Storage Area Networks in Video Applications

By Mitchell Seigle

Reducing the time it takes to produce videos is important to anyone working in the industry. One timesaving element available is the implementation of storage area networks (SANs). SANs use high-bandwidth interconnects that enable transmission of blocks of video data for editing and production, as well as compressed streams of data for server and broadcast operations. This paper will discuss the role and benefits of SANs in video applications.

In video application environments, storage area networks (SANs) provide scalable, high-bandwidth interconnects between storage devices and other equipment such as servers and workstations. The high-bandwidth interconnects inherent in SANs enable transmission of blocks of video data for editing and production, as well as compressed streams of video data for video server and broadcast operations (Fig. 1).

Along with content and creativity, time is a critical element in most video applications. Reducing the time to produce and prepare content is an important objective when it comes to the infrastructure, equipment, and tools used to create video content and prepare it for delivery. Whether the application is production of a movie, a news broadcast, a commercial, or a training video, shorter production time lowers production costs, yields higher productivity, and aids in meeting deadlines.

The advent of digital video and nonlinear editing has brought about dramatic improvements in the production quality and complexity of video content. Early generations of digital video editing systems utilize special workstations that use traditional analog video clips, convert them to digital format, edit them, convert them back to analog video format, and then store them on traditional videotape systems. SANs, however, provide a new solution for storing and distributing digital video content among workstations and servers—a high bandwidth, scalable network that allows workstations and servers to directly connect to and share digital video content either in compressed or noncompressed formats. The content is stored on direct access disk array storage systems that provide immediate access to the data, just as if it were stored on a local disk.

With Fibre Channel interface technology, a key enabling technology of SANs, workgroups in separate buildings—up to 10 km apart—can access the same storage as if they were located in the same room. A combination of direct high-speed access to the data and file-sharing software, significantly reduces the time required to access and share the data, improving productivity, shortening production times, and lowering costs. Redundancy features of SANs and redundant array of independent disks (RAID) storage systems can also reduce unplanned downtimes significantly.

SANs have three layers of value: the infrastructure, its applications, and

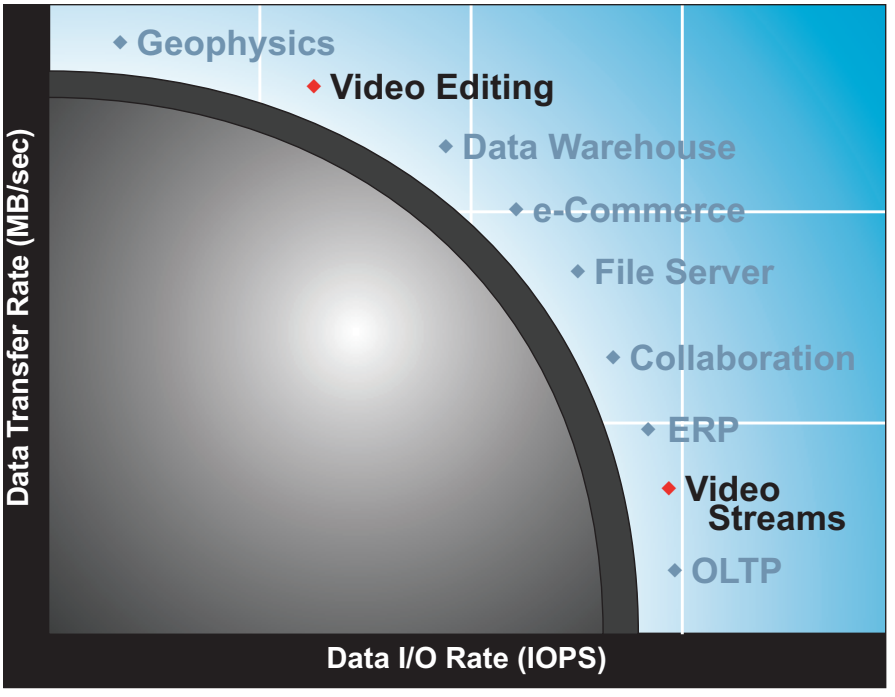

Figure 1. Video applications require high bandwidth and fast response times; ideal architectures optimize both performance dimensions.

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management software (Fig. 2). A common misconception is that once the infrastructure is in place, a SAN is succesfully implemented. Unfortunately, that's not the case. What's more important is what you can do with it and what problems it can solve. In the development of SAN applications, storage consolidation is widely available, and other applications, such as remote copy and LAN-free backup, are slowly emerging. Products to build the infrastructure are in place, although interoperability among vendors' products is still an issue.

Finally, the management layer is key to simplifying and organizing stored data; however, standards are lacking, with most vendors offering proprietary solutions. The industry, through cooperative consortiums, is working to develop a standard for comprehensive SAN management tools.

SAN Infrastructure

A quickly maturing technology, Fibre Channel is today's standard in SANs. It is important to review its characteristics to see exactly how SANs can be configured to meet various requirements of video applications, as well as compare it to other technologies for data transfer.

Fibre Channel SANs are well suited to meeting the needs of digital video applications. A SAN is a dedicated network, connecting multiple computers (servers or workstations) to storage devices (Fig. 3). It provides any-to-any connections between the computers and storage devices. The ideal network technology for a SAN is one that provides high-bandwidth connections, low latency, scalability, distance and reliability. Fibre Channel meets all of these requirements with data transfer rates at 1 Gbit/sec and supports up to 10 km without extenders.

A growing number of Fibre Channel-compatible host adapters, switches, hubs, routers, and storage devices exist to meet most configurations. Although Fibre Channel solutions with limited features have existed for a few years, inherent interoperability problems and the lack of software to fully utilize SANs have delayed full implementation. Focus on these issues is providing today's SAN users the benefits envisioned by original Fibre Channel architects.

Hardware

SAN components are available from many companies. The current market for Fibre Channel is very competitive, providing system integrators with choices in cost, performance, and features. Host adapters for a wide range of platforms (Windows NT, Sun/Solaris, SGI/IRIX, and Apple/Mac OS) are available from workstation and server companies as well as independent input/output (I/O) companies, such as Agilent, Emulex, JNI, LSI Logic, Prisa, and QLogic).

A number of hubs (Emulex, Gadzoox and Vixel), and switches (Ancor, Brocade, Gadzoox, McData and Vixel) provide choices in cost, performance, extensibility, availability, and management. Hubs provide lower cost connections but share bandwidth among devices that may connect to the hub. They are generally limited to 126 Fibre Channel devices.

Switches cost more, but typically provide full bandwidth to all connections simultaneously, and switched Fibre Channel fabrics can scale up to 16 million devices. Bandwidth of switched fabrics is also highly scalable. Both hub- and switch-based networks can be used in redundant configurations providing fault-tolerant solutions if required (Fig. 4).

Software

Although Fibre Channel is the standard, SANs can be built onto other I/O and networking technologies, such as small computer system interface (SCSI). This technology continues to improve and will soon advance from speeds of 80 MBytes/sec to 160 MBytes/sec, keeping pace with a single Fibre Channel connection, which will advance from 1 Gbit/sec (~100 MByte/sec) to 2 Gbits/sec (~200 MBytes/sec). Drawbacks of SCSI, however, are limited distances, addressing, and scalability. SCSI is not a network and although it has good performance for I/O connection, it cannot scale up to meet the needs of SANs.

Another important feature in systems that broadcast realtime video streams is guaranteeing delivery of data. Work has been done by the Fibre Channel standards organization to define guaranteed bandwidth features, but equipment vendors have yet to implement them. This has not been an issue because most video application environments (i.e., content production) don't require realtime delivery, or systems are configured such that there is sufficient performance to meet objectives without special hardware. Where realtime delivery is critical, video servers cache data to compensate for any brief interruptions or delays in the storage and I/O systems.

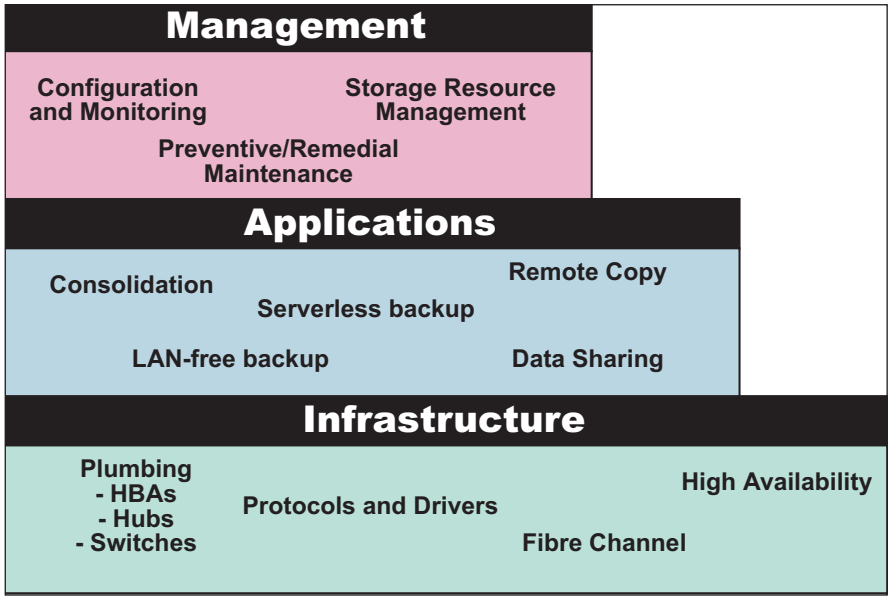

Figure 2. Three layers of SAN value.

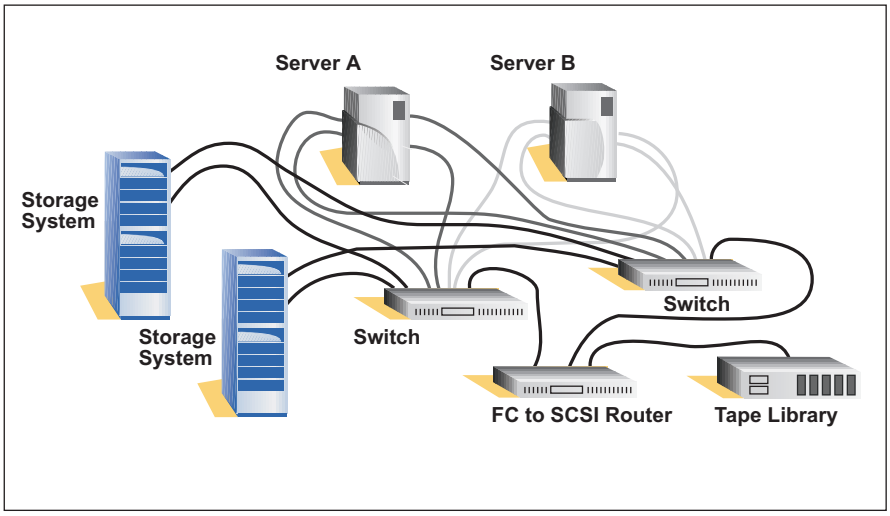

Figure 3. A SAN is a dedicated network connecting storage devices and computers.

SAN Applications and Management Software

Data delivery functions, such as moving, sharing, replicating, and backing up data, make SAN software critical to achieving the multiple benefits of the SAN infrastructure. Although the hardware (host adapters, hubs, switches, and storage systems) provides the resources for any-to-any connections and shared storage, without additional SAN software to manage and optimize the access and movement of data over SANs, the benefit is very limited.

SAN file-sharing software has great value in video applications. There are several products on the market, including SANergy, CentraVision, and FibreNet. Each product is implemented differently, but all have a common use: enabling files to be shared among multiple users directly over the high-speed SAN infrastructure.

The various SAN file-sharing products differ in how they communicate file access control information, what file system they use to manage shared files, and what platforms are supported. All of the products, however, allow users to share single copies of files and to transfer the data directly over the SAN at Fibre Channel speeds. This can result in significant improvements in digital video application environments. Large data files can be moved in shorter times. Several streams of video can be sent in parallel over the SAN. One copy of content can be accessed and worked on by multiple workers simultaneously. Work can be "pipelined" without having to move and/or copy the data. When content is complete, broadcast servers have direct access. The combination of high-speed transfers and file sharing eliminates delays and allows for parallel operations, reducing the cost and time spent producing and transmitting video content.

Backup Software

SAN backup software increases backup performance, consolidates backup operations, and frees LANs from being bogged down with backup data transfers. Storage partitioning and logical unit (LUN) masking software allow disk array storage systems to be shared even for data that is not part of shared file systems. Each server and workstation on the SAN can have its own dedicated and private storage in the disk array that is not accessible by other systems. This eliminates the need to maintain disk capacities at each individual server and workstation, and instead, allows access to pools of high-performing, highly available storage in centrally managed disk arrays. Software and hardware available for SANs offer many possibilities for improving the operations of a video work environment.

SAN Storage Systems

Video applications require high-bandwidth storage systems and SANs put more emphasis on storage architecture that can deliver high-quality performance. At the heart of SANs for video storage are the disk storage systems that store and deliver the video content being produced and transmitted. One of the first decisions many users make is whether to use just a bunch of disks (JBOD) or RAID.

JBOD arrays are individual disk drives that are accessed directly over the SAN. RAID is a disk array storage system that commonly includes redundant/hot-swappable components, caching, striping, and management features. The main advantage of JBOD arrays is the initial cost of the hardware. For SAN environments where storage is a resource shared among many users, almost all other advan-

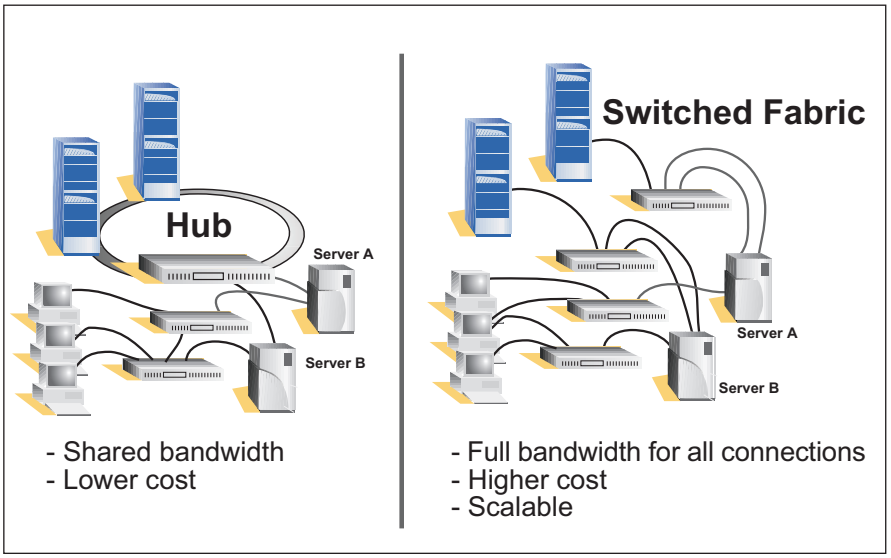

Figure 4. Hubs and switches provide any-to-any connections between computing elements and storage devices.

tages favor a RAID storage system.

Key requirements for a shared disk storage system in a SAN are high performance, scalability, availability, and manageability. These attributes, which are important in any business-critical system, are even more important in a shared SAN environment where bottlenecks or loss of access to data can bring productivity to a halt.

Striping, caching, high I/O rates, and high bandwidth are important criteria to consider when judging performance. Storage systems that have strong performance features and benchmark well in both large block and small block I/O environments are recommended. A key architectural feature in disk array storage controllers is the internal bandwidth of the controller. Video applications require systems that can fully utilize the Fibre Channel infrastructure by sustaining data transfers at close to 100 MBytes/sec. This typically requires more than double the bandwidth inside the controller. Controllers with internal bandwidths of more than 500 MBytes/sec are also recommended for video applications.

Scalability

Running out of disk space is a common problem in many systems. For capacity, a disk storage system should be capable of scaling to multiple terabytes and dynamically adding storage while the system is in operation. This is even more critical in a shared environment because it minimizes disruptions to operations.

The capability of scaling up controller performance along with and separate from the number of disk drives is also important. Configuration flexibility is key to meeting performance needs while holding total system cost to a minimum. This is one reason why a large, monolithic enterprise storage system is usually not a good match for video applications. Typically, video applications will cause such storage systems to reach their bandwidth limitations long before the system is fully populated with storage, making it an inefficient way to buy storage.

Availability

Availability of the disk storage system is another concern because loss of access to shared storage can negatively impact operations. In considering disk storage, there are systems that provide redundant storage options such as mirroring, RAID, easy-to-use fault-tolerant alert information, and the ability to replace any major component while the system is running.

Manageability

In order to minimize resources required and to keep total cost of ownership low, manageability of shared SAN disk storage should be a purchase consideration. Adequate systems provide management tools that centrally manage all of the disk storage systems on the SAN. These tools should have an easy-to-use graphical interface and be run from anywhere in the environment, including remote locations. Additionally, to allow storage system sharing between disparate servers and workstations, the ideal disk storage system should have the capability to set up separate partitions of storage that can be assigned to one or more servers and workstations.

The difference between JBOD storage systems and integrated disk array storage systems with controllers is that many of the disk storage features mentioned above will be required no matter which type of disk system is selected. With a JBOD configuration, most of this is left to various host software products that may not be consistent across the environment, making it very difficult to configure, manage, and maintain the storage system. Complete disk array storage systems with controllers and management software, however, provide a solution that includes these capabilities and allows storage to be consolidated, shared, and easily managed.

Conclusion

Like all new technologies, the SAN market has not yet evolved to the state where individual products are designed to work together without problems. In choosing a storage system, it's best to find tested solutions that are proven to work together.

SAN component flexibility and vendor choice should factor strongly in your decision. There is no single vendor that builds all components of a SAN solution, so it's important to look for solution suppliers who have strong cooperative relationships with other SAN component vendors. Buy from vendors who work together to ensure the interoperability of SAN components and join together to provide customer support.

Consider what is important in configuring the best solution for your storage system needs and extending your SAN for future needs. Seek out vendors who are committed to an open market model as opposed to a provider who limits choices and system flexibility and tries to lock you into a single source. The best choice for meeting current and future needs is a SAN strategy that stresses openness and utilizes cooperative vendors, while keeping future options open and total associated costs at a minimum.

THE AUTHOR

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