

# HP 3PAR Storage Systems for SAP

Technical white paper

## Table of contents

Executive summary.....	2
Introduction.....	3
SAP configuration on HP 3PAR.....	5
SAP system layout .....	5
HP 3PAR features for SAP .....	7
Thin technologies .....	7
Autonomic storage tiering .....	9
Remote Copy.....	12
Virtual Copy.....	13
HP 3PAR performance.....	13
Performance density .....	14
SPC-1 Benchmark .....	15
Conclusion.....	17
For more information.....	18



## Executive summary

The HP 3PAR Storage System is the next-generation Tier 1 storage designed to deliver the agility and efficiency demands of a virtual data center and cloud computing environments. The HP 3PAR family consists of the F-Class F200/F400 Systems and T-Class T400/T800 Systems as shown in Figure 1 and these systems are targeted for the enterprise market. All HP 3PAR models deliver simple yet powerful and dynamically tiered, multi-tenant storage arrays. They are supported by a powerful suite of software products for ease of management, thin provisioning, autonomic storage tiering and leading availability features such as remote replication and disaster recovery (DR).

Large SAP customers tend to consolidate their IT infrastructure, particularly their storage facilities, to achieve greater efficiency. HP 3PAR Storage System centralizes data storage on a number of high-disk storage arrays into a single high-performance, high-availability system that allows multiple SAP systems to share the same storage system. As a result, customers can apply common administration and high-availability processes to all their systems and achieve greater flexibility by dynamically assigning storage capacity according to business needs. The features of the HP 3PAR Storage System are suitable for SAP systems that rely on a robust, scalable, and efficient storage solution.

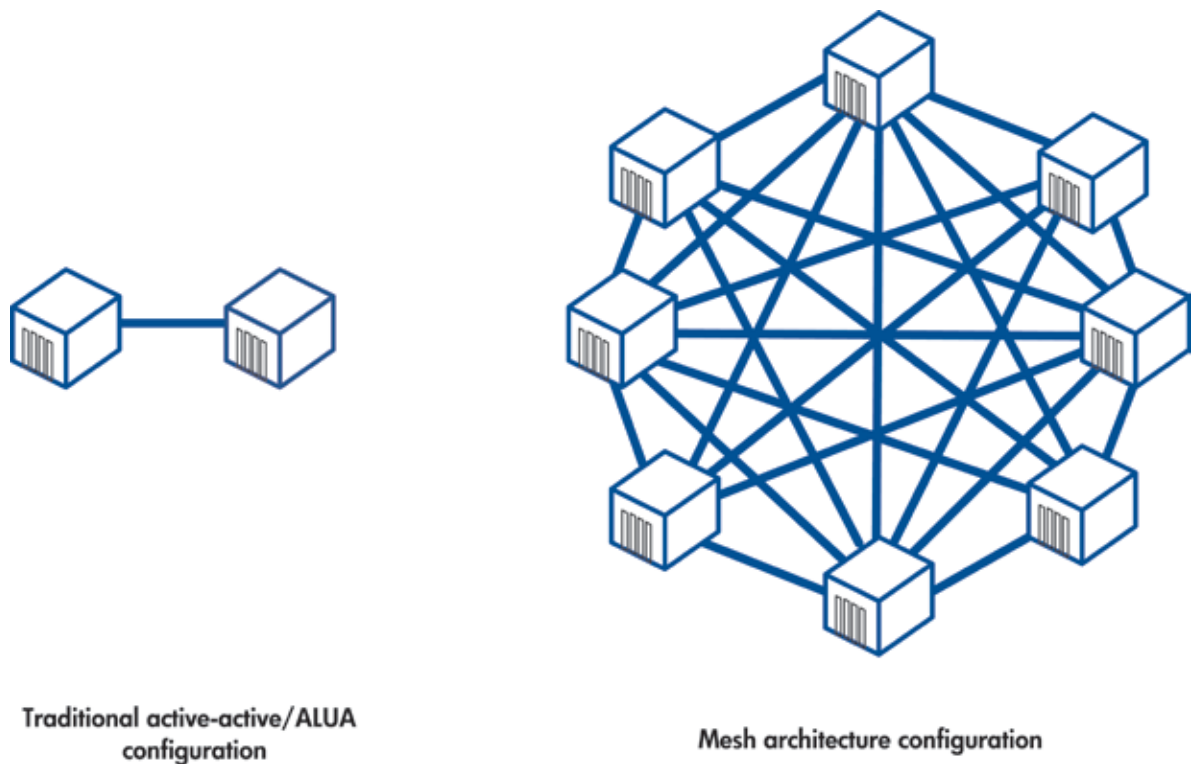
Figure 1: HP 3PAR Storage System models



## Introduction

The HP 3PAR Storage System is a tightly clustered, multitenant utility storage subsystem allowing business requirements to start small, and then scale up. New applications and workloads can be added affordably and in a non-disruptive fashion all within a single, autonomously tiered array. At the heart of the HP 3PAR design is the full-mesh interconnect architecture that is cost effective, scalable, and resilient. This architecture is more robust than traditional “active-active” or asymmetric logical unit access (ALUA) controller architecture where each storage volume is only active on a single controller. The HP 3PAR full-mesh design delivers robust, load-balanced performance by having the storage volumes simultaneously active on every mesh controller on the system as shown in Figure 2.

Figure 2: HP 3PAR hardware architecture



Moreover, complementing the full-mesh architecture is the application specific integrated circuit (ASIC) based zero-detection mechanism for converting traditional “fat” volumes to “thin” volumes without impacting storage performance. The ASIC leverages a unique, software-based virtualization mapping engine for space reclamation, giving HP 3PAR Storage Systems the power to remove allocated but unused space in existing volumes. HP 3PAR Storage System is the only storage platform with this fat-to-thin processing capability built in to system hardware. Besides reclaiming unused space, the ASIC can handle processing mix workloads more efficiently than traditional storage controller nodes. The ASIC can process the control and data information in separate paths instead of a single path on a traditional storage. This unique hardware capability gives HP 3PAR Storage System the power to remove allocated but unused space without impacting performance. The accelerated performance of the HP 3PAR ASIC combined with Rapid RAID Rebuild capabilities enables businesses to achieve the performance of traditional RAID mirroring with up to 66 percent less data protection overhead.

Depending on the size and requirements of an SAP system, there are four models of HP 3PAR systems to choose from. Each model in the HP 3PAR storage family can accommodate different size and performance requirements of SAP systems. The F-Class system has two models, F200 and F400. The F-Class is the one of the world's first cache-coherent, quad-controller architecture for scalable, efficient departmental and remote office consolidation. At the high end is the T-Class system also with two models to choose from, T400 and T800. The T-Class is a faster, more efficient, single-system array available, delivering better consolidation and performance headroom for enterprises and service providers. A suitable model depends on the required workload and how much growth an SAP system will have. For example, an SAP customer may require only a small capacity workload for analysis purposes but requires the high performance and throughput from the storage array. In such situation, a T400 system is a recommended solution. Table 1 is a comparison of the four models with F200 at the low end and T800 at the high end.

An SAP system can benefit from the unique architecture of HP 3PAR by starting with a smaller single system landscape. A system landscape is a layout of servers containing SAP software and applications. A typical SAP landscape consists of a development system, quality assurance system, and production system. The example shown in Figure 3 has two landscapes. An SAP system could initially start with just the transaction system landscape by using SAP ERP. Then as the business grows, a second landscape can be added for analysis and the data can be migrated efficiently by using HP 3PAR software utilities. This technical brief provides an overview of how an SAP system can grow and benefit from the technological innovations of HP 3PAR Storage Systems.

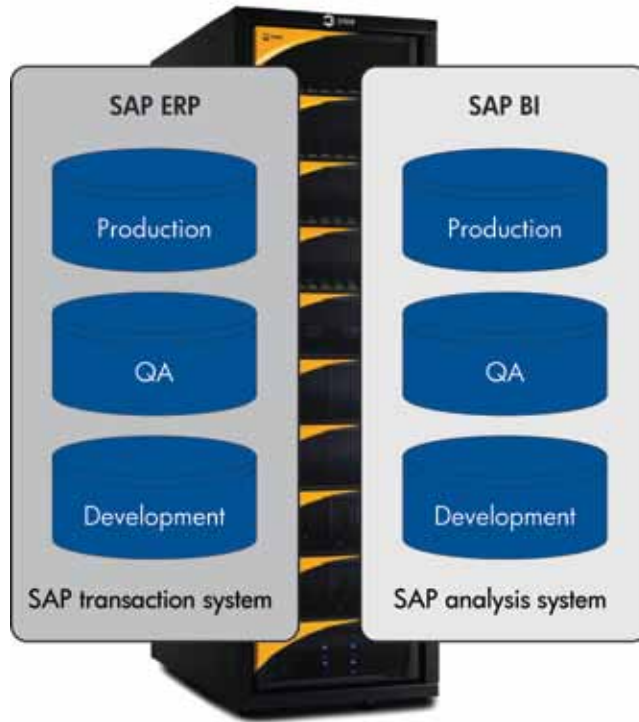
**Table 1:** HP 3PAR Storage System models<sup>1</sup>

Description and usage	F200	F400	T400	T800
Controller nodes	2	2–4	2–4	2–8
Control cache	8 GB	8–16 GB	8–16 GB	8–32 GB
Data cache	12 GB	12–24 GB	24–48 GB	24–96 GB
Built-in Remote Copy ports	2	2–4	2–4	2–8
Fibre Channel ports	0–12	0–24	0–64	0–128
iSCSI host ports	0–8	0–16	0–16	0–32
Disk drives	16–192	16–384	16–640	16–1280
Drive chassis	16 drives (max) in 3U	16 drives (max) in 3U	40 drives (max) in 4U	40 drives (max) in 4U
Number of drive chassis	2–12	2–24	2–16	2–32
Drive types (mixable)	Fibre Channel Enterprise SATA SSD	Fibre Channel Enterprise SATA SSD	Fibre Channel Enterprise SATA SSD	Fibre Channel Enterprise SATA SSD
Max capacity (approximate)	2.3–128 TB	2.3–384 TB	400 TB	800 TB
RAID level	RAID 0, 10, 50, 6	RAID 0, 10, 50, 6	RAID 0, 10, 50, 6	RAID 0, 10, 50, 6
Cabinets	HP 3PAR 2-M or third party standard 19-in cabinet	HP 3PAR 2-M or third party standard 19-in cabinet	HP 3PAR 2-M cabinet(s)	HP 3PAR 2-M cabinet(s)

<sup>1</sup> All models have the HP 3PAR Gen3 ASIC with Thin Built In and Gigabit Ethernet (GbE) ports. Please refer to the latest HP 3PAR product specifications for current information.

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Figure 3: Scaling SAP landscapes with HP 3PAR



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## SAP configuration on HP 3PAR

A typical SAP environment consists of multiple production, quality assurance, and development systems. Multiple tiered SAP systems can be configured on a robust disk array such as the HP 3PAR Storage System without compromising reliability, performance, and availability.

### SAP system layout

All SAP databases consist of data containers that hold actual data and transaction logs, which maintain a record of all changes that have been made to the database. In the event of system failure, successful recovery of the database depends on the availability of the transaction logs. It is therefore recommended that the log files and data files be stored on different virtual volumes to simplify overall manageability. There is no difference in performance between using a single versus multiple virtual volumes for SAP.

Table 2 illustrates a sample of how SAP and database components can be distributed on different virtual volumes and RAID levels for Oracle. A variation would be to group different LVM volume groups into a single virtual volume. For example, combine SAP and Oracle binaries into one virtual volume and/or SAP DATA, logs and archive into one virtual volume.

**Table 2:** Sample LVM configuration of SAP ERP using Oracle database for HP-UX

Virtual volume	LVM volume group	LVM LVOL	Mount point	RAID level
sapvvol01	vg_sap_binary	lv_sapbin1	/sapmnt/<SAPSID>	1
		lv_sapbin2	/usr/sap/trans	
		lv_sapbin3	/usr/sap/<SAPSID>	
sapvvol02	vg_oracle_binary	lv_orabin1	/oracle	1
		lv_orabin2	/oracle/client	
		lv_orabin3	/oracle/stage/102_64	
		lv_orabin4	/oracle/<SAPSID>	
		lv_orabin5	/oracle/<SAPSID>/102_64	
sapvvol03	vg_oracle_log	lv_oralog1	/oracle/<SAPSID>/origlogA	1
		lv_oralog2	/oracle/<SAPSID>/origlogB	
		lv_oralog3	/oracle/<SAPSID>/mirrlogA	
		lv_oralog4	/oracle/<SAPSID>/mirrlogB	
		lv_oralog5	/oracle/<SAPSID>/sapreorg	
		lv_oralog6	/oracle/<SAPSID>/saptrace	
sapvvol04	vg_oracle_arch	lv_oraarch	/oracle/<SAPSID>/oraarch	1
sapvvol05	vg_sapdata	lv_sapdata1	/oracle/<SAPSID>/sapdata1	1, 5, or 6
		lv_sapdata2	/oracle/<SAPSID>/ sapdata2	
		lv_sapdata3	/oracle/<SAPSID>/ sapdata3	
		lv_sapdata4	/oracle/<SAPSID>/ sapdata4	

# HP 3PAR features for SAP

Table 3 is a list of important features of HP 3PAR available for SAP systems. These features enhance the reliability, performance, and capacity requirements of SAP systems.

**Table 3:** Selected features of the HP 3PAR for SAP

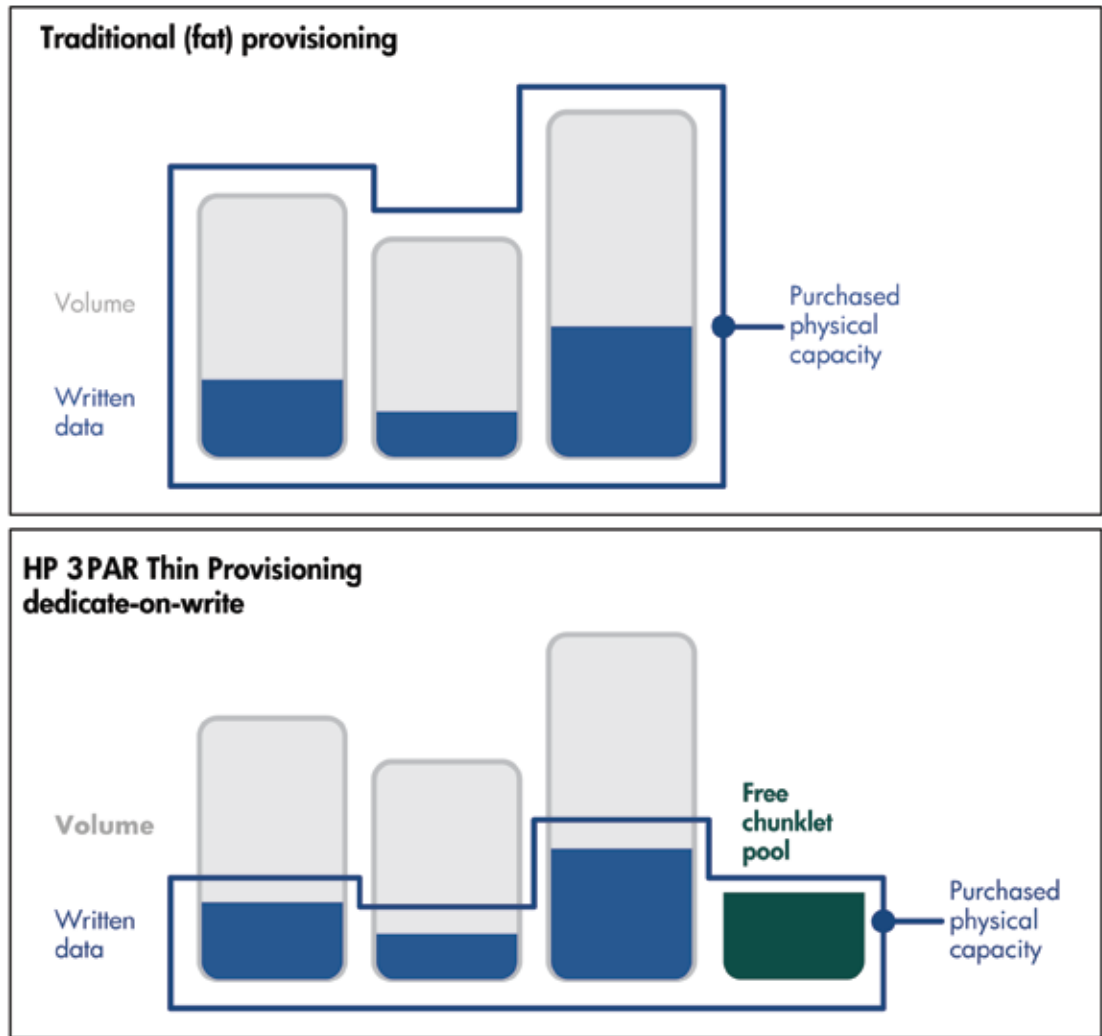
Category	Feature	Description
Thin technologies	HP 3PAR Thin Provisioning Software	Thin provisioning reduces the amount of over-allocated storage capacity and helps eliminate the cost of stranded or unused capacity. Thin provisioning reduces power, cooling, and floor space for immediate cost savings.
	HP 3PAR Thin Conversion Software	Thin Conversion software allows for the migration of legacy (fat) provisioned arrays to a thin provisioned array. This solution reduces storage footprint (power, cooling, and space) thereby reducing up-front capital costs and ongoing operation costs.
	HP 3PAR Thin Persistence Software	Thin Persistence software ensures that thin volumes on HP 3PAR Storage Systems stay as lean and efficient as possible. It reclaims unused space associated with deleted data within system storage volume simply, quickly and without disruption.
	HP 3PAR Thin Copy Reclamation Software	Thin Reclamation is similar to Thin Persistence except it reclaims unused space from thin copies such as virtual copy snapshots and remote copies.
Autonomic tiering	HP 3PAR Dynamic Optimization Software	Dynamic Optimization (DO) is an autonomic storage tiering solution based on service level optimization for enterprise and cloud data centers at the lowest possible cost while increasing agility and lowering risk. With DO, full application volumes are non-disruptively distributed and redistributed across storage tiers.
	HP 3PAR Adaptive Optimization Software	Adaptive Optimization (AO) is also an autonomic storage tiering solution like DO but implemented at a more granular level. In AO, application volumes can use multiple storage tiers at any given time. AO allows for the non-disruptive distribution and redistribution of sub-volumes across storage tiers.
Backup and recovery	HP 3PAR Remote Copy Software	Remote Copy is a unique, simple, thin provisioning aware, and cost-effective autonomic DR and data replication solution over Ethernet or Fibre Channel.
	HP 3PAR Virtual Copy	Virtual Copy is an array-based point-in-time (PIT) copies of data volumes with little or no impact to applications. These “snapshots” can then be repurposed for a number of other uses.

## Thin technologies

The key thin technologies of HP 3PAR summarized in Table 3 are Thin Provisioning, Thin Conversion, Thin Persistence, and Thin Reclamation. These thin technologies of HP 3PAR are widely considered as the gold standard in thin provisioning since it was first introduced in 2002.

Thin provisioning takes advantage of HP 3PAR’s dedicate-on-write capabilities to make organizations more efficient and cost effective (more green), allowing them to purchase only the disk capacity needed. HP 3PAR Thin Provisioning software allows for the purchase of lesser storage capacity instead of the full capacity allocated on a traditional (fat) provisioned storage. Figure 4 compares traditional provisioning to a HP 3PAR Thin Provisioning dedicate-on-write feature. With traditional provisioning, the allocated storage includes those needed for future growth on the purchased capacity. In contrast to thin provisioning, the allocated storage is the same as with traditional provisioning but the storage capacity for future growth is not purchased up front.

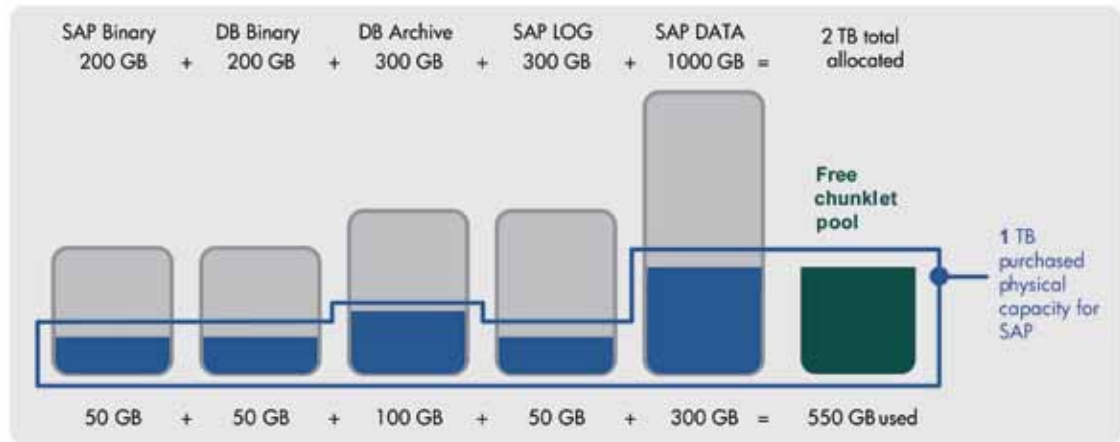
Figure 4: Capacity savings with HP 3PAR Thin Provisioning



By using HP 3PAR Thin Provisioning, businesses can implement a single SAP landscape initially and expand as necessary. This greatly reduces capital expenditures while delivering excellent performance and sufficient capacity. The volume groups of the sample SAP configuration in Table 2 earlier maps out to the thin-provisioned volumes for SAP shown on Figure 5. Without Thin Provisioning, 2 TB of capacity needs to be allocated up front for SAP. The actual usage is only 25 percent of the total capacity. By applying Thin Provisioning, only 1 TB capacity can be initially purchased or half of the original non-thin provisioned capacity.



Figure 5: Sample SAP system configuration using thin-provisioned volumes



HP 3PAR Thin Provisioning is well received by customers due to its ease of use, simplicity, and efficiency through Thin Conversion, Thin Persistence, and Thin Copy Reclamation. By migrating data from traditional arrays to HP 3PAR via Thin Conversion, legacy SAP systems can reduce up to 80 percent of the capacity in the storage environment. In an SAP system, data gets moved around or deleted within system storage volumes. HP 3PAR Thin Persistence enables that the thin volumes used by SAP systems stay efficient as possible by reclaiming unused space associated with deleted data equating to an additional 10 percent additional capacity savings. HP 3PAR Thin Copy Reclamation is similar to Thin Persistence but instead of reclaiming space from thin volumes, this software reclaims unused space from thin copies such as virtual copy snapshots and remote copies which are described later.

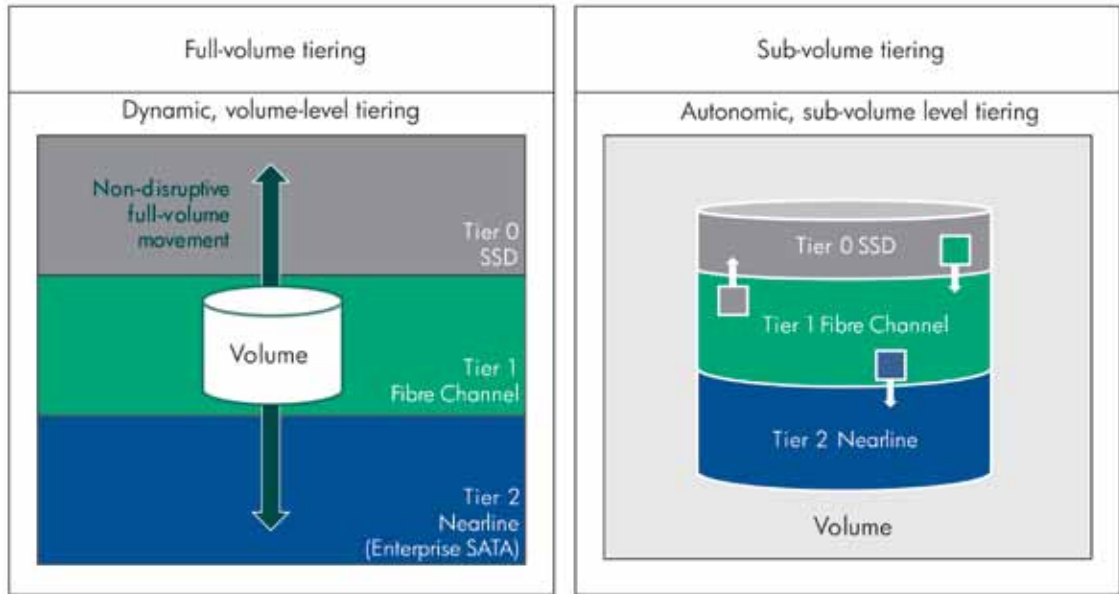
## Autonomic storage tiering

Customers want to be able to dynamically tune the storage system used for their database and applications based on the I/O activity fluctuations naturally occurring in that type of environment. By being able to do this, customers can get the most IOPS per dollar for storage. Solid-state drives (SSD) bring an unprecedented storage I/O performance but come at a high cost to implement. Therefore it is prudent to use as little SSD as needed or near capacity containing only the most active data or hotspots on an SAP system. Infrequently accessed data is better suited for slower, cheaper storage, but also be able to move to faster devices when needed.

HP 3PAR autonomic storage tiering is a mechanism for doing dynamic performance tiering for the data used by SAP and other applications. The dynamic storage tiering enables effective resource usage, giving customers better use of faster, more expensive storage media, such as SSDs. The storage array does this by automatically migrating the busiest data to the highest performing storage and those with low activity to slower storage tiers. The autonomic storage tiering equates to reduced cost by migrating less busy data to lower cost storage, freeing up the more expensive storage resources for the data that needs to use it.

Autonomic storage tiering of HP 3PAR is implemented using DO or AO software shown in Figure 6. HP 3PAR DO Software non-disruptively moves the data of the full volume between storage tiers. HP 3PAR AO Software is more granular than DO where sub-volumes are moved non-disruptively across storage tiers. AO allows for full application volumes to use multiple storage tiers at any given time.

Figure 6: Dynamic and Adaptive Optimization

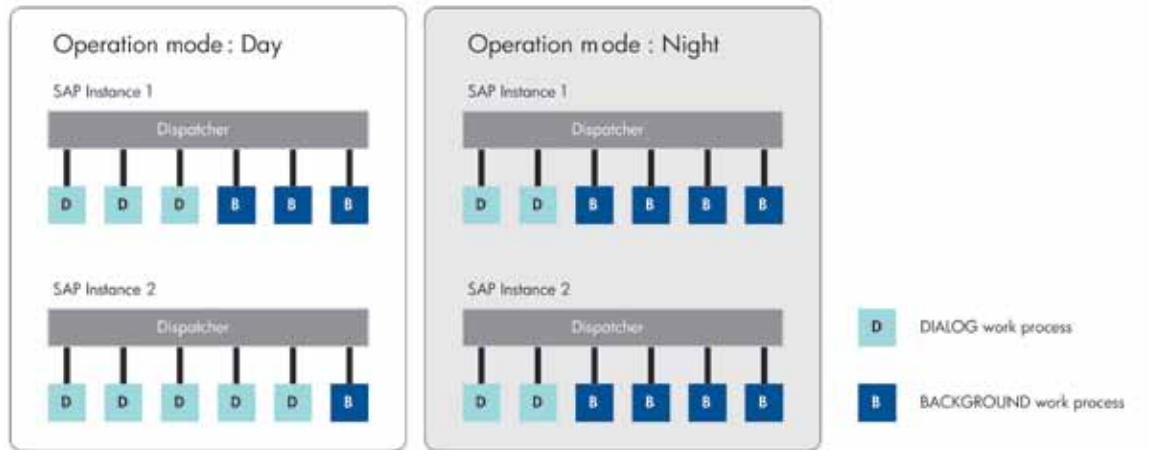


SSDs in HP 3PAR Storage Systems are ideal for SAP customers requiring an efficient, high-performance, and reliable storage solution but can be costly and must be used as efficiently as possible. The performance of an SAP system can be improved by using SSDs (Tier 0) storage mixed with Fibre Channel (FC) and Nearline Enterprise SATA (NL) drives as tiered storage. Because AO allows the SSD performance to be leveraged across all tiers when necessary, the number of SSDs is usually much lower than the number of FC or NL drives. So, it is important to use SSDs in a more efficient way by DO or AO.

#### SAP operation modes

SAP systems workload and performance vary during the course of the day. More transactions normally occur during the day requiring a large number of dialog users and work processes that require high performance. By night time, usually a smaller number of dialog users and work processes run. An SAP system can be configured using its mode of operation feature. In Figure 7, more dialog and less background work process during the day. By night time, it is reversed. This performance tuning feature of SAP can be enhanced using HP 3PAR DO and AO software.

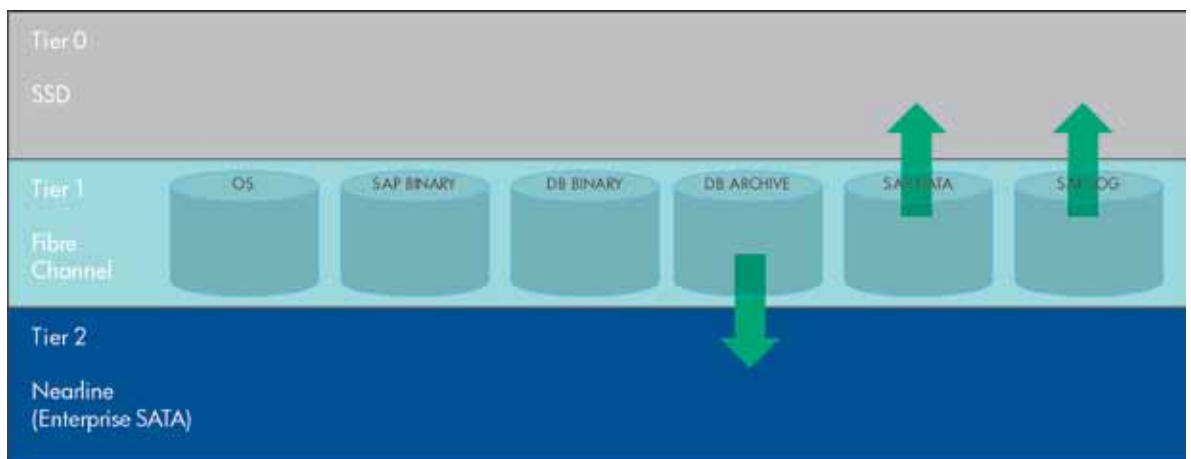
Figure 7: SAP operation modes



### Dynamic Optimization for SAP

SAP Dialog processes require more system resources than SAP Background processes to operate. When the system is busiest during the DAY operation mode, DO can move the volumes of SAP systems with active Dialog processes volumes into higher tiered storage such as SSD or Fibre Channel and the SAP systems with mostly Background processes into nearline storage. Figure 8 illustrates how DO optimizes the performance of Dialog processes of an SAP system by moving the SAP DATA and SAP LOG volumes to a higher tier storage and the DB ARCHIVE volume to a lower tier storage. By night time or when there are lesser transactions, the SAP DATA and SAP LOG volumes can stay in the middle tier or be moved to a lower tier if necessary. In this way, the top storage tiers are freed up for other applications to use.

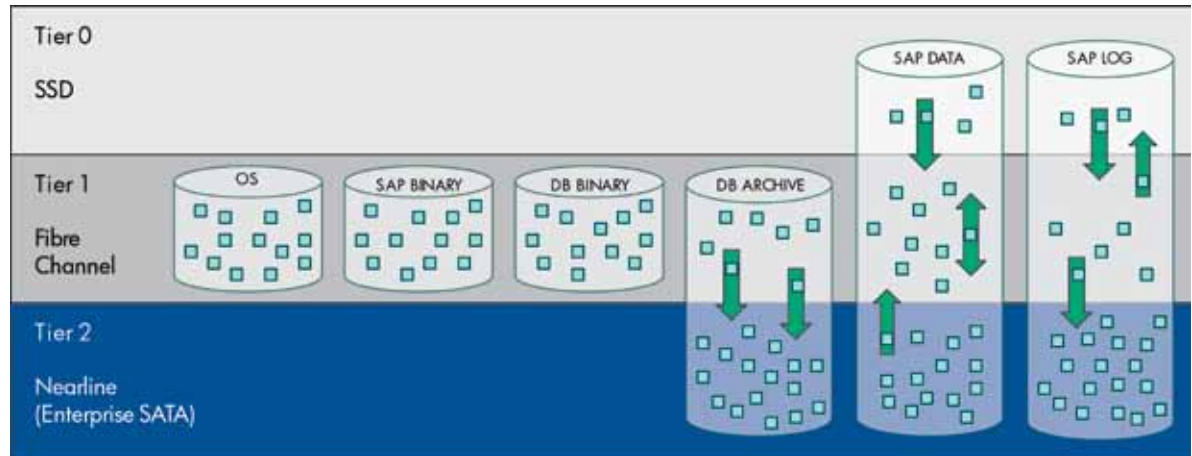
Figure 8: Sample SAP configuration using DO



## Adaptive Optimization for SAP

HP 3PAR AO software increases the use of higher tier storage such as SSDs for an SAP system by moving sub-volumes instead of full volumes in DO. At a minimum, apply AO into the SAP DATA volumes and leave the SAP LOG and DB ARCHIVE on FC. If the storage array is sufficiently sized, AO can be applied to DB ARCHIVE, SAP DATA, and SAP LOG as shown in Figure 9.

Figure 9: Sample SAP configuration using AO



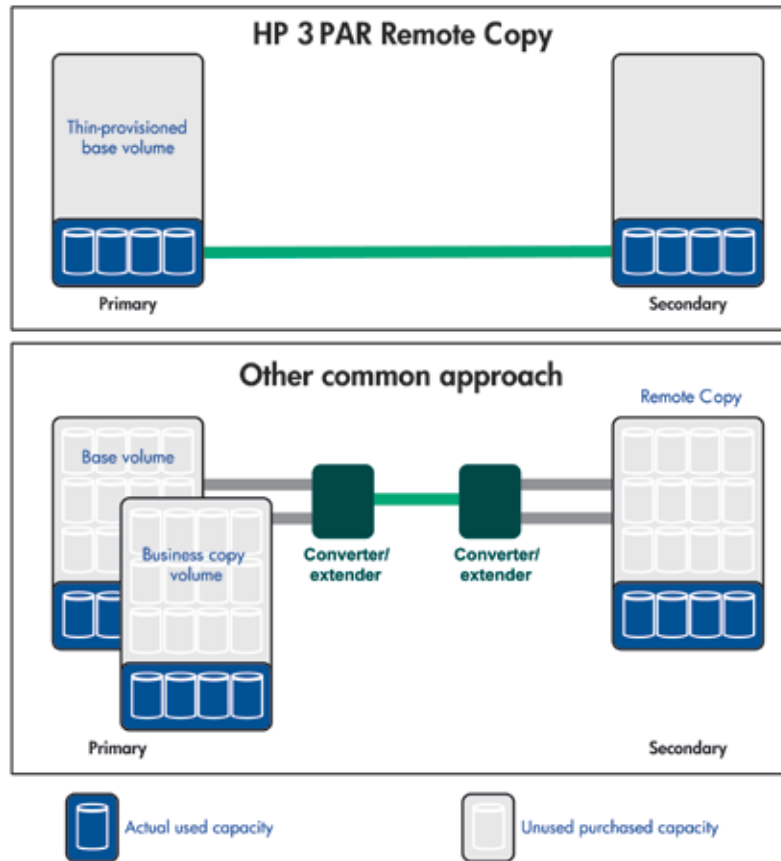
## Remote Copy

HP 3PAR Remote Copy is an array-based remote replication feature between HP 3PAR storage systems. HP 3PAR Remote Copy provides remote data replication and a DR solution. SAP customers would benefit from the high performance, simple management, and cost savings of the HP 3PAR Remote Copy.

The replication is a high-performance, multi-protocol application implemented using Gigabit Ethernet (GbE) or Fibre Channel (FC). A typical FC remote copy can achieve transfer rates of up to 500 MB/s while GbE remote copy up to 180 MB/s. The HP 3PAR Remote Copy is simple to manage by having it integrated with the Management Console software. The cost savings associated with using HP 3PAR Remote Copy is in the reduction of capital and operating expenditures. Replication is implemented without the use of converters and specialized hardware by using the built-in GbE remote copy ports. Since Remote Copy is thin provisioning aware, only the written data is mirrored, saving both in transmission and physical capacity costs. This lowers unnecessary disk expense required for the replication. HP 3PAR Remote Copy also leads to reduced power, cooling, and floor space. Other operating expenditures reduced are the bandwidth costs and administration associated with setting up a DR solution. Figure 10 compares HP 3PAR Remote Copy over common replication approaches that are not thin provisioned and use extra hardware to implement.

HP 3PAR Remote Copy is an important feature for enterprise application like SAP where DR is part of the overall system design and configuration.

Figure 10: Remote Copy



## Virtual Copy

HP 3PAR Remote Copy creates a mirror copy of a volume but HP 3PAR Virtual Copy copies only a snapshot or PIT copies. Traditional PIT copy allocates full capacity when making a new copy. Other traditional PIT copies require manual allocation before a copy could be made. HP 3PAR Virtual Copy is automatically allocated to the exact size of the changed data to copy. In an SAP system, virtual copies can be created for reporting, test, and analysis purposes without creating a full copy of the database. The storage array does not take a performance hit from the process.

## HP 3PAR performance

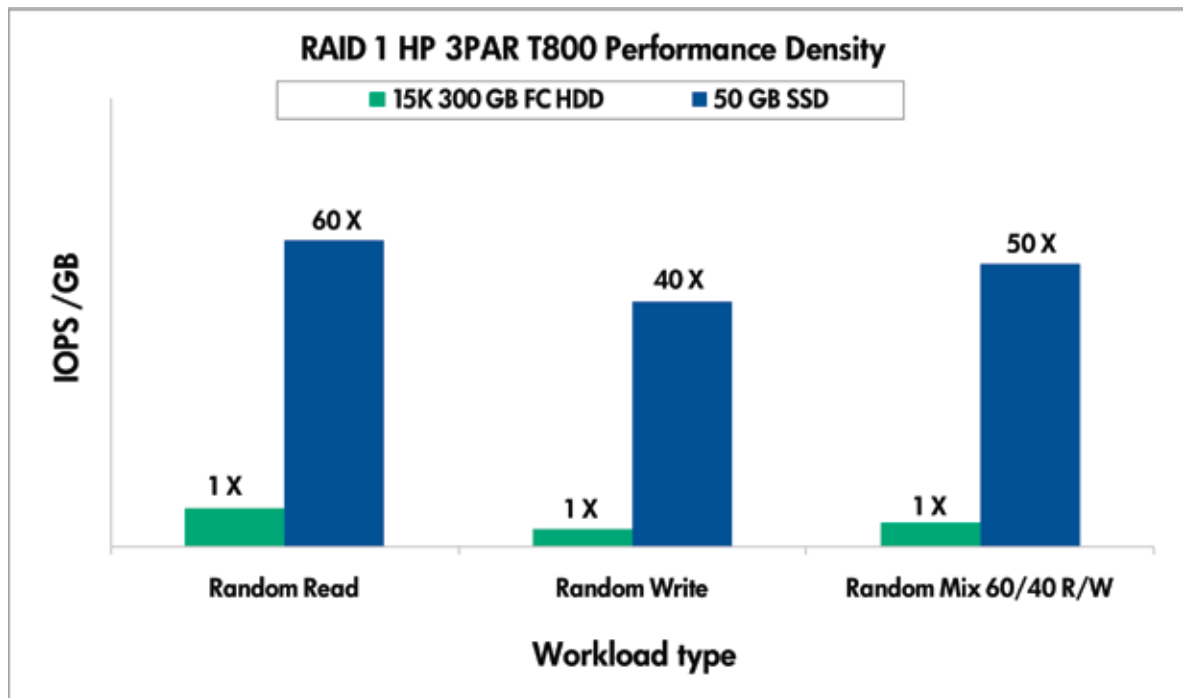
HP 3PAR Storage Systems deliver scalable levels of performance for multiple disparate applications in a single, dynamically tiered array. HP 3PAR Storage System provides outstanding performance density metrics for its tiered storage optimization software. In addition, HP 3PAR Storage System achieved the overall best-in-class Storage Performance Council (SPC-1) Benchmark.

## Performance density

Performance density is a measure of the relative performance in IOPS per GB of a storage device in a particular workload and RAID configuration. Such measurement is important for determining the proper size of storage tiers relative to the expected performance especially when sizing the storage tiers for DO and AO. Figure 10 and 11 show the relative performance density of an HP 3PAR T800 Storage System for RAID 1 and RAID 5 configurations. The three workload types used are Random Reads, Random Writes, and Random Mix 60/40 RW all using an I/O size of 8 KB.

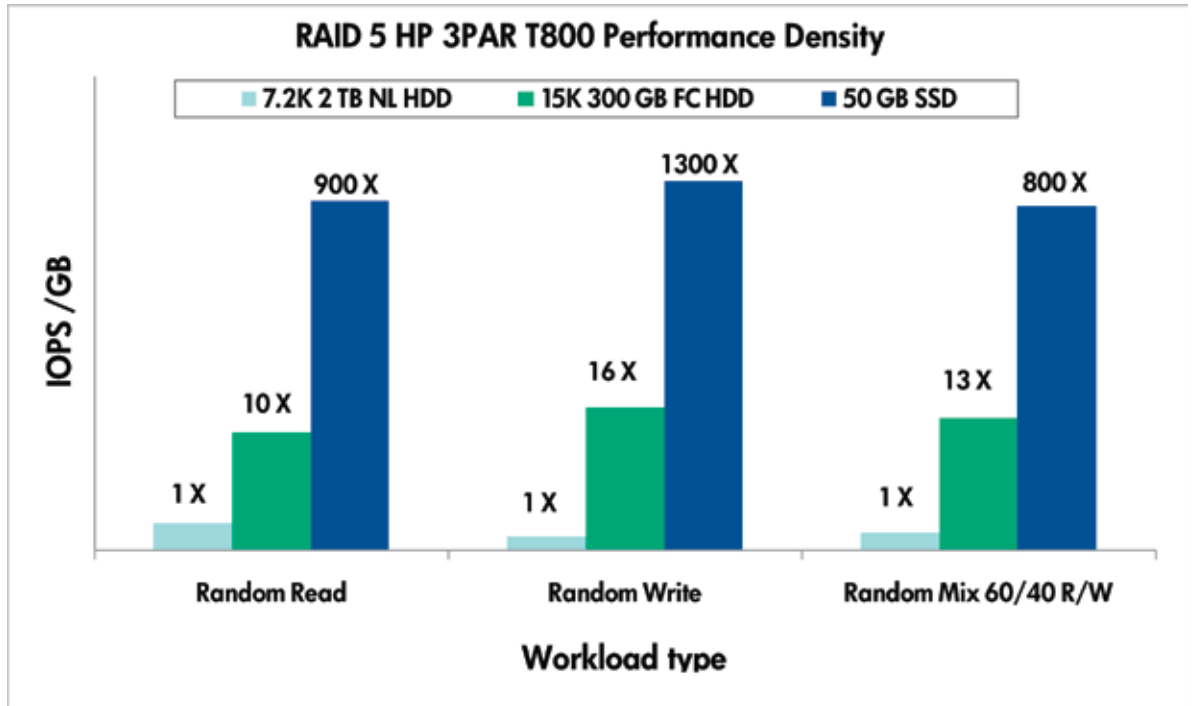
In a RAID 1 configuration, IOPS per GB of using 50 GB SSDs ranges from 40 to 60 times over the measured rate when using 15K RPM 300 GB FC HDDs. No measurements were taken from nearline (SATA) drives.

Figure 11: HP 3PAR SPC-1 performance comparison



In a RAID 5 configuration, the base measurements of using 50 GB SSDs and 15K RPM 300 GB FC HDD were compared relative to the performance of a 7.2K RPM 2 TB nearline drive. The IOPS per GB of using SSDs over FC HDDs ranges from 60 to 90 times. When SSDs are compared to nearline drives, it ranges from 800 to 1300 times performance improvement.

Figure 12: HP 3PAR SPC-1 performance comparison



## SPC-1 Benchmark

SPC-1 Benchmark is designed for business-critical applications that process large and multiple complex transactions such as SAP or any other online transactional processing application.

The results on Figure 13 show HP 3PAR F400 and T800 Storage Systems setting individual performance records. Figure 14 compares the SPC-1 Benchmark test results of the HP 3PAR T800 Storage System with the competition. The HP 3PAR F400 and T800 Storage Systems set individual performance records by achieving SPC-1 Benchmark results of 93,050 IOPS for the F400 and 224,989 IOPS for the T800.

HP 3PAR Storage Systems offer unique mixed workload support so that transaction- and throughput-intensive workloads run without contention on the same storage resources, alleviating performance concerns and cutting traditional array costs dramatically. HP 3PAR Storage Systems are massively parallel and autonomically load balanced, making simplified performance and high levels of consolidation easily achievable by any organization. The HP 3PAR Storage System makes it suitable for a mission-critical enterprise software application such as SAP that relies on top storage array performance.

Figure 13: HP 3PAR SPC-1 performance

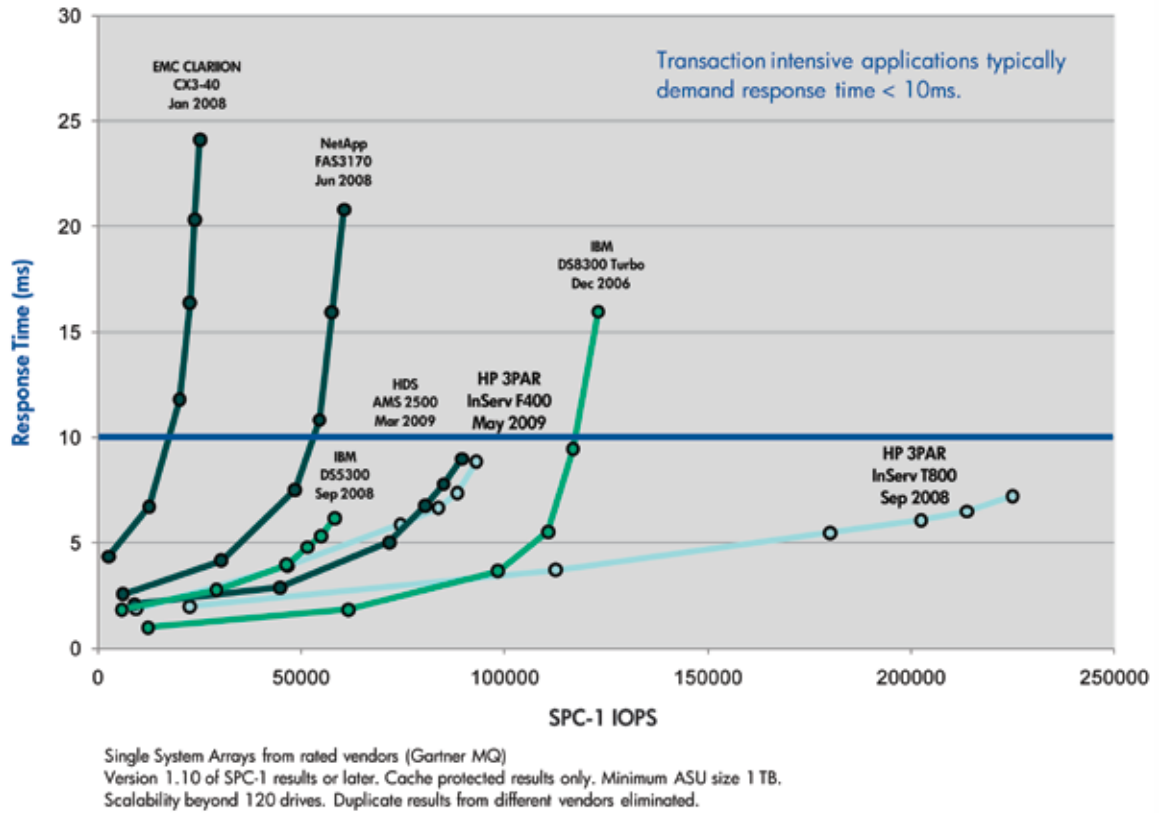
Tested Storage Configuration		HP 3PAR InServ T800	HP 3PAR InServ F400	EMC CLARiiON CX3-40	IBM TotalStorage DS5300	NetApp FAS3170	Hitachi AMS2500	IBM TotalStorage DS8300 Turbo
SPC-1 IOPS	Ready	224,989.65	93,050.06	24,997.49	58,158.69	60,515.34	89,491.81	123,033.40
Total ASU* Capacity (GBs)		77,824.00	27,046.70	8,465.02	13,742.22	19,628.50	15,900.00	9,103.36
SPC-1 Price/Performance \$/SPC-1 IOPS	Thin	\$9.30	\$5.89	\$20.72	\$12.42	\$10.01	\$6.71	\$18.99
\$/ASU TB		\$26,882	\$20,277	\$61,187	\$52,563	\$30,861	\$37,767	\$256,653
TSC** Configuration Script Command Lines	Smart	142	69	119	166	225	636	474
TSC Configuration Script Command Lines per ASU TB		1.8	2.6	14	12	11	40	52
Data Protection Level		Mirroring	Mirroring	Mirroring	Mirroring	RAID 6	Mirroring	Mirroring
Identifier		A00069	A00079	A00059	A00070	A00066	A00078	A00049
Version		1.10.1	1.10.1	1.10.1	1.10.1	1.10.1	1.10.1	1.10.1

\* Application Storage Unit  
 \*\* Tested Storage Configuration

Single System Arrays from rated vendors (Gartner MQ) version 1.10 of SPC-1 results or later  
 Cache-protected results only. Minimum ASU size 1 TB.  
 Scalability beyond 120 drives. Duplicate results from different vendors eliminated



Figure 14: HP 3PAR SPC-1 performance



## Conclusion

Customers demand the highest efficiency and performance in their SAP environment, while keeping costs under control. SAP customers need a storage solution they can count on to increase total resource utilization and productivity, adapt quickly to changing business conditions, protect storage investments and maintain business continuity in the face of unexpected disasters. HP provides a wide selection of reliable storage solutions that address such requirements. For SAP customers, data availability and performance are critical. When SAP customers need a storage solution, HP 3PAR is what they can count on—it is the ideal enterprise-class solution. The HP 3PAR Storage System is the ideal enterprise-class solution.

The HP 3PAR Storage System is designed to enable business success while driving down the cost of ownership through its key features—thin provisioning for efficient allocation and utilization of storage, autonomic storage tiering for self-tuning and self-management of storage tiers, and DR solutions such as remote copy and virtual copy. Combining the reliable performance of the HP 3PAR Storage System with SAP delivers the business solutions needed to drive return on investment that adds to profitability.

## For more information

Data Storage from HP

<http://www.hp.com/go/storage>

HP 3PAR Storage System

<http://www.hp.com/go/3par>

Sizing for SAP

<http://h71028.www7.hp.com/enterprise/cache/42968-0-0-225-121.html>

HP SAP Solutions

<http://www.hp.com/go/sap>

Experience what HP can do for your business

<http://www.hp.com/go/solutiondemoportal>

HP Converged Infrastructure:

Unleash the potential of your infrastructure today—be ready for the future.

<http://h18004.www1.hp.com/products/solutions/converged/main.html>

HP Single point of connectivity knowledge (SPOCK)

<http://www.hp.com/storage/SPOCK>

HP StorageWorks SAN

<http://www.hp.com/go/SAN>

HP 3PAR Sizer

<http://h30144.www3.hp.com/SWDSizerWeb/default.htm>

Let us help you turn your business vision into a strategy for the data center that gets you a better business outcome or visit: <http://www.hp.com/go/3PAR>



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