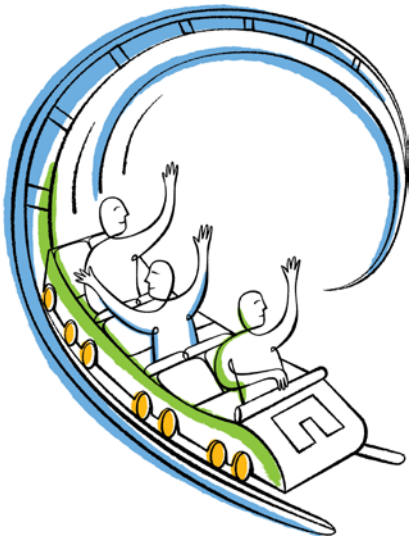
Technical Case Study

Making Good Times Great: Optimizing Customer Experiences with Real-Time Access to Data

How Six Flags Entertainment Is Keeping Quality and Spirits High with NetApp and VMware

The first Six Flags park opened in 1961 in Texas under founder Angus Wynne, who aspired to create a network of conveniently located and affordable theme parks. More than 50 years later, Six Flags Entertainment Corp. has grown to become the world's largest regional theme park company. Headquartered in Grand Prairie, Texas, the company now has 18 properties across North America and employs more than 39,000 people every year.



Facing tough competition for tourist dollars, Six Flags is always looking for ways to improve business and streamline operations. To keep customers coming back and extend their stay inside the parks, Six Flags is laser-focused on providing world-class guest service. The company wanted to take customer experiences to new heights by using technology to power real-time access to data about visitor behaviors, interests, and trends. To optimize staffing and merchandise inventory levels and effectively customize promotions to address diverse customer segments, it needed immediate, accurate insight into all park operations.

Goals for Consolidated Theme Park Infrastructure

To support its business analytics goals, Six Flags had to standardize IT across parks nationwide and consolidate the data from 18 major data centers into one primary data center. Decentralized operations, with data and applications sitting locally at each park, made it impossible to monitor the business from a cross-park perspective and measure the success of one park versus another. Consolidating IT operations would allow the company to collect real-time business intelligence across all parks to empower more granular and effective decision making, as well as improve operational efficiency and streamline support.

Six Flags wanted to implement technology that would allow it to:

- Bring enterprise applications together on a single data center infrastructure architecture and Cisco® based network while maintaining high availability for data.
- Virtualize most of its servers with VMware® vSphere®.
- Support a standardized "mini data center" infrastructure running on Microsoft® SQL Server® at each park location and quickly process data collected using radio frequency identification (RFID) technology.
- Collect real-time data from 3,500 point-of-sale terminals.
- Achieve nimble operations and adapt quickly to changing conditions.

"For Six Flags, the single most important objective is the quality of experience in our parks," says Michael Israel, CIO. "We're in the business of making people happy, and we want to implement technology that will allow us to continuously improve the guest experience."

How Six Flags Connected Data and Decision Makers by Using NetApp and VMware

Six Flags met its goals by standardizing on Microsoft applications and VMware virtualization technologies and deploying NetApp® FAS6240 and FAS3240 storage systems at a primary data center in Dallas and a remote disaster recovery facility. At the same time, it created identical mini data centers at the 18 theme parks using NetApp FAS3240 storage systems in high-availability pairs (Figure 1) to support park-specific services. Six Flags uses Microsoft Dynamics® GP as its primary financial system, and relies on IBM Maximo asset-management software for parts inventory and maintenance ticket tracking. Also business critical are an Agilysys Eatec® food-service procurement application and a retail management solution from Epicor.

All the individual park data is transmitted to the primary data center, where it is then aggregated through reporting and analytics tools based on Microsoft SQL Server to provide visibility into ticketing, attendance, weather, and point-of-sale data. This approach allows Six Flags to monitor changes in park conditions and customer behavior from a higher business perspective. For example, Six Flags can respond to a drop in temperature at a given park by decreasing the number of lifeguards and increasing the number of ride operators; or, if pizza has been a popular item, it can make sure enough supplies are on hand to meet demand.

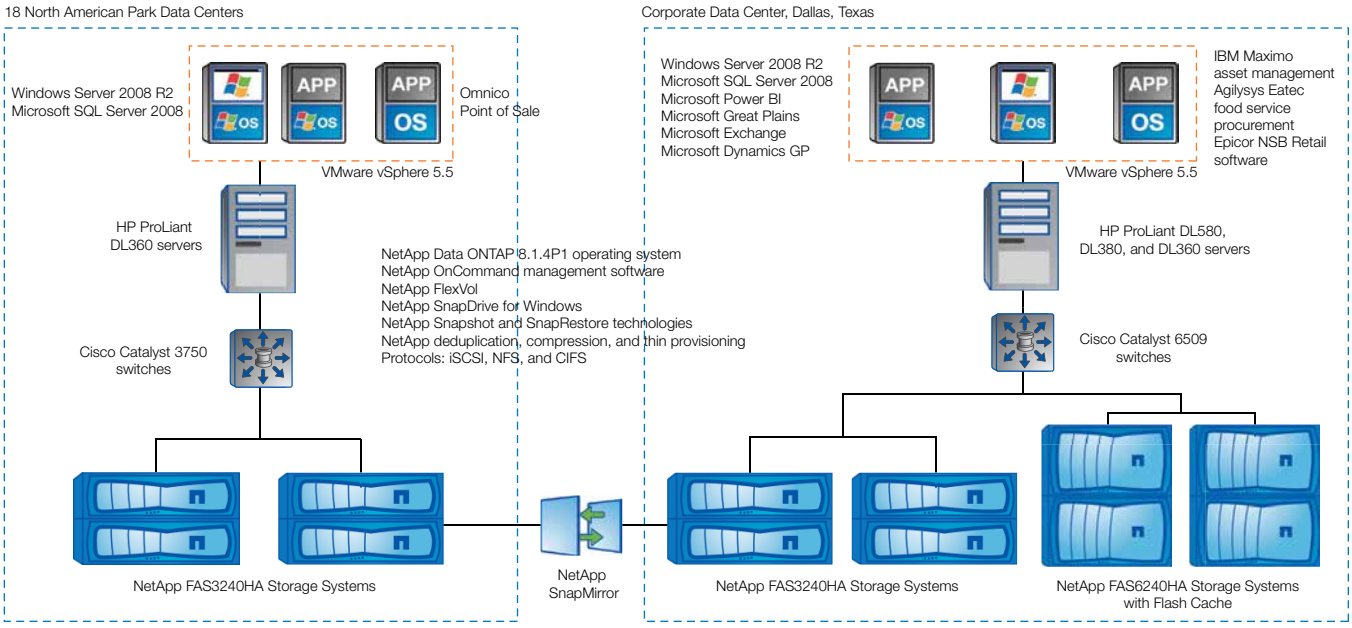


Figure 1) Six Flags Entertainment's NetApp storage infrastructure. Identical mini data centers at 18 theme parks replicate data back to the primary data center in Dallas by using NetApp SnapMirror® technology.

Additional NetApp FAS3250 and FAS3210 storage systems support other operational areas within the business. All of Six Flags' NetApp systems run NetApp Data ONTAP® technology.

NetApp storage is connected to HP ProLiant servers over an Ethernet network using Cisco switches. Over 90% of the server environment is virtualized with VMware vSphere. Virtual machines (VMs) access the NetApp storage cluster through the NFS protocol. To provide redundancy and improve performance for physical servers, Six Flags uses two QLogic iSCSI host bus adapters in each server and uses NetApp Data ONTAP Device Specific Module (DSM) technology for multipath input/output (I/O).

Six Flags selected NetApp technology for several reasons, including the following:

- NetApp has superior integration with VMware technology and features such as deduplication that improve efficiency in a virtual environment.
- NetApp Flash Cache™ intelligent caching improves storage I/O for random read-intensive workloads such as databases, speeding data analysis.
- Fast, efficient data replication from parks to the data centers eliminates the need to run local backups at each park.
- NetApp offers multiprotocol support (iSCSI, CIFS, NFS). As Six Flags virtualizes more servers with VMware ESX, it is shifting increasingly toward NFS; however, it still maintains 56 aggregates for iSCSI LUNs.
- Migrating to NetApp clustered Data ONTAP will allow Six Flags to achieve true nondisruptive operations, as described later.

With 784TB of total usable capacity across all NetApp systems, Six Flags has plenty of room to grow and implement new applications and services. "I try not to be a dedicated fan of any given technology, but NetApp is about as close as I'll get," says Matthew Nowell, manager of SAN operations at Six Flags. "We've done things that would have been impossible had we been limited to a traditional storage area network."

Storage Innovations Behind the Consolidated Theme Park Infrastructure

NetApp technologies play a major role in helping Six Flags consolidate its infrastructure and support real-time business analytics. "Understanding what our guests want is critical to us, and data plays a big role in that," says Israel. "We wanted a storage infrastructure that would allow us to support decision making based on true data instead of on assumptions and experience."

By standardizing on NetApp technology, Six Flags has implemented an elegant data protection and disaster recovery strategy while optimizing performance and maximizing efficiency.

Enhancing Data Protection and Business Continuity

With data being generated constantly at parks and corporate headquarters, Six Flags must ensure that information is protected even in the event of corruption or hardware failure. The company uses NetApp Snapshot™ and SnapRestore® technologies for local data protection, with incremental point-in-time copies automatically created every hour. IT staff can recover files or VM images in minutes, improving overall productivity.

NetApp SnapMirror software replicates 106TB of compressed data from parks to the primary data center, which is then backed up to tape and also replicated to the secondary data center. This approach provides business continuity without the cost and manpower of running tape backups at every park and transporting

them off site. Consistent data retention policies and the elimination of off-site storage contracts reduce operating costs, while savings on backup software licenses and tape hardware minimize capital expenditures.

“Using VMware and NetApp SnapMirror gives us the resiliency we need to keep business moving,” says Nowell. “Even if there were a major problem over a busy holiday weekend, we have enough resiliency built in that we would still be able to operate the parks and make smart business decisions.”

Optimizing Performance with NetApp Flash Cache

To improve performance for business analytics and other I/O-intensive workloads, Six Flags deployed NetApp Flash Cache on storage systems at its primary and secondary data centers. Flash Cache speeds data access through intelligent caching of recently read user data or NetApp metadata (Figure 2), and is very effective at improving I/O performance for random read-intensive workloads. Intelligent caching and NetApp storage-efficiency technologies enable the Virtual Storage Tier, which promotes hot data to performance storage in real time without moving data.

Multiple 512GB Flash Cache cards in the NetApp storage systems helped Six Flags reach more than 16,000 peak input/output operations per second (IOPS), with peak read performance of 962 MB/sec. Latency has been reduced to sub millisecond. “NetApp Flash Cache gives us the IOPS we need for big data processing and analysis,” says Nowell. “Reports complete in 1.5 hours instead of 3.5 hours, or 57% less time. We can respond to the need for data quickly.”

As previously mentioned, Six Flags also uses NetApp DSM for active-active load balancing and redundancy. Multipath I/O not only accelerates performance by utilizing the aggregate performance of multiple connections, but also protects against hardware failures by providing multiple paths from servers to the NetApp storage. Even if a core storage switch were to fail, operations would not be affected.

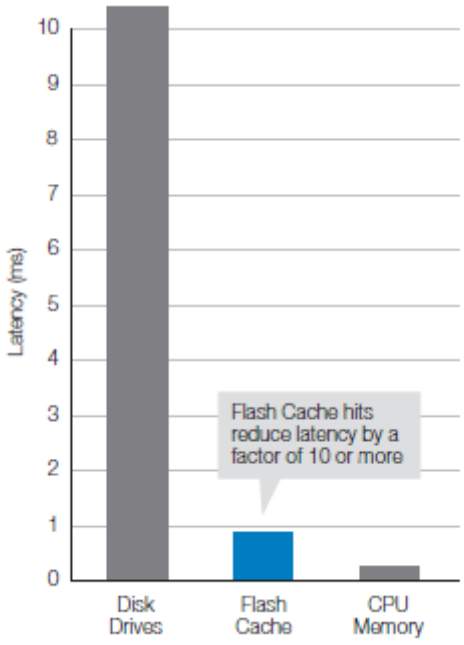


Figure 2) NetApp Flash Cache intelligent caching optimizes performance for business analytics. By using controller-attached PCIe intelligent caching instead of more hard disk drives, Flash Cache improves storage I/O for random read-intensive workloads, reducing latency by a factor of 10 or more.

Maximizing Storage and Management Efficiency

NetApp deduplication and thin provisioning help Six Flags make the most of its storage space. NetApp deduplication is decreasing the storage footprint by 17%, reclaiming 21TB of capacity, while NetApp FlexVol® thin provisioning software creates virtual volumes that can be managed and moved independently from physical storage. Using FlexVol thin provisioning allows Six Flags to delay the purchase of storage capacity by allocating space up front that is not yet being used.

Six Flags has more than 560 NetApp FlexVol volumes in its environment, saving about 50% of storage capacity for its NFS and CIFS volume data. "Using NetApp thin provisioning, we're able to save approximately 140TB out of what would be 280TB of committed storage space," says Nowell.

NetApp OnCommand® management software provides a unified storage management interface to manage multiple NetApp systems across multiple sites, reducing administrative overhead amid rapidly expanding data volumes. With comprehensive monitoring and management from a central console, IT staff can easily track performance metrics and utilization statistics. "We can troubleshoot our NetApp storage from 1,000 miles away," says Nowell. "That makes a huge difference in time to resolution, allowing us to get maximum benefit from the standardized architecture we've implemented at the parks."

The NetApp AutoSupport™ tool checks the health of the NetApp systems on a continual basis. My AutoSupport, a web-based application that works with AutoSupport, enables self-service support by providing Six Flags with tools designed to analyze, model, and improve the operational efficiency of NetApp systems.

IT Benefits and Business Impact

The NetApp and VMware environment enables Six Flags to send park visitors customized offerings based on time of day, location, preferences, and previous activities. The ability to provide more responsive, tailored services enhances the visitor experience and opens up additional revenue streams. Moreover, the ability to process data at an enterprise level instead of the individual park level gives Six Flags better insight into the impacts of its marketing campaigns.

"We're pulling 9TB of data from the parks to optimize staffing levels and target the appropriate promotions to individual customers," says Nowell. "As a result, our guests are staying longer and having a better time."

Since implementing real-time, data-driven park operations, Six Flags has enjoyed steady year-over-year revenue growth and improved customer loyalty. Guest satisfaction scores, which Six Flags measures regularly and uses as a barometer of success, have never been higher, and 2013 was a record year for financial results.

Complete Interoperability with VMware on NetApp

Six Flags is 90% virtualized with VMware vSphere, with more than 600 virtual machines on its NetApp storage systems. IT staff members appreciate the many integration points between the two technologies, which save time and improve transparency. One example is NetApp Virtual Storage Console for VMware vSphere, which provides discovery, health monitoring, capacity management, provisioning, cloning, backup, and restore capabilities directly from within VMware vCenter™.

"It's obvious that NetApp and VMware are committed to working together for the benefit of their mutual customers," says Nowell. "They write plug-ins for each other's solutions. They cooperate to the point where it becomes so simple to manage our environment that we can focus on what the data is and how we deliver it to the appropriate decision makers. We don't have to worry about whether a server is up, or whether we have sufficient storage capacity or I/O."

"From a revenue perspective, 2013 was our best year to date," says Israel. "Our profit margins have never been better. With NetApp and VMware behind our new consolidated infrastructure, we are balancing profitability with making sure our guests are happy."

What's Next

Six Flags plans to begin using additional NetApp technologies in the near future to further improve performance, availability, and scalability. NetApp Virtual Storage Console for VMware vSphere will make administration even easier by providing integrated, end-to-end virtual storage management capabilities (see the sidebar "Complete Interoperability with VMware on NetApp"), and NetApp SnapManager® for SQL Server will automate backup and recovery at the database level.

In the near future, Six Flags is planning to migrate to NetApp clustered Data ONTAP, which will allow the company to manage clusters of storage systems as a single logical pool and maintain high availability for data even while rebalancing volumes across controllers and spindles. "With NetApp clustered Data ONTAP, we'll be able to move workloads around seamlessly and perform updates during the day," says Nowell.

The company's future vision includes new applications such as proximity-based marketing with RFID chips. "We've been able to turn the tide and become much more innovative as an organization," says Israel. "Whether it's a park entry process, reengineering our season pass processing, or rolling out TV and menu board systems, the structure that we have with NetApp allows us to just keep building right on that approach. The future for us from an IT and innovation perspective is as thrilling as one of our biggest coasters."

Product List

- NetApp FAS6240, FAS3240, FAS3250, and FAS3210 storage systems
- NetApp Flash Cache
- NetApp Data ONTAP 8.1.4P1 operating system
- NetApp OnCommand management software
- NetApp deduplication
- NetApp Snapshot and SnapRestore technologies
- NetApp SnapMirror
- NetApp FlexVol
- VMware vSphere 5.5
- HP ProLiant DL580, DL380, and DL360 servers
- Cisco Catalyst® 6509, 4510, 3750, and 2960 switches
- QLogic QLE4060C iSCSI host bus adapters
- Microsoft Windows Server® 2008 R2
- Microsoft SQL Server 2008
- Microsoft Dynamics GP software
- IBM Maximo Asset Management software
- Agilysys Eatec
- Epicor® NSB Retail software

Services

- NetApp SupportEdge Premium
- My AutoSupport

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