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IN DEPTH

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Storage Area Networks: A Bet Worth Taking

By **JAMES E. GASKIN**

Here's why the Mirage Resorts Inc. in Las Vegas needs a storage area network: The busiest time of the day for the \$1.5 billion company is between 10 p.m. and 2 a.m., which means the staff has four hours to back up more than 570 GB of data to tape before the day's first shift starts at 6 a.m.

On top of its backup needs, the company is making a push toward a Web-based paperless office, which means managers need access to reports 24 x 7. And, Mirage also has to accommodate the requirements of Nevada



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Gaming Board auditors who demand complete access to every transaction during the most recent period under scrutiny. Tack on that the company's Las Vegas hotels run more than 5,000 desktops and servers, another 5,000 network printers, and track more than 6,000 slot machines daily and you can understand why the hotels needed a powerful, flexible storage system.

Glenn Bonner, CIO at Mirage Resorts, says all of this network traffic generates 3.5 terabytes of online tape storage a week—a data onslaught he says the company couldn't possibly handle without a SAN.

The SAN offers Mirage Resorts something traditional storage doesn't: It moves all the storage components to a separate network. A dedicated server controls all storage details for the storage devices, and the storage network is attached to the main computer network through one or more links.

High-performance SANs like the one Mirage Resorts uses have multiple links between their client/server network and the SAN, all controlled by high-throughput switches. Bonner needs the fastest link possible between disk storage and tape libraries, and the high-speed SAN supports both devices, keeping back-up traffic away from the operational networks.

"There's a small window between the slowdown of the casino transaction volume and the ramp up of transactions for room service, starting about 6 a.m.," says Bonner. "We fit the start of the back-up procedure and night auditing into our available window only because the SAN lets us back up nearly 600 GB without impacting real-time Web transactions and our other systems.

"The largest volume comes from our hotel systems—phones, keylocks, front desk operations and the like," adds Bonner. "The next largest set of transactions comes from the casinos, with slots leading the way, closely followed by the casino credit system."

The Mirage Resorts SAN supports all of these transactions at three of Mirage Resorts' 3,000-plus room hotels. All three are within a mile and a

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half of one another. Each of the hotels is a world-class facility already famous as a Las Vegas landmark. The Mirage is the resort with the volcano erupting out front every 15 minutes. Treasure Island has a complete pirate ship outside. And, the Bellagio boasts a world-class art gallery inside and thousands of fountains in the lake outside. Other "smaller" properties (each with about 2,000 rooms and still among the world's largest hotels) include Golden Nugget hotels in Las Vegas and Laughlin, Nev., the Beau Rivage in Biloxi, Miss., and the Les Jardine in Atlantic City, N.J. All these sites are connected to the SAN via a T1 connection to the corporate WAN.

Here's how the Mirage Resorts SAN works: Data from hundreds of servers flows to one of two StorageTek 9310 PowderHorn tape libraries. The 9310s are separated by a Fibre Channel link about one and a half miles long between IS headquarters, based in a separate building apart from the hotels, and the computer room in the Bellagio.

Mirage Resorts uses two T1 links to provide Web and Internet services, both to customers and business partners. Its online reservations system, which handles tickets to concerts and special performances, ties directly to the hotel system. Business-to-business Web activity includes group reservations and links to an extranet bid management portal so hotel purchasing agents can buy perishable food like meat, fruit and vegetables. All transactions flow into the hotel management system, one of hundreds of homegrown applications developed by Mirage Resorts.

One of the SAN's most important features is backup, because it's the best way to keep massive, streaming amounts of traffic from clogging a network. Walt Hinton, chief strategist for StorageTek, says that by building a separate network for storage and backup, the production network is free to support server-to-client and server-to-server transactions. Separate networks let Mirage shovel gigabytes per minute of data between disk and tape on the SAN without slowing down the transactions for the front desk operations or casino on the production network.

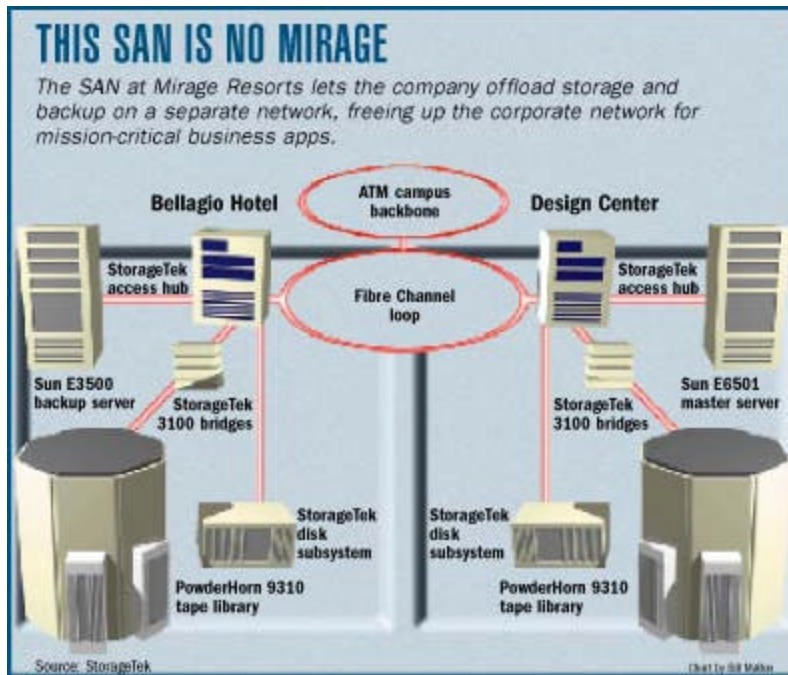
Bonner assigned his best engineer to research storage options three years ago, when the company realized it would need a new system to accommodate traffic increases at the then-forthcoming Bellagio. Finding a

method to execute backup in the time allowed was critical, but so was the stability of the vendor. Local service and support was non-negotiable. Few businesses generate revenue every minute of the day, but casinos do. Taking thousands of slot machines off-line for backup was never an option.

StorageTek made the short list of vendors that had the right equipment and local support. Bonner visited CitiBank's nearby credit card clearinghouse. CitiBank has eight 9310 automated cartridge systems online, and StorageTek already had local support in place. Bonner felt that StorageTek provided the scalability and reliability he needed, and had the company's 9310 installed in September 1997.

Planning for the Bellagio's opening in September 1998 pushed Bonner into purchasing the second tape storage unit. The company had made capacity projections based on the Mirage Resort, but the Bellagio's success almost overwhelmed its projections.

"The Bellagio, in the first month, did twice our previous total transaction volume," says Bonner. The volume came from the 3,000-plus rooms, sales of show tickets and retail sales from the adjacent mall, which includes Chanel, Giorgio Armani, Gucci, Tiffany & Co. and others.



The main IT headquarters is in the Mirage Resorts Design Center, which shares a building with the company's construction arm. A second large data center was added in the Bellagio, a mile and a half away.

"We decided to try the Fibre Channel connection because we didn't have room in the Design Center for a second 9310 tape unit," Bonner explains. Mirage Resorts has dark fibre between each of its four Las Vegas properties, and runs all remote computer rooms dark as well. A T1 links the company's new Beau Rivage property in Biloxi, Miss. "We use Web cameras to monitor anyone coming in or out of the remote computer rooms," Bonner adds.

A Sun 6500 with eight processors controls the SAN; it was upgraded from a Sun 3000 when the second tape library was added. The company runs a Sonet OC-3 (155 Mbps) data connection between the Design Center and the Bellagio that will be upgraded to OC-12 (622 Mbps) before the crush of New Year's business.

The SAN supports 21 operating systems, which includes all the normal desktop, server and mainframe systems, plus specialized systems for doors, keylocks, slot machines, casino banking and credit, and security, among others. Three Tandem systems with a total of 30 processors are spread across three of the properties; redundant 12-way systems at the Bellagio and Treasure Island, and a six-way system at Beau Rivage in Mississippi. These handle the casino credit accounts, among other functions, acting as a bank for guests.

There are three AS/400 systems, with a redundant system for backup. Fifteen IBM RS/6000s, including an eight-way R50 model, handle the slot machine transactions. Windows NT servers abound, and most are from Dell Computer. Five Dell Quad Xeon servers running Windows NT Terminal Server software support 500 Wyse WinTerm desktops. Since Mirage Resorts has an excellent working relationship with Dell, it also has been testing a new Dell eight-way server to drive thin clients.

Bonner wants to move away from discrete RAID arrays to a so-called "wall" of disks, planning to save money with the replacements over time. The Mirage Resorts SAN is controlled by a new StorageTek Access Hub that uses a loop switch technology. This technology lets any server on any network loop reach any tape drive on any other loop. The new Access Hub supports up to 32 Fibre Channel Arbitrated Loop connections, all without blocking traffic from one loop to the other. Each Arbitrated Loop can support up to 126 devices at speeds of 100 megabytes per second for a distance of 10 kilometers. The new Access Hub eliminates one of the problems with basic Arbitrated Loop. In the past, when any one unit on a loop failed, it took down the entire loop.

Dell's Fibre Channel RAID technology helps Bonner stay ahead of the demand curve. For performance, Bonner converted one of the earlier Clariion disk units to a 600 GB cache for the tape libraries. Both the

Design Center data site and the Bellagio data center have 1 TB Fibre Channel arrays for online disk storage and tape library cache.

Bonner installed the second 9310 tape silo for several important reasons. First, Mirage Resorts was looking for a way to reduce paper consumption and reliance on printed reports. The second 9310's added capacity lets Bonner offer information—previously printed as reports—in real time. The quality of the information increased as well, since online reports are always up-to-date. Using Computer Output To Tape made the paper reduction possible by printing reports in an easily viewable online format and increased security since sensitive information couldn't go out in the trash by accident. Quick access to all information is necessary for the Nevada Gaming Board auditors. In addition, the extra "nearline" tape storage eliminates the need to archive old tapes to an outside group. This saves Mirage Resorts more than \$250,000 per year.

Shared storage under centralized control also adds peace of mind. Each of the six data centers beyond the Design Center are controlled remotely, which also keeps the 195 Mirage Resort IT employees centralized. Between 40 and 100 servers of various types are in each property, yet the SAN provides online storage or backup for all sites and servers.

"About three-quarters of our systems are front-ended by Sun systems," says StorageTek's Hinton.

To formalize that relationship, Sun and StorageTek announced a partnership in mid-August that lets Sun sell tape libraries from StorageTek, while StorageTek will offer disk subsystems from Sun. Bonner's network storage is all Clariion disk subsystems marketed by StorageTek, but that relationship may change since StorageTek's main competitor, EMC, just bought Data General, parent company of Clariion.

Of course, whatever happens with Data General, StorageTek will be part of Bonner's network for quite a while.

"We have high confidence in their products and service," says Bonner. "With two tape silos, I can add up to 400 terabytes of storage. There are

options to move up to higher-throughput storage if necessary, all with StorageTek."

Which is why for Bonner and the IT staff at Mirage Resorts, installing a SAN is as close as you can get to a sure bet in Las Vegas. And it certainly has been a bet worth taking.

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