While it is possible that device-level pacing may escalate to group-level pacing, this is a more granular approach designed to target a R2 side condition involving few volumes that may lead to cache exhaustion. The new device pacing capability is automatically enabled and disabled as part of group write pacing and is controlled via the GPACE option in Mainframe Enablers.

Note that SRDF/A write pacing does support the ability to exempt volumes from group/device write pacing function.

Also a monitor for device pacing statistics has been added and is described in the Mainframe Enablers 7.4 enhancements section in this paper.

**SRDF/A copy improvement**

SRDF/A has always supported the ability to resynchronize volumes within the context of the SRDF/A cycle switch process by allowing track copies to be carried within the SRDF/A cycles. There exists a 30,000 track limit per cycle (divided across all SRDF/A groups) with this capability.

While this process can achieve resynchronization for SRDF/A volumes, it does not fully exploit the bandwidth available if the actual SRDF/A cycle time is less than the minimum cycle time specified by the user.

Enginuity 5876 improves track copy performance when SRDF/A is active by allowing direct R1→R2 copying, bypassing SRDF/A cycles, and allowing extra copies until the minimum cycle time is reached. This behavior is automatic and will invoke if the current cycle is empty and the previous cycle was at the minimum cycle time.

**Mixed mode SRDF**

Symmetrix SRDF Remote Adapters (RA) have previously been restricted to supporting either SRDF/A or SRDF/S, but never both that the same time. This was due to concerns about the impact on SRDF/S performance, and, as a result, limited flexibility for SRDF mode switching and increased overall costs by requiring dedicated RAs for each mode.
Enginuity 5876 introduces the ability to mix SRDF/S, SRDF/A, and SRDF copy operations on the same RA by providing a prioritization mechanism for each I/O type that is user-configurable at the RA level for both Fibre Channel and GigE RA types.

The default settings for each SRDF mode’s percent of the RA CPU are shown below and can be displayed and set using MFE Quality of Service’s new `MRDFDIS` and `MRDFSET` commands.

- Default policy (RA CPU%):
  - SRDF/S: 70%
  - SRDF/A: 20%
  - Copies: 10%

**FAST VP support for SRDF**

FAST VP, first introduced in Enginuity 5875, operates independently in each Symmetrix system in an SRDF relationship. One consequence of this is that decisions made on data placement among the FAST VP tiers are not reflected in partner arrays across an SRDF link. During failover operations, data could be in a different tier on the secondary Symmetrix from where it was in on the primary Symmetrix. If this behavior persisted into 5876, it would be of particular concern in mainframe AutoSwap environments when I/O is dynamically redirected to the secondary site, possibly resulting in erratic response times following an Autoswap event.

Enginuity 5876 has addressed this issue by adding SRDF support to the FAST VP statistics gathering mechanism. FAST VP statistics are now sent to the secondary Symmetrix array in SRDF/S, SRDF/A, and concurrent SRDF configurations. With statistics from the R1 side, the FAST VP engine on the R2 Symmetrix array is better able to make promotion and demotion decisions that reflect the workload activity on the R1 Symmetrix array, and to better position the secondary Symmetrix array to provide similar performance for the workload.

**Hardware compression for Fibre RA**

The VMAX 40K with Enginuity 5876 has added a hardware-compression capability on the Fibre RA. Previously hardware compression for SRDF was only available on GigE remote adapters.

Support for hardware compression with Fibre RAs requires a configuration setting in the Symmetrix subsystem to be enabled and both sides to be running VMAX 40K with Enginuity 5876.

**Mainframe Enablers 7.4**

Mainframe Enablers V7.4 includes host controls for Virtual Provisioning pool management for Symmetrix VMAX Series arrays running Enginuity 5876. This section includes several important functional and usability enhancements in Mainframe Enablers V7.4.
**Virtual Provisioning support**

Virtual Provisioning and FAST VP controls for the z/OS environment are implemented across multiple EMC Symmetrix storage management products.

As has been true for several years, Symmetrix level configuration definition is done using the Symmetrix Management Console (SMC). This product allows the creation of thin devices and the definition and management of virtual pools. It also provides the controls for the definition of FAST VP policies. Note that the SMC connection to Symmetrix subsystem can be achieved in one of three ways:

- Using a Fibre Channel SAN connection
- Internal to the Symmetrix subsystem by running SMC on Symmetrix service processor
- By way of IP to a z/OS host running EMC Solutions Enabler under Unix System Services

**General Pool Management**

Mainframe Enablers V7.4 contains an enhanced pool management function that provides support for managing virtual pools, as well as save pools for TimeFinder/Snap virtual devices, and DSE pools for SRDF/A Delta Set Extension.

The new support is implemented through a new Symmetrix Control Facility environment, called General Pool Management (GPM), and has both a z/OS MODIFY command interface and a batch utility interface. Prior to V7.4, pool management consisted only of a batch utility and a set of CONFIGPOOL commands. While these commands are still supported, a new command set has been developed to support all pool types in MFE 7.4.

Using GPM customer can perform both virtual-pool-oriented functions and thin-device-oriented function as listed below:

- **Pool-oriented commands:**
  - CREATE – Creates a thin, DSE, or snap device pool.
  - DELETE – Deletes an empty device pool.
  - DISPLAY – Displays thin pool information.
  - POOLATTR – Specifies pool-level attributes.
  - REBALANCE – Initiates leveling of allocated tracks within a pool.
  - RENAME – Changes the name of a thin pool

- **Device-oriented commands:**
  - ADD – Adds one or more back-end devices to a thin pool.
  - ALLOCATE – Causes assignment of all thin device tracks to data devices.
  - BIND – Binds one or more thin devices to a thin pool.
• DISABLE – Changes the status of one or more pool devices from active to inactive.
• DRAIN – Initiates reassignment of allocated tracks to other pool devices.
• ENABLE – Change the status of one or more pool devices from inactive to active.
• HDRAIN – Halts the draining activity of pool devices.
• QUERY – Displays information about thin provisioning device entities.
• MOVE – Causes movement of assigned tracks from prior bound pool to current pool.
• REBIND – Changes the pool to which a thin device is bound.
• REMOVE – Removes an inactive device from a device pool.
• UNBIND – unbind one or more thin devices from a thin device pool. This will result in loss of any data on thin device.
• USR_NRDY – Changes the device’s control unit status to user-not-ready.
• USR_RDY – Changes the device’s control unit status to user-ready.

Examples of how these commands are used to manage virtual pools from z/OS can be found in the white paper titled z/OS and Virtual Provisioning Best Practices.

Thin Reclaim Utility

The second major component of Mainframe Enablers V7.4 virtual provisioning support is another new Symmetrix Control Facility environment called the Thin Reclaim Utility (TRU).

For thin devices which are not bound with the PERSIST and PREALLOCATE attributes, TRU enables the reclamation of thin device track groups for reuse within the virtual pool by other thin devices. It does this by first identifying the free space in VTOC, initially by way of a scan function, then on an ongoing basis by way of the z/OS SCRATCH exit. It then periodically performs a reclaim operation, which marks tracks as empty in the Symmetrix array (no user records, only standard R0). Both SCAN and RECLAIM can be triggered based on user settable thresholds. The Symmetrix zero reclaim background task then returns these empty track groups to the free list in the virtual pool.

Note that this function only applies to volumes that have been thin provisioned in the Symmetrix array. Volumes that are fully pre-allocated and marked persistent are not eligible for reclamation.

Thin device monitor

The Symmetrix Control Facility currently supports persistent monitors for the SAVE device pools used by TimeFinder/SNAP and the DSE pool used by SRDF/A’s Delta Set Extension feature. Mainframe Enablers V7.4 extends this monitoring function to virtual pool capacity on behalf of Virtual Provisioning. The controls for the thin device
monitor are identical to those for SAVE and DSE monitors, and are denoted by THN in the SCF monitor control statement syntax. Values for alerts and actions can be set at global, controller, or individual pool levels. An example of global setting for the thin device monitor follows:

```
SCF.THIN_LIST=ENAB
SCF.THIN_DEBUG=YES
SCF.THIN_STATS=YES
SCF.THIN_LIST=PERCENT (01,40)  For pool utilization b/w n 1 and 40%
SCF.THIN_LIST=DURATION=20  check every 20 min
SCF.THIN_LIST=ACTION=DIS (NEARHALF)  Issue this message
SCF.THIN_LIST=FREQUENCY=REPEAT  Perform action each time or ONCE
SCF.THIN_LIST=PERCENT (41,75)
SCF.THIN_LIST=DURATION=05
SCF.THIN_LIST=ACTION=DIS (WATCHITL)
SCF.THIN_LIST=FREQUENCY=REPEAT
SCF.THIN_LIST=PERCENT (76,90)
SCF.THIN_LIST=DURATION=05
SCF.THIN_LIST=ACTION=USEREXIT (MYEXIT)
SCF.THIN_LIST=FREQUENCY=ONCE
```

**Thin gatekeeper support**

Prior to Enginuity 5876, thin devices were not allowed to be used as gatekeepers by host software. With Mainframe Enablers V7.4 and Enginuity 5876 controllers, thin devices can be used as gatekeepers. Gatekeepers can be CKD or FBA, and the thin devices do not have to be bound.

**SRDF/A Write Pacing monitor**

The Write Pacing monitor exposes relevant information regarding SRDF/A write pacing activities within the Symmetrix array. Pacing activities are collected at the group and device level.

The monitoring is performed on the controllers and SRDF groups specified by the user. The level of detail, whether on the group and/or device level, is also performed according to user specifications. The types of data that can be collected and reported on by the monitor follows:

- Changes in the ARMED state by device.
- Total paced delay by device.
- Total paced track count by device.
- Changes in the ENABLED/SUPPORTED/ARMED/PACED state for the group.
- Total paced delay for the group.
- Total paced track count for the group.

The data collected by the monitor is presented in a similar manner as the current ASY monitor: It’s presented as formatted messages by way of WTOs and/or written as SMF records.

Control of these messages from the WTO interface is provided via SCFINI parameters. The SRDF H/C commands consist of the following:
• #SQ SRDFA_WP displays SRDF/A write pacing dynamic parameters and stats.
• The #SQ SRDFA_WP_VOL commands displays devices with non-zero paced delay and non-zero total paced track count numbers.

**SRDF Host Component enhancements**

SRDF Host Component in Mainframe Enablers V7.4 contains two usability enhancements.

The first is the extension of the SELECT filter list functionality to the SQ VOL, STATE, and MIRROR commands. This enables an extensive filter list with Boolean operators to be applied to these commands, which allows much more control and granularity in display results.

The second enhancement is the addition of a very powerful HELP SYNTAX command that displays detailed syntax maps for all SRDF Host Component commands.

In addition, SRDF Host Component contains support for Federated Tiered Storage, an Enginuity 5876 feature for FBA devices only. This feature allows other arrays to be direct FCP or SAN attached to Symmetrix VMAX Series array in such a way that FBA devices (known as eDisks) behave as though they were attached to disk adapters in the Symmetrix array. A new director type (DX) has been defined in the Symmetrix array that enables the FTS feature.

Two FTS modes are supported. The first mode, external provisioning, supports the establishment of a new Symmetrix device to be provisioned on an external volume. The data that previously existed on the external volume is not preserved.

The second mode, encapsulation, allows the establishment of a Symmetrix device to be provisioned on an external volume, preserving the data on the external volume for the purpose of migration.

Mainframe Enablers allows the end user to display and control devices that are externally provisioned. The output of Mainframe Enablers Host Component V7.4 SQ commands identifies FTS devices as well as DX directors. The SRDF Host Component SC command is able to manipulate the state of FTS externally provisioned volumes in the same manner as traditional volumes are controlled (subject to licensing requirements).

For more information on FTS please refer to the white paper titled *Managing SAN-attached Disk Arrays with EMC Symmetrix Federated Tiered Storage.*

**TimeFinder/Clone Mainframe Snap Facility**

TimeFinder/Clone has added an extensive SMF recording capability that writes a detailed SMF record for each EMCSNAP command. This function is available in Mainframe Enablers V7.4 and does not have any Enginuity dependencies. The SMF record layout is described in the TimeFinder/Clone Mainframe Snap Facility product guide.
In support of Virtual Provisioning, TimeFinder/Clone has added AUTO_BIND and AUTO_UNBIND options on the SNAP VOLUME and STOP SNAP commands respectively. These options can be used when a thin device is the target volume for one of these commands, and automatically performs the binding that is required in the case of SNAP VOLUME and unbinding that is recommended in the case of STOP SNAP.

TimeFinder/Clone also has added support for VP Snap, an FBA device only capability that allows TimeFinder/Snap to operate on virtually provisioned volumes and exploits shared allocations of track groups within the virtual pool.

**Quality of Service enhancements**

The QoS batch utility has been enhanced to provide commands to display and control the new mixed mode SRDF support for remote adapters in Enginuity 5876. An example of displaying of the mixed SRDF weights follows:

```
MRDFDISP WEIGHT LCL(3A01)
```

**Current selection policy for Symm serial:000195700086**

<table>
<thead>
<tr>
<th>Director #</th>
<th>POLICY</th>
<th>Sync CPU%</th>
<th>A-Sync CPU%</th>
<th>Copies CPU%</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>LEGACY</td>
<td>70</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>56</td>
<td>LEGACY</td>
<td>20</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>57</td>
<td>LEGACY</td>
<td>70</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>59</td>
<td>LEGACY</td>
<td>70</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

Quality of Service currently also includes the ability to manage Enginuity’s Dynamic Cache Partitioning feature, allowing the addition of individual devices or device ranges to a dynamic cache partition. In Mainframe Enablers V7.4, this capability has been enhanced by adding a parameter to the SETCPMVD command that provides the ability to move every device in a specified pool to a DCP. All pool types (THIN pools, SNAP pools, and DSE pools) are supported by this function. Note that the action is point-in-time specific, meaning that devices added to a pool after this new command has been executed are not dynamically added to DCPs. Also note that in Enginuity 5876, up to 16 dynamic cache partitions are supported.

In the area of copy priority controls, QoS has also added the ability to operate on an RA group or entire Symmetrix boundary, and filter the results by copy priority type.

**AutoSwap enhancements**

AutoSwap has had SAF authorization added to its operator commands as follows:

- Commands that require UPDATE access to the resource:
  - DEFINE
  - VALIDATE
  - SWAP
  - DELETE
- SET
- SETSWAP
- Commands that requires READ access to the resource
  - DISPLAY

**DISKCOMPARE enhancement**

The DISKCOMPARE utility in Mainframe Enablers has been enhanced to improve performance of disk compares done across SRDF links by utilizing a new 32-bit CRC comparison of track data, instead of the previous method of reading track contents across the link for comparison.

**Electronic License Management enhancements**

New packaging and licensing simplification has been introduced for VMAX 40K. This means that with MFE 7.4 and Enginuity 5876 you see eLicensing reported differently from earlier releases of hardware and software.

One of the key changes is that some previously licensed features are now included in the SYMM_VMAX_ENGINUITY entitlement. For the VMAX 40K the following products are now available and do not have to be licensed through ELM:
- Dynamic Cache Partitioning (formerly SYMM_VMAX_DCP)
- Symmetrix Priority Controls (formerly SYMM_VMAX_SPC)
- Optimizer (formerly SYMM_VMAX_OPTIMIZER)

Mainframe Enablers V7.4 ELM support has been enhanced to display these license bundles on VMAX 40K. Feature checking by Mainframe Enablers components continues to be done on the individual feature level.

The following table describes the changes in licensing for the VMAX 40K.

<table>
<thead>
<tr>
<th>Feature name</th>
<th>Entitlement</th>
<th>Replaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYMM_VMAX_FAST_TIERING</td>
<td>FAST and FAST VP</td>
<td>SYMM_VMAX_FAST</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SYMM_VMAX_FAST_VP</td>
</tr>
<tr>
<td>SYMM_VMAX_SRDF_REPLICATION</td>
<td>SRDF/S, SRDF/A, SRDF/AR Compatible peer</td>
<td>SYMM_VMAX_SRDF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SYMM_VMAX_SRDF_S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SYMM_VMAX_SRDF_A</td>
</tr>
<tr>
<td>SYMM_VMAX_TIMEFINDER</td>
<td>TimeFinder/Clone</td>
<td>SYMM_VMAX_TF_SNAP</td>
</tr>
<tr>
<td></td>
<td>TimeFinder/Snap</td>
<td>SYMM_VMAX_TF_CLONE</td>
</tr>
<tr>
<td></td>
<td>Compatible Native Flash</td>
<td></td>
</tr>
</tbody>
</table>

The following is an SCF ELM LIST command output example which includes the new feature bundles:
**New Features in EMC Enginuity 5876 for Mainframe Environments**

SCF0341I ELM,LIST,CONTROLLER(00258)

SCF5005I Report for (Local) Controller follows  501
Symmetrix ID : 000195700258
Issue Date : 03/06/2012

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Activation Type</th>
<th>ID</th>
<th>Capacity Type</th>
<th>Licensed</th>
<th>Install Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYMM_VMAX_ENGINUITY</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SYMM_VMAX_FAST_TIERI</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SYMM_VMAX_SRDF_REPLI</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SYMM_VMAX_TIMEFINDER</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SYMM_VMAX_SRDF_STAR</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SYMM_VMAX_ORS_DM</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SYMM_VMAX_SMC</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>SYMM_VMAX_SRM</td>
<td>P-IND</td>
<td>1699326</td>
<td>R-TB-Non-Sata</td>
<td>117</td>
<td>03/06/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R-TB-Sata</td>
<td>66</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- **E-IND** = Evaluation Individual
- **P-IND** = Permanent Individual
- **P-ENT** = Permanent Enterprise Agreement
- **P-LTD** = Permanent Limited

Prior releases of Mainframe Enablers only display the individual features and not these bundle names on the VMAX 40K.

**Conclusion**

Enginuity 5876 marks a significant change in Symmetrix VMAX support for mainframe environments. The introduction Virtual Provisioning and Fully Automated Storage Tiering for Virtual Pools ushers in a new era of autonomic mainframe storage management for Symmetrix users.

Additional enhancements in performance and configuration capabilities, both in base FICON connectivity and SRDF, combine to make Enginuity 5876 one of the most important mainframe releases of the Symmetrix subsystem in over a decade.