Demartek

HPE 3PAR All-Flash ROI via Copy-Data-Management with Assured SLA

Executive Summary

All-flash arrays are becoming increasingly common in the data center. Raw performance numbers continue to improve as maturing technology increases bandwidth and throughput while decreasing I/O response times. To stand out amongst competing high-performance storage systems, simple-to-use yet robust storage management features are critical.

HPE 3PAR All-Flash storage systems support a number of features that enable customers to fully exploit performance capabilities by enhancing management and user experience. This paper will focus on four critical features—snapshots, storage domains, user roles, and priority optimization. HPE commissioned Demartek to evaluate the business advantages of authorizing users to create virtual copy snapshots to create test and development data from a live production system. New non-production workloads were then run simultaneously with production to demonstrate how the storage system can guarantee levels of service based on defined priorities.

The HPE 3PAR StoreServ 8450 All-Flash Storage System was selected as the 3PAR platform for this evaluation due to its positon in the market as a mid-tier system, making it affordable for small-to-medium businesses. In general, these businesses are highly motivated to extract the maximum return on investment from their storage system purchases. This paper seeks to make the case that these HPE 3PAR OS features can be used to simplify administrative functions and reduce the operational expense of 3PAR systems.

It bears mentioning that HPE 3PAR Virtual Copy Snapshots are integral to the HPE Recovery Manager Central (RMC) backup and recovery product as well. RMC is essentially a management framework built to enhance the versatility of 3PAR Virtual Copy Snapshot and leverages the HPE StoreOnce appliance as physical storage for snapshot data blocks. Designed with VMware virtualization environments in mind, RMC also includes plug-ins for easy integration with common applications. Evaluating RMC is out of scope for this paper, but will be addressed in another analysis.

Key Findings

> HPE 3PAR Virtual Copy Snapshot will create multiple point-in-time copies of virtual volumes with no measurable performance impact on active storage I/O

> HPE 3PAR Domains and user definitions can be used to give a user permission to manage volumes assigned for their use. Role-based access permits multiple levels of control for security and ease of use.

> HPE 3PAR Priority Optimization increases utilization of storage systems through defined Quality of Service rules that guarantee levels of the service for high priority volumes.

HPE 3PAR Storage Domains, User Roles, Virtual Copy Snapshots, and Priority Optimization

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Improving Storage System ROI with Delegated Management, Volume Snapshot, and Priority Optimization

Current generation, enterprise-class all-flash storage systems deliver gigabytes of bandwidth and millions of IOPS at sub-millisecond response times. Features that improve data management, enhance usability, and simplify administration may be perceived to be of secondary importance compared with these raw performance metrics. However, this is a short-sighted view and may be costly in the long run if it drives purchasing decisions.

HPE 3PAR All-Flash Storage Systems, like the 3PAR StoreServ 8450 highlighted in this report, leverage the 3PAR OS to deliver high performance flash plus a wealth of other features. Many of these OS features are designed to capitalize on the benefits of flash to significantly expand the role a 3PAR storage system can play in the data center. It would take several whitepapers to describe all of the extras HPE has packed into the 3PAR OS. Instead, this paper will focus on four advantages the HPE 3PAR 8450 can bring to a use case that is fairly common to many businesses, specifically replicating production data for development and testing.

Most businesses that develop in-house software for operations, or purchase enterprise software, will maintain active development and test environments to protect production from errors and outages. It is a common practice to populate these development environments with production data. Copying and staging this data consumes human and compute resources, both of which have a cost, particularly if development/test environments are isolated to non-production hardware (historically a best practice to avoid resource stealing and outages on production systems). HPE 3PAR storage systems and the 3PAR OS include technology specifically designed to minimize these expenses. The following is a brief summary of the features leveraged to validate how the HPE 3PAR OS and the StoreServ 8450 All-Flash storage system make this use case more efficient in terms of effort and cost.

Domains and Users

The 3PAR storage administrator has the ability to define storage domains, which can be thought of as logical groupings of resources on the HPE 3PAR storage system. Once defined, users added to the storage system can be assigned to a specific domain and granted privileges ranging from view-only to full administration of the volumes within that domain.

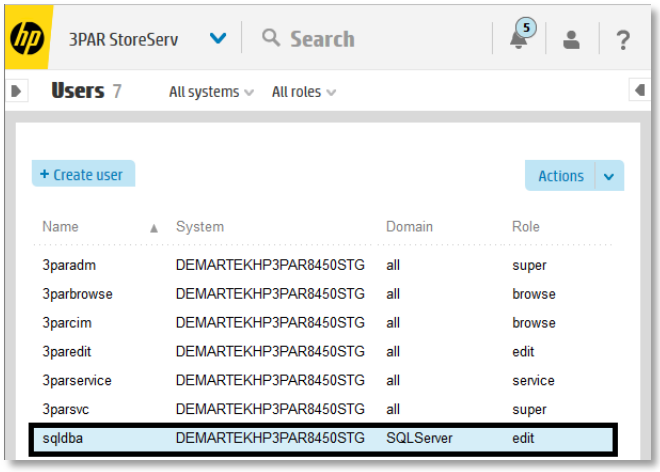

Figure 1 – Defined users and domains

In Figure 1, the user sqldba is assigned an 'edit' role to the SQLServer domain. This configuration permits the storage administrator to offload many of the management functions for this domain to the sqldba user. The 'edit' role is pretty liberal in the number of privileges it grants, so the storage admin needs to have a high degree of confidence in the human being granted access to this 3PAR user. The payoff is in time saved by the administrator through offloading storage management tasks needed by the applications using volumes on the SQLServer domain.

Virtual Copy Snapshots

A snapshot is an exact image of a volume or set of volumes. Some implementations of snapshot technology create complete physical copies of the original volumes. The HPE 3PAR OS creates much more space-efficient snapshots through metadata copies of the original image. This involves making pointers to the original data blocks rather than duplicating those blocks. When snapshots are read, the pointers direct

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the read process to the appropriate blocks in the "parent" volumes. When data is written to an original volume, any data referenced by a snapshot is preserved and the updates are written elsewhere while appropriate metadata changes are made. For all intents and purposes, the snapshots require no space on-drive until updates occur to the parent volumes.

Read-only snapshots may be taken as point-in-time backups. The HPE 3PAR OS also supports read-write snapshots which, as the name implies, can be updated any time after they are created. As with read-only snapshots, space requirements for read-write snapshots start out very small, with actual data blocks only written as the snapshot is edited.

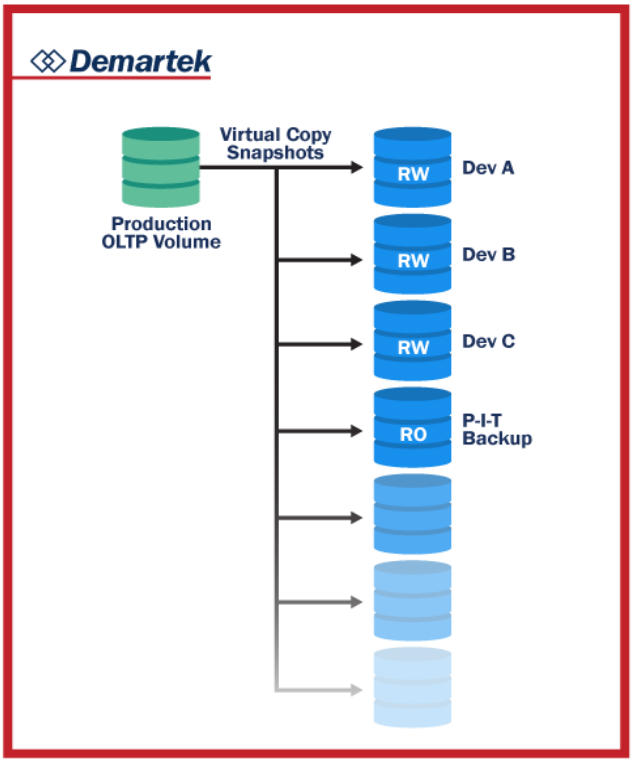

Figure 2 – A parent volume with multiple snapshots.

Figure 2 represents a use case in which multiple snapshots are created against a single database volume. Read-write snapshots, which will change over time, can be assigned to development and test databases, while a read-only snapshot may be retained as a backup, or a "golden image" from which to create additional snapshots.

Since the process of creating a snapshot is a metadata operation, it is performed instantaneously and consumes very little processing power. This allows snapshots to be taken against live production data with little to no performance impact on the volumes. As a true point-in-time image, snapshots of live volumes can be used to restore those volumes or applied to other application environments without risk of data corruption.

Priority Optimization

One of the reasons to separate production data from non-production is to prevent development and test jobs from consuming the storage resources that are needed to meet production service level agreements. This is typically done by deploying separate environments. However, all-flash systems may deliver enough performance to accommodate these functions on the same storage system, potentially saving money by reducing device counts in the data center.

Unfortunately, even with all-flash systems, the risk of impacting production doesn't completely go away. Production needs may grow over time, or resource consumption of non-production loads may spike for some reason or other. Fortunately, the HPE 3PAR OS has a way to mitigate this risk. Priority Optimization allows storage administrators or users with sufficient role-granted privileges to assign performance thresholds on 3PAR volume sets. Volumes can be limited to certain ranges of bandwidth, IOPS, or assigned minimum latency goals. Individual priorities allow the operating system to throttle the performance of low priority volumes (development for instance) if high priority volumes are in danger of not meeting defined performance requirements.

Figure 3 demonstrates priority optimization settings applied to two virtual volumes and three snapshots that are exported to development systems as database data volumes. The production OLTP volume is configured with a response time goal of .5 milliseconds and assigned a "high" priority. A data warehouse volume is given a bandwidth range and the

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development OLTP snapshots are assigned IOPS ranges to operate within. Data warehousing and the development snapshots are assigned a "low" priority.

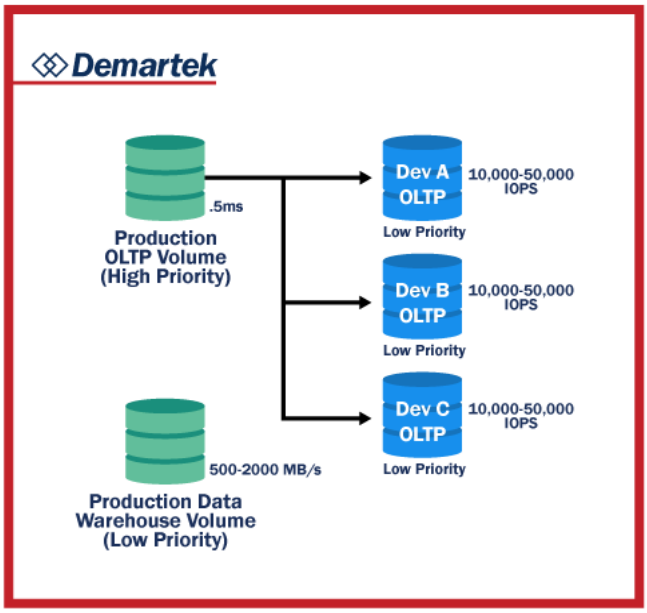

Figure 3 – Priority Optimization values assigned to different volumes on the storage system

The HPE 3PAR OS will balance the performance of all volumes to try to keep each one within the defined ranges. If the production OLTP volume, with its high priority, begins to exceed its response time target, the OS will throttle performance of the lower priority volumes to guarantee service to production OLTP.

The Use Case Validation

The test case evaluated by this project is the same one described in the preceding section. We configured an HPE StoreServ 3PAR 8450 All-Flash storage system (Figure 4) with a domain for our hypothetical database team to manage. A separate Windows server was deployed to support each Microsoft SQL Server application instance, receiving storage resources from the 3PAR 8450 over Gen 5 Fibre Channel. As this was a storage system validation and not a server performance test, we reduced the server memory available to SQL Server to a mere 8GB to minimize data caching and force storage I/O.

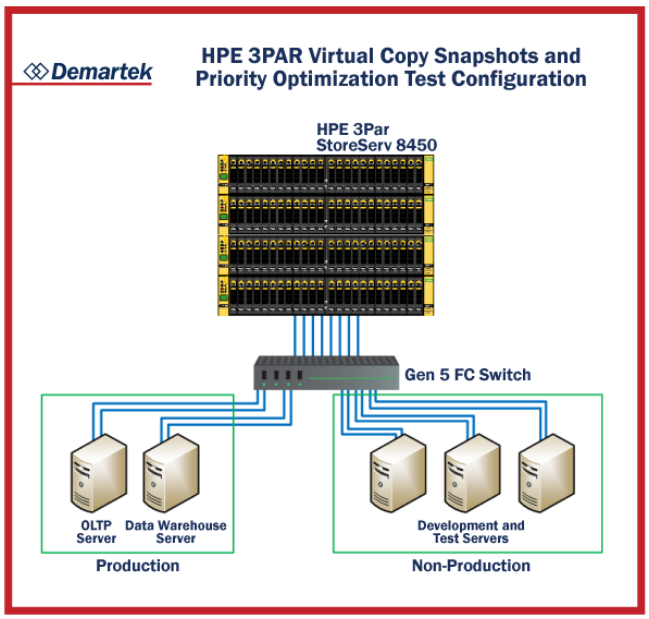

Figure 4 – Use case test configuration

Two validation tests were executed in turn. First, the production OLTP application was started. After it achieved a steady-state of operation, a series of six snapshots were taken while we examined the performance metrics for any noticeable impact. The second scenario involved assigning three of the read-write snapshots as data volumes for development databases and deploying a data warehouse application in addition to the production OLTP workload.

Thresholds, latency goals, and priorities were set as shown in Figure 3. Beginning with the production OLTP workload, followed by data warehousing, and finally the development/test databases, each application was started in turn at roughly fifteen minutes intervals. Performance was recorded and evaluated with priority optimization definitions initially disabled, then enabled and the workload repeated for comparison. Metrics were gathered through Windows Perfmon, at the application servers, and directly on the 3PAR StoreServ 8450 by way of HPE 3PAR System Reporter.

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Results and Analysis

Administration Delegation and Virtual Copy Snapshots

The user and domain configuration worked as defined. We were able to log on to the HPE 3PAR StoreServ 8450 and manage all resources within the SQLServer domain, including creating volumes and volume sets, taking snapshots, and assigning priority optimization settings. As the sqldba user, we could neither see nor interact with any other resources on the 3PAR system. The 'edit' role does offer a great deal of autonomy to the user. This has the benefit of allowing the storage administrator to set up the domain and basically walk away from it. However, if the application team does not possess the appropriate knowledge and/or experience to safely manage the storage resources, more restrictive roles are available.

After creating volumes for the production OLTP database and the data warehouse, the OLTP database application was started and tuned until the processes consumed roughly 65% of the server processing capacity. This produced about 9000 database transactions per second. I/O response times were just under .4 milliseconds, and storage bandwidth was steady at around 1270 megabytes per second. Operating under the assumption that any performance degradation on the storage system would be magnified at the server, all three metrics were gathered by Windows Perfmon at the database host.

After about thirteen minutes of steady state operation, six virtual copy snapshots were taken. As Figure 5 demonstrates, no noticeable performance impact was recorded in any of these metrics.

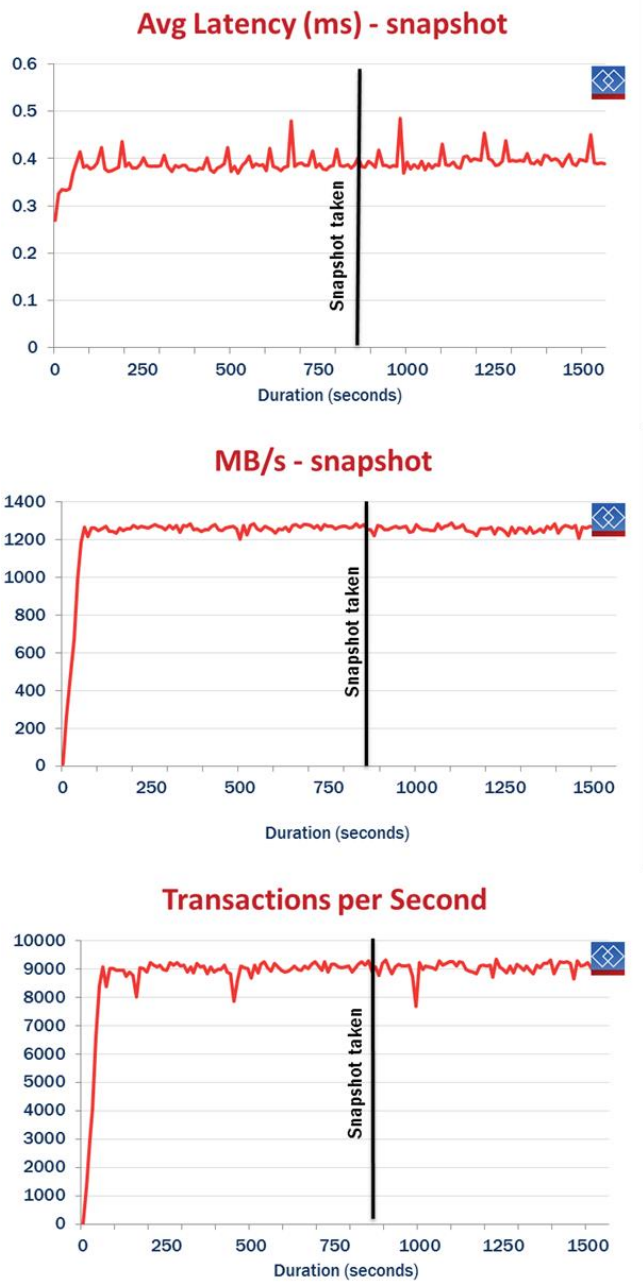

Figure 5 – Several metrics demonstrating no impact to storage or application performance when taking multiple Virtual Copy Snapshots

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We indicated earlier that HPE 3PAR snapshots were very space efficient, given that no data blocks are affected until updates occur to the parent volume or to a read-write snapshot. For this reason, the operating system will support thousands of snapshots. As Figure 6 shows, six snapshots of the 1.5TB production volume consume only 342GB of on-drive space, which were the data blocks written to by the development workloads after many hours of execution and those blocks in the parent volume that had to be written out due to updates after the snapshots were taken.

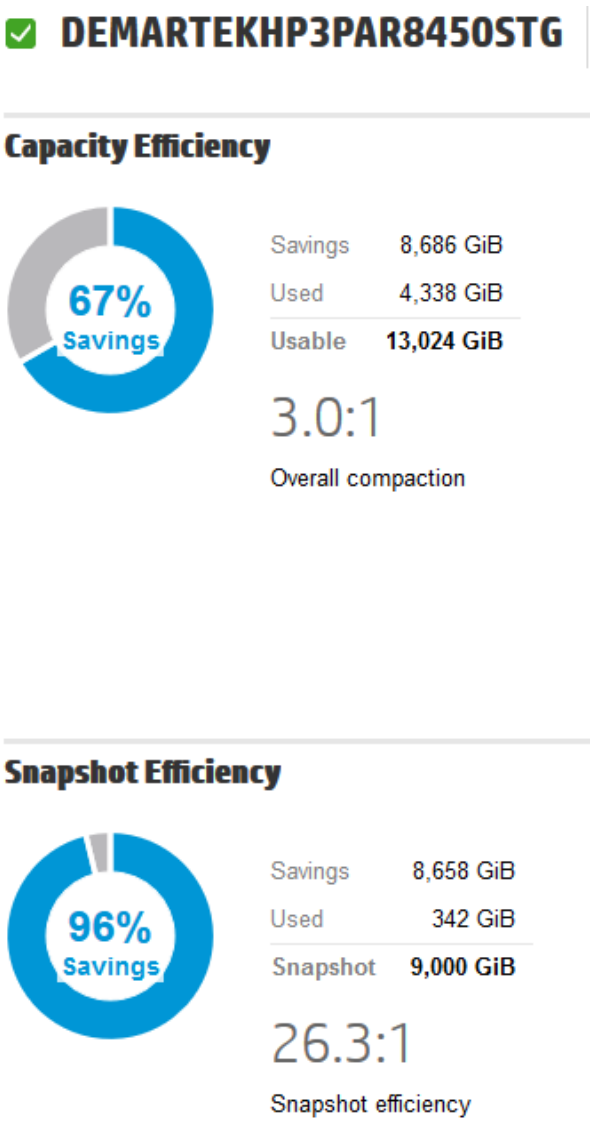

Figure 6 – Snapshot space efficiency

Priority Optimization

Taking advantage of three of the read-write snapshots created in the prior test phase, we provisioned three development servers and exported those snapshots to them as data volumes (it is worth noting that the snapshotted data volumes were attached without issue to the development database instances). The value of priority optimization is supposed to be the ability to consolidate multiple workloads of differing importance on the same HPE 3PAR storage system, without risk to the service levels of the most critical. In this section, we will examine that claim by evaluating the performance of each workload against its defined priority optimization settings.

With production OLTP considered the highest priority application in the test environment, we will consider the behavior of its volumes first. Our hypothetical service level requirements declare latency to be the critical measure of acceptable performance. Figure 7 contrasts the average response times of production OLTP I/O with priority optimization first disabled then enabled.

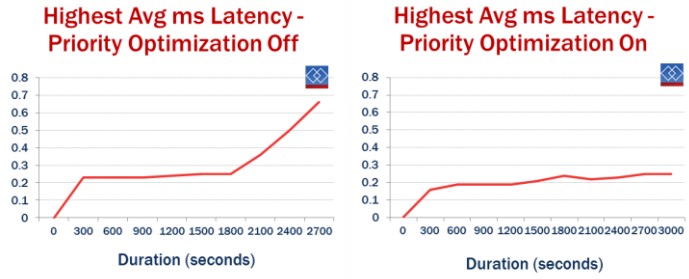

Figure 7 – Highest average latency of production OLTP workload volumes

It is clear that with priority optimization turned off, the storage system is not keeping latency within .5 milliseconds. This is most evident starting around 1800 seconds into the workload, when the development/test database applications were started. This is contrasted with a steady .2 to .25 millisecond response time when the priority optimization engine is enabled.

Data warehousing was assigned a low priority, but as another production job, we'll examine it next. This

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workload is not latency sensitive, nor does it generate a lot of IOPS, but it is bandwidth intensive. In Figure 8, we can see the volume bandwidth dipped below the minimum bandwidth threshold of 500 megabytes per second several times when priority optimization was disabled. This happened only once after we turned priority optimization on and was corrected very quickly. After the development workloads were executed (at 1800 seconds), the highly variable nature of the bandwidth suggests that the priority optimization engine was making adjustments to volume performance to support response time demands of production OLTP.

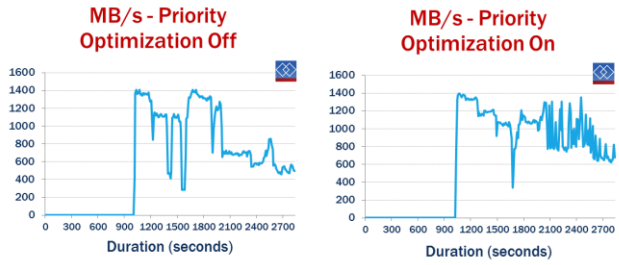

Figure 8 – Data warehouse bandwidth

The final workload in this use case was composed of the three development databases created from the production snapshots. These low priority workloads were given a fairly narrow IOPS range to operate in (or rather a narrow range for an all-flash system). Here we see the most obvious re-balancing of I/O to guarantee the latency target of the highest priority rule—production OLTP. The databases appear to be capable of a little over 100,000 IOPS in this mixed workload environment. The priority optimization engine actually reduced that I/O by 10,000 IOPS over the baseline (Figure 9). Comparing time stamps when this occurred to the production OLTP latency charts in Figure 7, we can see that this adjustment lines up nicely with when response times would have increased were priority optimization disabled. From this we conclude that the development I/O was corrected by the operating system to keep production latency low.

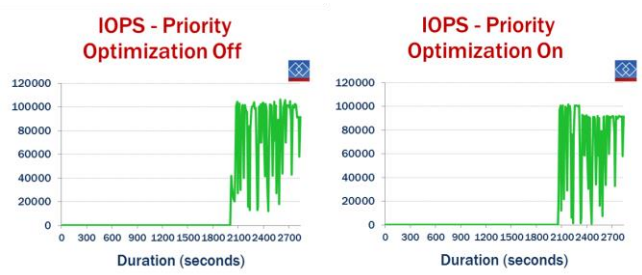

Figure 9 – IOPS of dev/test database volumes

The performance profile of this test case seems to bear out the claim that HPE 3PAR priority optimization can provide a performance guarantee to critical applications in a multi-workload environment. This type of feature is a logical addition to a high-performance all-flash storage system like the HPE 3PAR StoreServ 8450 and should be a definite value-add to enterprises interested in consolidating applications onto fewer, more powerful storage systems.

Summary and Conclusion

Bandwidth, IOPS, and response times should not be the only factors under consideration for high-end storage investments. These storage systems are multi-function computers in their own right and can deliver a bevy of features to simplify and streamline storage management across the datacenter. Additionally, current generation all-flash systems have performance capacity to spare in all but the most extreme use cases. This extra capacity can be harnessed to support more work than ever before. Storage management notions held over from the era of slow magnetic media may be holding back the full value of flash storage in the data center by limiting the complete deployment of usable storage.

Features to ease and reduce storage administration tasks make the entire enterprise more efficient. Application owners are able to take control of their own resources on their own schedule, without placing other assets at risk, and the storage administrator no longer needs to respond to basic maintenance and management requests from those teams. Technology that facilitates greater utilization of a storage system

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reclaims underutilized capacity for a greater return on investment and potentially empowers the enterprise to consolidate functions onto fewer, or individual, devices for significant cost savings in hardware and administration.

HPE provides all these opportunities in the HPE 3PAR StoreServ product line. The HPE 3PAR OS is purpose-built to enable storage teams to compartmentalize storage resources for delegated management and to capitalize on the power that flash systems bring to the data center. Guaranteed performance levels, through priority optimization, challenge traditional implementation strategies by offering low risk consolidation of disparate workloads. Storage architects, administrators, and data center managers are advised to consider the value-add of features such as those highlighted in this report when considering future storage system investments or strategies to get more out of already deployed HPE 3PAR StoreServ 8000 series systems. To do otherwise risks leaving valuable cost saving opportunities and system performance on the table.

The most current version of this report is available at http://www.demartek.com/Demartek_HPE_3PAR_Snapshots_2017-01.html on the Demartek website.

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