Abstract

This white paper examines the performance considerations of SAP applications using EMC® FAST Suite technologies (FAST VP and FAST Cache) on EMC unified storage. It also discusses the best practices for deploying SAP applications using the EMC FAST Suite.

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**Executive summary**

The business challenge that many SAP customers face today is reducing total cost of ownership (TCO) while improving service-level delivery. Frequently, responsiveness to sensitive SAP applications has deteriorated over time due to increased data volumes, unbalanced data stores, and changed business requirements. The challenge we face currently is that Serial Attached SCSI (SAS) drive technology does not keep up with the demand for more storage and performance. By using EMC’s new VNX™ storage platform, in conjunction with the software in the FAST Suite, SAP deployments under performance pressure can often gain a significant responsiveness boost without the need to redesign the applications, adjust the data layouts, and reload significant amounts of data. The FAST Suite includes FAST Cache, Fully Automated Storage Tiering for Virtual Pools (FAST VP), Unisphere™ Analyzer, and Unisphere Quality of Service Manager. This white paper focuses on two products included in the suite: FAST Cache and FAST VP.

FAST VP provides performance improvements by means of automated sub-LUN level tiering and allows a single LUN to leverage the advantages of Flash, SAS, and Near-Line Serial Attached SCSI (NL-SAS) drives through the use of storage pools. Properly balancing data distribution automatically over the tiers of storage optimizes both space utilization and the performance delivered from the storage investment.

FAST Cache leverages Flash drives to add an extra layer of cache between Dynamic Random Access Memory (DRAM) cache and rotating spindles, which increases the I/O service responsiveness. The SAP application’s hot and cold data is automatically identified and hot data is either placed in the FAST VP’s Flash tier or cached in the FAST Cache layer to speed up the data access.

FAST VP and FAST Cache provide very low latencies to frequently accessed data, thus improving overall application response times. By dedicating Flash drives to the most frequently accessed data, the investment made toward the Flash drives is optimally leveraged to deliver a magnitude of application service improvement. As the focus of business changes, the data that becomes the most important, and most frequently used, will be automatically cached in these Flash drives. Hence, the business applications will always be taking full advantage of the investments made in these Flash drives, delivering optimal application service improvement. The performance improvements gained by using the FAST Suite in SAP deployments provide measurable and meaningful operational cost savings over time. The following figures show FAST VP with three tiers of storage layers and FAST Cache.
This white paper is intended for SAP administrators, storage architects, customers, and EMC field personnel who want to improve the performance of business applications by implementing FAST VP and FAST Cache technology in their SAP environments using EMC® VNX unified storage.

Introduction

The introduction of the new EMC VNX family of unified storage platforms not only continues the tradition of providing one of the highest industry standards in data reliability and availability, but has factored into the design a boost in performance and bandwidth to address the sustained data access bandwidth rates. The new system design has also placed heavy emphasis on storage efficiencies and density, as well as crucial “green” storage factors, such as data center footprint, lower power consumption, and improvements in power reporting.

This white paper covers some of the key products included in the FAST Suite that are relevant to deploying SAP enterprise applications supported by some findings resulting from an EMC engineering case study using SAP. This white paper also covers the workload experiments that EMC has conducted with an SAP ECC 6.0 system using storage pools. The goal is to verify that the use of FAST VP and FAST Cache together can boost performance and reduce TCO for certain kinds of SAP applications when used along with traditional LUN-based technology. EMC tested these aspects by comparing the various SAP transaction response times that require no application-level changes. The findings from these experiments serve as the basis of some of the deployment best practice recommendations for leveraging FAST VP and FAST Cache.
technology in different SAP environments. Let’s first review the technology involved in the study.

**EMC VNX unified storage and SAP technology**

![EMC VNX models](image)

Figure 3. EMC VNX models

The new generation of EMC unified storage, like most of the previous EMC midrange storage product generations, offers a range of choices for meeting diverse business requirements, including performance, capacity, and protection, all at the lowest total cost of ownership.

A key distinction of this new generation of platforms is support for both block- and file-based external storage access over a variety of access protocols, including Fibre Channel (FC), iSCSI, FCoE, NFS, and CIFS network shared file access. Furthermore, data stored in one of these systems, whether accessed as block- or file-based storage objects, is managed uniformly via Unisphere, a web-based interface window. To find more details about the new features supported by Unisphere, refer to Unisphere documentation.

The rapid increase in SAP deployments has added a tremendous amount of new data that is stored inside the storage systems. In addition, to be able to scale readily to accommodate new data at an unprecedented rate, new-generation systems must also push the bandwidth envelopes to a totally new level to keep up with that data volume growth.

Another consequence of the rapid data growth is the need to store the data more compactly. Data centers are continually contending with physical facility space, power, and cooling challenges while storing the ever-increasing volume of data that the business demands. Our
new storage family now supports the 2.5” SAS drives in a 2U disk array enclosure (DAE) that can hold up to 25 drives, one of the densest offerings in the industry. For example, compared to the older-generation technology of storing 15 x 600 GB worth of data using the 3.5” FC drives in a 3U DAE, the new DAE using 25 x 600 GB drives in a 2U footprint means an increase by 2.5 times. The power efficiency of the new DAES also makes it more cost-effective to store the increased data in this much more compact footprint without the need to increase power consumption and cooling.

Most of the data points discussed in this paper were generated on the VNX5500™ and apply to any VNX platform except the VNX5100™ model.

**EMC FAST Suite (FAST VP, FAST Cache)**

**FAST VP**

VNX FAST VP is a policy-based auto-tiering solution for enterprise applications. FAST VP operates at a granularity of 1 GB, referred to as a “slice.” The goal of FAST VP is to efficiently utilize storage tiers to lower customers’ TCO by tiering colder slices of data to high-capacity drives, such as NL-SAS, and to increase performance by keeping hotter slices of data on performance drives, such as Flash drives. This occurs automatically and transparently to the host environment. High locality of data is important to realize the benefits of FAST VP. When FAST VP relocates data, it will move the entire slice to the new storage tier. To successfully identify and move the correct slices, FAST VP automatically collects and analyzes statistics prior to relocating data. Customers can initiate the relocation of slices manually or automatically by using a configurable, automated scheduler that can be accessed from the Unisphere management tool. The multi-tiered storage pool allows FAST VP to fully utilize all three storage tiers: Flash, SAS, and NL-SAS. The creation of a storage pool allows for the aggregation of multiple RAID groups, using different storage tiers, into one object. The LUNs created out of the storage pool can be either thickly or thinly provisioned. These “pool LUNs” are no longer bound to a single storage tier. Instead, they can be spread across different storage tiers within the same storage pool. If you create a storage pool with one tier (Flash, SAS, or NL-SAS) then FAST VP has no impact on the performance of the system. To operate FAST VP, you need at least two tiers.

**FAST Cache technology**

In traditional storage arrays, the DRAM caches are too small to maintain the hot data for long periods of time. Very few storage arrays give an option to nondisruptively expand DRAM cache, even if they support DRAM cache expansion. FAST Cache extends the cache available to customers by up to 2 TB using Flash drives. FAST Cache tracks the data activity temperature at a 64 KB chunk size and copies the chunks to the Flash drives once its temperature reaches a certain threshold. After a data chunk gets copied to FAST Cache, the subsequent accesses to that chunk of data will be served at Flash latencies. Eventually, when the data temperature cools down, the data chunks get evicted from FAST Cache and will be replaced by newer hot data. FAST Cache uses a simple Least Recently Used (LRU) mechanism to evict the data chunks.
A complete introduction to FAST Cache is beyond the scope of this document. This paragraph attempts to introduce FAST Cache briefly. FAST Cache is built on the premise that the overall applications' latencies can improve when most frequently accessed data is maintained on a relatively smaller sized, but faster storage medium, like Flash drives. FAST Cache identifies the most frequently accessed data that is temporal in nature and copies it to Flash drives automatically and nondisruptively. The data movement is completely transparent to applications, thereby making this technology application-agnostic and management-free. For example, FAST Cache can be enabled or disabled on any storage pool simply by selecting/clearing the “FAST Cache” storage pool property in advanced settings.

FAST Cache can be selectively enabled on a few or all storage pools within a storage array, depending on application performance requirements and SLAs.

There are several distinctions to EMC FAST Cache:

- It can be configured in read/write mode, which allows the data to be maintained on a faster medium for longer periods, irrespective of application read-to-write mix and data re-write rate.

- FAST Cache is created on a persistent medium like Flash drives, which can be accessed by both storage processors. In the event of a storage processor failure, the surviving storage processor can simply reload the cache rather than repopulating it from scratch by observing the data access patterns again, which is big differentiating point.

- Enabling FAST Cache is completely nondisruptive. It is as simple as selecting the Flash drives that are part of FAST Cache and does not require any array disruption or downtime.

- Since FAST Cache is created on external Flash drives, adding FAST Cache will not consume any extra PCI-E slots inside the storage processor.

**SAP**

SAP has helped customers automate their business processes through the use of its standard Enterprise Resource Planning (ERP) software solution, called SAP R/3. The ERP solution was upgraded and launched as SAP ECC 6.0 in 2005. The purpose of positioning it as ECC (or ERP Central Component) is to enable SAP to build and develop an environment of other products that can function upon the foundation of the central component. ECC has the components of the traditional R/3 finance, logistics, sales, material management, human resources, and additional extension sets. Individually, each of these modules effectively serves to manage a business area or functional area for which a particular business unit is responsible. SAP NetWeaver is SAP’s integrated technology platform and is the technical foundation for all SAP applications.

The standard NetWeaver 7.0 business suite includes many systems that perform different activities. Each system is a separate SAP instance. However, the technical architecture of each system uses the same kernel architecture. The data that is
imported into each system’s database during installation is what makes it different. The difference between these NetWeaver products comes strictly from the type of data imported into these systems rather than the general architecture. This is also true with the rest of the NetWeaver Suite applications (CRM, SRM, and BI).

Typically SAP systems are deployed in two-tier or three-tier configurations. In a two-tier configuration, the application and the database run on one physical server and the distributed presentation clients access the SAP system using client tools like SAP GUI. In a three-tier configuration, the database and the central instance run on one powerful server while multiple application servers running on different machines and distributed presentation clients access the SAP system using client tools.

**Importance of storage performance in SAP**

The production SAP system can generate quite large volumes of data that need to be accessed with low response times for the online users as well as background batch-processing jobs. The design of a database server’s storage system is one of the most important choices in the design of the SAP infrastructure. A properly designed disk storage system has direct influence on the response times of the overall SAP landscape and instances. Typically, in the case of production SAP systems, the size of all the database files combined is significantly larger than the size of the physical memory (RAM) available, whether on the server or on the storage cache. Since most servers today do not support hundreds of gigabytes of physical memory, the data transfer to or from storage plays a crucial role in the overall performance of the SAP system.

**Disk I/O patterns from the business application perspective**

The number and type of hard disk drives have a considerable influence on the performance of disk I/O. In addition to the capacity requirements, the SAP system requires performance from the storage system in the form of high I/O throughput. Online Transaction Processing (OLTP) applications create millions of random disk accesses (usually 8K block for SAP databases). For SAP R/3 systems, the database server has a typical OLTP disk I/O access profile of an 80/20 percent read/write (4:1) ratio. Depending on the components you use and the customizations you make to the SAP system, other ratios are also possible. For example, if you want to import large amounts of data in batch mode, the read ratio is more when compared to the write ratio, where the storage system may need to be configured differently.

Online Analytical Processing (OLAP) systems such as SAP Business Information Warehouse (BW) or SAP Advanced Planner and Optimizer (APO) usually transfer large data quantities. For instance, user-generated BW queries and reports are extremely read-intensive and disk performance is the key for these kinds of operations. So the 80/20 percent read/write ratio does not necessarily apply to the BW system.

You can characterize the disk I/O performance as the number of I/O (read/write) operations that a hard disk can perform per second (IOPS). Disk arrays are used for production systems to perform several I/O operations concurrently. For our study we have used storage pools containing Flash, SAS, and NL-SAS drives configured as RAID
Using EMC FAST Suite with SAP on EMC VNX Unified Storage

5 on a VNX5500. Please note that this study has been conducted using RAID 5 as a default to maximize performance. Customers wishing to maximize high availability and minimize impact due to rebuild time—especially where large drives are utilized, should that occur in their environment—will choose RAID 6 instead, because of the benefit of the additional parity drive. For better performance and the best failure protection, EMC also recommends using RAID 1/0. In some cases, RAID 1/0 offers faster data reads and writes than RAID 5 because it does not need to manage parity.

Traditionally these OLTP applications are deployed on a huge number of rotating SAS spindles (a process known as short-stroking) to meet the low I/O latency requirement. So, when OLTP applications are deployed on a huge number of rotating spindles, the effective capacity utilization of these spindles is very low, thereby increasing the TCO. Disk drive technology did not evolve as much as CPU technology over the past few decades. Even the fastest rotating spindle with a 15k rpm speed performs only around 200 random 8K IOPs practically in most real-world application workloads. Flash drives are a disruptive technology with no rotating components, which significantly improves $/IOPS and, on a per $ per transaction basis, is relatively less expensive than SAS or NL-SAS drives. Using products found in the FAST Suite creates a faster intermediate medium along with tiered storage access for storing the frequently accessed data on Flash drives. This significantly reduces the need to buy more Flash drives while at the same time providing the Flash latencies to frequently accessed data.

**SAP Application Performance Standard**

The SAP Application Performance Standard (SAPS) is a hardware-independent unit that describes the performance of a system configuration in the SAP environment and is derived from the SAP Sales and Distribution (SD) benchmark. SAP standard benchmarks are geared more toward measuring the CPU and the memory of a hardware system based on customers' SAPS requirements. SAP standard application benchmarks are not I/O-intensive in nature and do not generate the required I/O load to compare and contrast SAP system performance using FAST Cache at the storage layer. Therefore, EMC has internally developed custom SAP OLTP workloads that are based on real customer data and can generate the I/O load for the purposes of our engineering study.

**System hardware setup**

To characterize FAST Cache with SAP OLTP workloads, EMC used the following hardware setup. The performance study is conducted on a SAP ECC 6.0 system running on SUSE Linux Enterprise Server 10 using a single instance of an Oracle 10g database hosted on a Dell R900 server with 16 Intel 64-bit processors connected to a EMC VNX5550 storage array. Figure 4 shows EMC's hardware configurations. In the configuration, two back-end buses on the VNX5500 are used to connect all disk trays in a daisy-chain fashion. You should configure your back-end buses depending on your I/O requirement and by following EMC best practices for bus and disk layout. The
figure shows the hardware system setup with front-end connections on the left side and the VNX5550 back-end connections on the right side.

**Figure 4. System hardware setup**

For the SAP system, we created two storage pools and four RAID 5 pool LUNs carved out of the first storage pool, and two RAID 5 LUNs out of the second storage pool on the VNX5500 to use it for the SAP FAST Suite configuration scenarios. Four LUNs from the first storage pool were used as DATA volumes (DATA1, DATA2, DATA3, DATA4), and two RAID 5 LUNs from the second storage pool were used as LOG volumes (LOG1, LOG2) for SAP’s Oracle database. DATA LUNs and LOG LUNs were created on different storage pools for better performance and recoverability. FAST VP and FAST Cache were only enabled on the DATA LUNs but not on the LOG LUNs for this study. In this case we created several storage pools with different numbers of drives. Details are covered in **FAST Suite configuration scenarios.**
SAP workload

The SAP workload used in this study consisted of 20 business processes from the SAP FI, SD, MM, and PP modules, which contained several batch jobs running in parallel accessing the 1.3 TB database. The OLTP-style transactions in this workload read the customer data from disk and processed it. This was followed by updating the data. The workload characteristics have been kept constant for all the configuration scenarios described next so that one can make a relative comparison of application metrics. To understand the impact of the FAST Suite on an SAP ECC system in these tests, we focused on I/O throughput and response times of the batch jobs by running the workload on several configurations.

EMC also used the following configuration scenarios to compare application-level metrics to demonstrate the impact of the FAST Suite on the workload in terms of performance and TCO. The goal of this study was to show how FAST Suite can significantly reduce the number of IOPS received from rotating spindles by relocating the hot data to faster Flash drives to improve performance.
**FAST Suite configuration scenarios**

To characterize FAST Cache with SAP transactions, EMC has used the following configuration scenarios with the SAP workload described above and demonstrated the benefits of FAST Suite in the typical SAP deployments. In this workload, the OLTP-style transactions simulate the reading of customer data from disk, followed by processing and updating of the data.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td>Storage pools with 90 x 600 GB SAS drives configured as one tier</td>
</tr>
<tr>
<td><strong>Scenario 1</strong></td>
<td>60 x 300 GB SAS drives configured as one tier</td>
</tr>
<tr>
<td><strong>Scenario 2</strong></td>
<td>FAST VP with 5 x 200 GB Flash drives in tier-0, 60 x 300 GB SAS drives, and 18 x 2 TB NL-SAS drives; FAST Cache created in read/write mode on 4 x 200 GB Flash drives</td>
</tr>
<tr>
<td><strong>Scenario 3</strong></td>
<td>30 x 300 GB SAS drives in a storage pool configured as one tier</td>
</tr>
<tr>
<td><strong>Scenario 4</strong></td>
<td>FAST VP with 5 x 200 GB Flash drives in tier-0, 30 x 300 GB SAS drives, and 22 x 2 TB NL-SAS drives; FAST Cache created in read/write mode on 4 x 200 GB Flash drives</td>
</tr>
</tbody>
</table>
Baseline scenario

Figure 5 shows the SAP workload running on the Baseline storage pool configuration established on an all-SAS rotating drive configuration. Out of a total of 90 x 600 GB disks used in this setup, SAP data files were deployed on 85 drives and SAP online redo logs resided on 5 drives. Looking at the transaction completion times in Figure 5, you’ll notice that it took approximately 93,253 seconds (25.9 hours) for all 20 jobs to complete where the longest job took 5,215 seconds (1.5 hours).

Figure 5. SAP workload running on Baseline scenario storage pools with 90 SAS drives
Scenario 1

Figure 6 shows the SAP workload running on the storage pool configuration established on an all-SAS rotating drive configuration also. Out of the total of 60 x 300 GB disks used in this setup, SAP data files were deployed on 55 drives and SAP online redo logs resided on 5 drives. Looking at the transaction completion times in Figure 6, you’ll notice that it took approximately 124,288 seconds (34.5 hours) for all 20 jobs to complete where the longest job took 7,113 seconds (2 hours).

![Job Overview]

**Figure 6.** SAP workload running on 60 SAS drives
Scenario 2
In this scenario, the SAP workload was configured to run using the FAST Suite. We enabled FAST VP in Scenario 1 by adding 5 x 200 GB Flash drives and 18 x 2 TB NL-SAS drives to the storage pool with 55 SAS drives. Also FAST Cache was configured on 4 x 200 GB Flash drives and was enabled on the storage pool with SAP DATA LUNs. This configuration resulted in a 45 percent performance improvement when compared to the Baseline scenario performance and 93 percent improvement when compared to the performance in Scenario 1. Leveraging the FAST Suite results in a significant improvement over the traditional deployment model. Looking at transaction completion times in Figure 7, you’ll notice that it took approximately 64,233 seconds (17.8 hours) total for the 20 jobs to complete where the longest job took 3,542 seconds (1 hour).

![Job Overview](image)

**Figure 7. SAP workload running on 60 SAS drives with FAST Suite**
Scenario 3

Figure 8 shows the SAP workload running on the storage pool configuration established on an all-SAS rotating drive configuration. Out of the total of 30 x 300 GB disks used in this setup, SAP data files were deployed on 25 drives and SAP online redo logs resided on 5 drives. Looking at transaction completion times in Figure 8, you’ll notice that it took approximately 175,867 seconds (48.8 hours) for all 20 jobs to complete and the longest job took 9,775 seconds (2.7 hours).

![Figure 8. SAP workload running on 30 SAS drives](image-url)
**Scenario 4**

In this scenario, the SAP workload is configured to run using the FAST Suite on top of Scenario 3 by adding $5 \times 200$ GB Flash drives and $22 \times 2$ TB NL-SAS drives to the storage pool with 25 SAS drives. Also, FAST Cache is created on $4 \times 200$ GB Flash drives and is enabled on the storage pool with the SAP DATA LUNs. This configuration resulted in a 42 percent performance improvement when compared to the Baseline scenario performance and 169 percent improvement when compared to the performance in Scenario 3. This significant improvement resulted after using FAST Suite with this configuration. Looking at transaction completion times in Figure 9, you’ll notice that it took approximately 65,416 seconds (18.2 hours) total for the 20 jobs to complete where the longest job took 3,639 seconds (1 hour).

![Job Overview](image)

Figure 9. SAP workload running on 30 SAS drives with FAST Suite
## Analysis of results

### Table 1. Comparison of SAP workload durations

<table>
<thead>
<tr>
<th>FAST Suite Configuration Scenario</th>
<th>Total duration (sec) for the workload</th>
<th>Duration (sec) for the longest job in the workload</th>
<th>Performance factor w.r.t Baseline</th>
<th>Storage capacity (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline Scenario</strong> ([90 x 600 GB SAS Drives – 100% SAS])</td>
<td>93253</td>
<td>5215</td>
<td>NA</td>
<td>54000</td>
</tr>
<tr>
<td><strong>Scenario 1</strong> ([60 x 300 GB SAS Drives – 100% SAS])</td>
<td>124288</td>
<td>7113</td>
<td>25% decrease</td>
<td>18000</td>
</tr>
<tr>
<td><strong>Scenario 2</strong> ([with FAST Suite] [60 x 300 GB SAS + 9 x 200 GB SSD + 18 x 2 TB NL-SAS drives - 32.3% SAS + 3.2% Flash + 64.5% NL-SAS])</td>
<td>64233</td>
<td>3542</td>
<td>45% increase</td>
<td>56000</td>
</tr>
<tr>
<td><strong>Scenario 3</strong> ([30 x 300 GB SAS Drives – 100% SAS])</td>
<td>175867</td>
<td>9775</td>
<td>47% decrease</td>
<td>18000</td>
</tr>
<tr>
<td><strong>Scenario 4</strong> ([with FAST Suite] [30 x 300 GB SAS + 9 x 200 GB SSD + 22 x 2 TB NL-SAS drives - 16.5% SAS + 3.3% Flash + 80.2% NL-SAS])</td>
<td>65416</td>
<td>3639</td>
<td>42% increase</td>
<td>55000</td>
</tr>
</tbody>
</table>

After analyzing the results in the table, in the case of the Baseline scenario configured with a storage pool that contains 90 SAS drives, it took a longer time to complete all the transactions in the SAP workload when compared with Scenario 2 or Scenario 4 with the storage pools that contain fewer SAS drives with FAST Suite enabled. For instance, after enabling the FAST Suite, the phase of the longest running job in the workload changed from 5,215 seconds to 3,639 seconds when comparing the Baseline scenario with Scenario 4. This results in an improvement of approximately 1.5 times faster performance than the Baseline. The improvement we observed for the total duration of the workload when using the FAST Suite (93,253 seconds vs. 65,416) also resulted in approximately 1.5 times faster performance. This result is also in line with the other individual workload job duration improvements. The results obtained in Scenario 2 and Scenario 4 are very similar. This demonstrates the fact that FAST Suite can absorb much of the load and that having a larger number of SAS drives did not improve performance. In terms of TCO, out of all the scenarios listed in Table 1, by taking into consideration performance, storage capacity, storage drive cost, footprint, and power consumption, Scenario 4 provides an optimal configuration by leveraging the FAST Suite while compensating for the reduced storage capacity with an additional NL-SAS tier along with the SAS tier.

The following figures show the configuration and performance gains resulting by enabling the FAST Suite on a storage pool with 30 x 300 GB SAS drives when compared to one with 90 x 600 GB SAS drives configured as one tier (Baseline scenario vs. Scenario 4).
**Using EMC FAST Suite with SAP on EMC VNX Unified Storage**

**Figure 10. Configurations of the Baseline vs. Scenario 4 with FAST Suite**

**Figure 11. Performance chart of the Baseline vs. Scenario 4 with FAST Suite**
Storage considerations when using the FAST Suite

Before you choose your system configuration, take the following considerations into account:

- To expand the storage pool you should add as many drives as possible because it minimizes the likelihood of temporarily skewed I/O activity clustering. When you add new drives to the pool, the system usually assigns the new data coming in to the newly added drives first to ensure that there will be a balanced amount of data stored over all the drives in the pool over time.

- Use thick LUNs with FAST VP for the SAP DATA LUNs and use “Auto-Tier” as a tiering policy

- Enable FAST Cache on the storage pool containing DATA LUNs.

- Use a homogeneous pool with only SAS drives for SAP LOG LUNs.

- Include the appropriate tiers in your storage pool for guaranteed performance (that is, Flash and SAS drives for high performance, SAS and NL-SAS drives for high capacity).

- Based on the results of our study (see Table 1), EMC suggests using these FAST Suite proportions in terms of storage capacity for SAP deployments:
  - For FAST VP
    - 2% Flash drives
    - 16% SAS drives
    - 80% NL-SAS drives
  - For FAST Cache
    - Up to 2% Flash drives in FAST Cache in terms of storage capacity

These recommendations ensure good performance in the case of large data allocation (table expansion, bulk loads) and periodic maintenance (batch jobs, reporting). The tier proportion recommendation may vary with each system depending on the working data set size, the number of active users, and the locality of the data.

Impact of data placement and locality of data on FAST Suite performance

FAST Cache continuously ensures that the hottest data is served from high-performance Flash drives, whereas FAST VP optimizes storage pools automatically, ensuring only active data is being served from high-performance drives and cold data is moved to high-capacity drives. High locality of data is important to realize the benefits of FAST VP. FAST VP recalculates the activity temperature of all slices in a
pool periodically and proposes the movement of data based on this calculation. The relocation of data can be done manually or in a configurable schedule. When the SAP system is installed for the first time, it takes a few relocation cycles until all the relevant data is relocated to the appropriate tiers and the data relocation may need to be configured to execute more frequently initially to speed up the data warm-up process. Since it may take some time before all the data is allocated to an appropriate tier, you will see improved performance with time. However, using the same system for totally different types of work during the day and night will change the locality of data and may have an impact on system performance. FAST VP operates at the storage pool level and FAST Cache operates at a storage pool level that can be shared by other pools. FAST Cache can be conveniently enabled and disabled at a storage pool level depending on the application performance requirements and can be shared flexibly across all storage pools in the system.

**Conclusion**

The FAST Suite significantly increases performance and reduces the TCO of SAP enterprise applications by reducing the investment for the Flash tier and improving the capacity utilization of the rotating drives. The FAST Suite provides the highest performance and capacity efficiency automatically in an application-agnostic way, which makes this technology applicable to any application with a low I/O latency requirement. Even though the FAST Suite can be used with any application with any type of I/O pattern, it is especially well suited for applications that access data with high locality of reference with random I/O and relatively small working sets compared to the total database size. While the performance improvements observed with our scenarios may not be representative of all SAP customer scenarios that decide to switch to the FAST Suite, it nevertheless illustrates the potential for significant improvements in the processing times and better TCO. Also, we were able to improve the SAP system performance without changing the application, tuning the parameters, or adjusting the deployment process.

The following best practices should be followed to realize the full advantage of the FAST Suite on VNX:

- Do not use FAST VP on storage pools with LUNs that don’t require it (for example, log LUNs).
- Size FAST Cache and FAST VP tiers appropriately depending on the application active data set.
- Do not use FAST Cache or FAST VP on LUNs where SAP database online redo logs reside. Enabling these products on database online redo logs may or may not help depending on workload characteristics. The relative gains of enabling them on online redo logs will be small compared to enabling them on LUNs with the database’s data files.
- Never enable FAST VP and FAST Cache on archive logs as these files are never overwritten and rarely read back unless the database needs recovery.
References

The following white papers and documentation can provide more information:

- Using EMC FAST Cache with SAP on EMC Unified Storage
- Using EMC FAST with SAP on EMC Unified Storage
- EMC FAST VP for Unified Storage Systems
- Adaptive Hardware Infrastructures for SAP
- SAP Performance Optimization Guide

The following websites can also be used for information:

- SAP Service Marketplace
- SAP Community Network
- SAP Standard Application Benchmark page on SAP.com
- SAP Help Portal