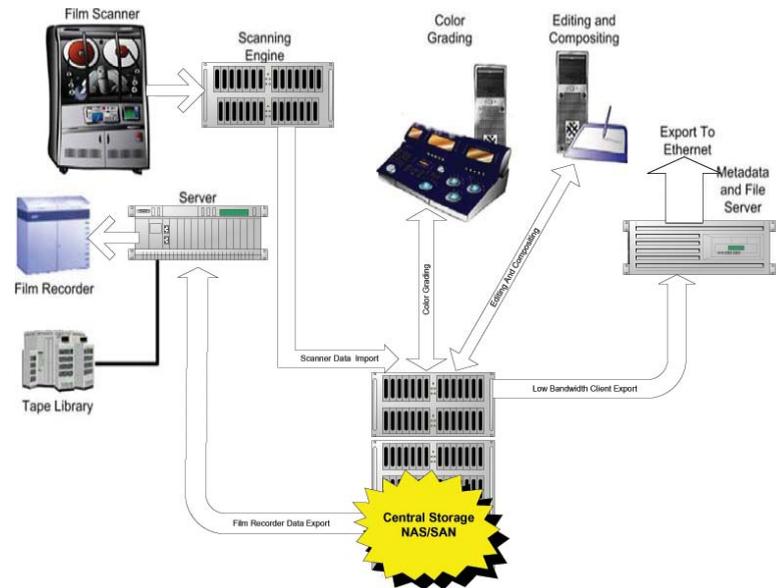




Kushal Shah, Storage Architect



# The Storage Area Network for **DI + Film Facilities**

*Kushal Shah, Storage Architect, in a logical analysis discusses the requirements, and solutions and comparisons between different technology. Studio Systems is highly approving Kushal Shah's article covering all the aspect of storage networking for DI + Film Facilities. A must read for all Studio Systems addicts.*

**W**ith an ever increasing trend to do Digital Intermediate and Visual Effects in Indian Films, requirement for storage area network (SAN) has become a must in every post-Production studio across India. To handle multiple films projects and their different Language versions at the same time almost all major post production studio have upgraded their storage one or another way.

Earlier in the history every film had workflow based negative cutting. Later on it moved to EDL Based Offline editing on NLE systems. Today it's more of Data Centric Workflow where the film negative is scanned and color graded; effects are created, conformed, and finished digitally; then the final is recorded back onto film. The mindset is to move from analog post production to digital post production as first step. This will be followed by film being shot entire digitally and digital cinema for final delivery in theaters.

This approach of creating a data-centric workflow that starts during production and dailies, continues through production

of preview versions of films, and ends with DI and other. Finishing Services appears to be a strategic goal of some of Indian Post Production Studio's in response to changing market forces and rapid technological advances.

## The requirement for Storage Area Network:

There is no Data Centric Workflow without Local or Centralized Storage. However in addition to the sizeable storage support that any DI system requires, the infrastructure for moving data is equally important. Unless you plan to store all your data in one centrally accessible storage.

## The requirement for Data management:

Data management Of Digital Assets is most of the time overlooked in India. It's clearly not a glamorous part, but it might be the most important. Productivity is very much enhanced by ability to manage the digital assets, control multiple versions, and accurately assemble the final film. Any Data Centric Work flow must

have a strong asset-management system. Some facilities abroad have developed proprietary asset-management systems as part of their workflow.

### The requirement to create stable storage environment (why?)

The ideal Storage Area Network should provide a single centralized storage that could, without any interruption of real-time streams, provide enough performance and capacity for all of the ingest, image processing, output and miscellaneous data accesses occurring simultaneously throughout the facility—and do so at an affordable price that provides a compelling return on investment for the facility. If the facility is working on more than one project within the same time frame, it may additionally be necessary to extend the workspace to accommodate multiple projects simultaneously to avoid excessive delays, loading and unloading projects. This extended space might not have to be accessible in real-time, but it must be relatively quick to swap projects in and out of the real time workspace; it would probably therefore also have to be based on disk storage.

### Local or Centralized storage

Historically, the industry has shied away from traditional centralized (SAN-based) storage due to high capital and operational costs with low perceived value over local direct-attached storage. Many customers in this industry view storage as a low-value commodity, which is interesting for an industry that uses the term “asset” to refer to digital content. Fortunately newer SAN storage offerings and the introduction of

low-cost technologies such as high performance NAS and iscsi are changing the buying behaviour of the industry. Centralized storage in a company that creates rich visualizations has some non-obvious operational benefits. When assets are stored centrally they can easily be tracked, monitored, and reused. This leads to improved production efficiencies which leads to shorter production times, meaning that company can deliver projects in a more predictable time frame.

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### The choice of storage Architecture and Technology

#### NAS (Network Attached Storage)

NAS are intelligent storage devices that connect to the standard Local Area Network (LAN). They appear as file server. NAS are attractive because they are usually more affordable and easier to set up than SAN and they use familiar networking technology. NAS has the right price point for this industry, but inexpensive. NAS has inherent stability and performance problems. Traditional NAS vendors cannot provide the bandwidth required. NAS with newer technologies such as 10GB Ethernet and Multi Node PolyServ Clustered NAS Solution have been able to match up with some of performance required for the workflow. This is very easy to setup with most of the operating systems used and doesn't need any heavy con-

figuration on clients side. Extremely useful where heterogeneous Operating Systems are used. Example Windows, IRIX, LINUX & MAC OS. All the Operating Systems can mount Network Attached Storage through built in NFS or CIFS File System clients.

### NAS Hardware

NAS Hardware can be of multiple types with three main categories:

#### Standalone Intel NAS

Which can scale generally not more than a 4-8 Terabytes. Running either Windows or Linux Operating system. Hardware consists of Server Class Xeon Processor with Multi Port Raid Controller with up to 24 SATA Drives and dual Gigabit connection to the network

**Ideal For: Small facilities with low capacity and performance requirements**

#### Specialized NAS:

This can be turnkey single box solution from some vendors like MAXT which is focused towards Media Industry. It has good management features but turns out very expensive and can not be scaled beyond certain capacity or performance. This can work also as DDR for networked play out for your media or it can take digitized data directly from any tape based sources and covert them for File based applications.

**Ideal for: Mid Sized Facility with storage requirement up to 15-20 Terabyte, Integrated Digital Media management + no budgetary constraint**

#### Clustered NAS:

This is right choice if at all you decide to go for NAS instead of SAN. Advantages are for facility where lot of graphics workstations needs to access content from centralized storage at same time data is pumped in from scanner or other ingest sources. This is achieved by Multiple NAS headers able to mount same Storage volume which connects over SAN between NAS headers. It has many features like load balancing between multiple NAS headers.

### Latest Storage Interconnects

10 Gigabit Ethernet  
10 Gigabit Infiniband  
4 GB Fibre Channel

### Latest Hard Drive Interconnects

3 Gigabit SATA/SAS  
4 Gigabit Fibre Channel

**Ideal for: Large facilities with storage requirement of 100-200 Terabytes and has multiple graphic workstations which needs access to DATA. Can also work as hybrid SAN / NAS Combo**

#### **SAN (Storage Area Network)**

If a studio has a rich budget, SAN is the only way to go. Fiber attached SAN connectivity is relatively expensive compared with all other storage attachment methods. Currently every aspect of fiber attached storage is expensive the cables, the adapter cards, the SAN switch equipment, and the fiber SAN storage controllers. At the moment, 2 GB fiber is common with the 4 GB bandwidth just becoming available. SAN can provide much better performance and scalability than NAS but are typically more expensive and more sophisticated because they usually require the deployment of a dedicated and specialized network. A Fiber Channel SAN is a specialized network, separate from the company's Local-Area Network (LAN), and specifically configured to allow servers to communicate with large storage arrays using a connectivity protocol called Fiber Channel. Fiber Channel SANs have the potential to deliver throughputs exceeding 3000MB/sec on distances of 10Km. One of the main drawbacks of SAN is that shared storage is only visible from the servers directly connected to the storage through a switch. When you connect multiple storage SAN, each storage system appears as if its locally attached to the computer and there is huge risk of data corruption caused by the concurrent accesses to the SAN due to many hosts trying to read and write on the same volume and taking ownership of the volume. To avoid this Shared San File system needs to be deployed with decisions on who would play role of traffic Police, decide File Level, the read and write permission on shared volume. Shared file systems are cross- platform software packages that support distributed clients and applications running on different operating systems and share the same storage. Shared file systems also provide a single, centralized point of access control for managing files and databases, which can help lower total

#### **List of Currently Shared San File System's in Studio Environment**

SGI CXFS (WINDOWS, IRIX, LINUX, MACOS)

ADIC STORENEXTFS (WINDOWS, IRIX, LINUX)

Tiger Technology MetaSan (WINDOWS, LINUX, MACOS)

costs by simplifying administration.

#### **Issues in SAN Hardware**

In a hardware-based RAID, as the number of concurrent users increases, the stripe group must be increased to meet the total bandwidth demand and not drop frames. High resolution files require

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significant increases in bandwidth for each additional user forcing RAID expansion. As stripe groups increase, it becomes increasingly difficult to maintain data synchronization, calculate parity, drive ports, and maintain data integrity. When concurrent high-resolution content users must rely on large file-based RAIDs and large network switches, performance is difficult to maintain and infrastructure problems arise. Spindle contention becomes an issue when multiple users request the same content within a stripe group; available bandwidth is reduced, variable latencies are created and the file system cannot deliver frame content accurately. If a RAID storage system becomes more than 50% full, content data fragments over time,

storage performance drops, and users lose bandwidth. These infrastructure issues must be resolved before users can take full advantage of shared file systems in a high resolution digital environment.

#### **Choice of SAN Hardware**

**Choosing** SAN Hardware can be a very tricky question due to a vast range of products available in the Indian market. These products mainly differentiate in three categories.

#### **1) Integrated Turnkey solution from your Application Vendor (Discreet, Apple)**

##### **Pros:**

This is best possible solution if you have most of the same vendor's application systems in your network. It's very easy to implement and integrate due to a single vendor solution.

##### **Cons:**

Every Best possible solution comes at a Heavy Price point. Due to its closed nature to work in single vendor solution implementing such storage in multi vendor environment can cause lot of performance and compatibility issues

#### **2) Tailor made storage specifically made for DI & Film Studios**

(Bright systems, Data Direct networks, Iqstor, MAX-T, Axus, Medea, Ciprico)

##### **Pros:**

This is a best solution for studios with multi-vendor setup and limited budget.

Some of the vendors mentioned above have best capacity and performance optimized systems. If you are building 100 + Terabyte storage in your facility then this would be your only alternative. Newest technology like 4 GB Fiber Channel and 10 GB Infiniband will be found in these products.

##### **Cons:**

Integration into your existing setup can be difficult due to non certification from your application vendor.

#### **3) General purpose storage from generic Storage vendors (Branded and Non Branded)**

##### **Pros:**

If you are buying other systems from generic storage vendors you may get storage at cheap price.

### Cons:

Generic storage vendors do not have required expertise to design and build storage for DI + Film facilities. While some of the vendors offer very fast storage but they lack basic performance requirements from initial design of the product. This generic storage is optimized for large number of small files with Random I/O while our workflow requires small number of large files with Sequential I/O.

### Hybrid SAN / NAS

One of the leading ways to achieve best of both storage environments is to create hybrid environment for different types of performance levels required in a Studio Environment.

Example your scanner will need SAN to scan at best possible speed, however it's not necessary to connect your Recorder to SAN as it doesn't need that much speed for accessing the data. In such situations keeping a price moderate, low bandwidth or different operating system,

clients can be connected to NAS which is also a (client) of Shared File System on centralized Fiber Channel Storage

### ● Sizing your storage area network for Capacity and Performance

Sizing the capacity is fairly straightforward. At a real-time rate of ~300MB/s, one hour of content requires about 1.1 TB of storage capacity. For real-time content, eight or ten hours of 2K are probably the very minimum amount of storage necessary to manage even a single project. Unfortunately, eight or ten hours of content is rarely enough, and real-time networked storage that uses Fiber-Channel disks (the highest-performance, most reliable disk technology) is the most costly per TB of available disk technologies.

An answer to augment the "First Tier" of real-time storage is to add a second tier of more cost-effective "Near On-Line Storage", generally using Serial-ATA (SATA) disks. Content that no longer requires real-time streaming may be migrated to the

Near On-Line Storage for more asynchronous activities - such as render farm processing, printed out to film, or tape back up. The Near On-Line storage can also be used as a temporary buffer to free up storage space on the real-time storage in the case of schedule changes, conflicts, etc. Near On-Line storage in a DI environment typically starts at 10 or 20 TB and can easily scale to the 100 TB range, at a very attractive costs per Terabyte.

Many manufactures offer hardware and software components for the DI process, but no company offers affordable turnkey solution. To date, in actuality, most post facilities design their own custom systems to suit their specific workflow requirements and integrate with existing hardware. Each of them uses different combinations of well-known industry hardware and proprietary tools and techniques. **SS**

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