

# Storage Technology Drives Visualization Advances

***Immersive environments combine with high-performance storage systems to raise E&P productivity and reduce costs***

## **Introduction**

Volatile economics and competitive pressures push exploration and production (E&P) professionals to find, manage and recover hydrocarbons ever more profitably. Immersive visualization environments (IVEs) help accomplish this mission, as one scientist says, “by connecting head and gut more effectively than anything else around.”

Immersive environments let users visualize earth volumes with an unprecedented sense of reality. This sense helps users combine their expertise and experience with intuition to guide make-or-break business decisions — determining which prospects to lease, where to drill, how to best exploit reservoirs and how to gain advantage with industry partners. IVEs also help E&P professionals from different disciplines collaborate more effectively, further improving decision support.

Recent technologies are making IVEs more flexible and cost-effective than in the past. For example, E&P companies are reducing cost and increasing geoscience productivity by linking IVEs to storage area networks (SANs) and placing higher-performance storage systems on these networks.

As a result, scientists and engineers can pool their expertise more readily to pursue multidisciplinary studies, migrate more quickly from project to project, and increase intuitive ability by better utilizing all seismic, reservoir and attribute data available on target volumes.

The E&P industry has gradually begun adopting SANs and high-performance storage systems to achieve these goals. In fact, early adopters have gained such significant advantage, they've been keeping their success under wraps to prolong this competitive edge.

## Background

IVEs increase geoscientific understanding and intuition by immersing users into increasingly rich data comprising larger earth volumes. These volumes are represented as visual displays on the walls, and sometimes the ceiling and floor, of a room designed for this purpose. Users gain the sense that they are walking or flying through the earth. Increasingly, IVEs heighten this effect with stereoscopic (3D) displays. An immersive environment enables groups of geoscientists and engineers to study and refine interpretations, sharing ideas and observations as the subsurface appears to change around them in real time. “Our ideal is to get everyone in the same room,” says an exploration manager. “Geologist, geophysicist, petrophysicist, reservoir engineer, whoever is needed.”

Teams can evaluate prospects and plan recovery by better understanding how seismic response relates to attributes such as reservoir rock and pore fluid properties. Superior recommendations for drilling and reservoir management can result. For instance, teams can also identify problems earlier in the design cycle to reduce drilling risks and enhance recovery.

Behind the scenes, a multiprocessing computer runs the required software; fast, high-capacity input/output (I/O) channels — “big pipes” — deliver huge amounts of data to multiple projection screens dozens of times per second; and high capacity disk holds and retrieves the data.

## Challenge

Today’s increasingly data-rich, dynamic, realistic IVE displays demand that disk systems randomly retrieve billions of bits per second to be pumped onto room-size screens. It’s a tall order. Displaying “4D” (time lapse) seismic intensifies this demand.

Conventional disk systems can’t keep pace. They retrieve information too slowly to feed the most data-hungry displays. Smooth, real-time display of earth volumes is interrupted, shaking up users’ mental focus and diminishing their gut-level grasp of the target.

In response, companies are utilizing high-performance storage systems that retrieves data 400 to 500 percent faster than conventional RAID-type storage. At the same time, they are deploying high speed, Fibre Channel-based SANs.

Why SANs? Why not connect high performance storage systems directly to immersive environments? Because utilizing local disk of any sort creates workflow bottlenecks that limit IVE flexibility, especially when multiple teams each work on multiple projects.

Problem is, large data sets still must be loaded on disk and unloaded to perform immersive visualization on various projects, consuming substantial time and effort. The more data that users require per project and per visualization session, the more quickly local disk capacity becomes an unacceptable constraint.

This bottleneck tightens with increasing use of 4D seismic to optimize recovery in producing reservoirs. A fully processed 3D reservoir “snapshot” may occupy 50 gigabytes on disk. To study five sequential snapshots in an immersive environment — observing how reservoir characteristics change as recovery progresses — can demand more than 200 gigabytes of stored data.

It’s not practical or cost-effective to keep all active projects on local disk for IVE use. Stacked seismic, plus related subsurface data, can range in quantity to dozens of terabytes for all projects combined. At large companies, pre-stack seismic — increasingly used for reprocessing to refine interpretations — can boost storage requirements to hundreds of terabytes.

## Solution

High-performance storage systems — intensive data demands can overwhelm conventional storage systems. That’s because IVE processors often must poll conventional disk multiple times for each data request until the storage system responds. Repeated polling wastes CPU cycles, in some cases bogging down processors and causing noticeable lags on immersive displays.

High-performance disk, unlike conventional disk typically requires just a single CPU cycle to retrieve requested data. Information is pumped out through processors and onto displays as fast as the processors request it. This lets immersive environments to do what they're supposed to do: give users the most intuitive experience of 3D/4D seismic and related subsurface data.

Storage area networks — Although high performance disk may be configured locally for an IVE, it's more productive to give users quick access to all active projects from central storage facilities. Also, a SAN makes it extremely cost-effective to have other users share this centralized data, simplifying data management and reducing costs.

SANs operate very fast, with “big pipes” to handle large data sets. They use Fibre Channel and fabric-type electronic switching technology to let multiple users share multiple storage systems. And they're flexible: administrators can do “dynamic resource allocation,” readily allocating to each user as much or as little storage capacity as needed from disks populating the storage network. Because a SAN accesses terabytes of project data yet emulates local disk, there's no local loading and unloading required. IVE workflow bottlenecks disappear.

“With high-performance storage residing on our storage area network,” says an E&P data administrator, “our immersion system can reach out and grab all the data it needs. On moment's notice, we can display any project in real time. It's a tremendous advantage.”

A geophysicist concurs: “It doesn't matter which prospect or field we're focused on today,” he says. “It doesn't matter if our schedule gets scrambled or priorities change or a visiting specialist is held up at Gatwick. All projects are right there whenever we need to display them. The speed is fantastic.”

## Business Benefits

The business case for connecting immersive environments to high-performance disk on SANs is compelling. Benefits include:

- **Avoided costs.** There's no longer a need to increase capacity of local disk to serve the increasing requirements of an IVE or other users of project data. Further, local disk can be redeployed, either by further populating the SAN or reallocating the disk to an alternative use. Obsolete storage systems can simply be turned off, eliminating maintenance and other ongoing ownership costs.
- **Reduced costs.** Centralizing data storage on a SAN lets system administrators and E&P data administrators work much more efficiently, increasing productivity. With project data more readily available, geoscientists and engineers can also work more flexibly and efficiently, further reducing costs.
- **Improved decisions.** Highly available data lets teams address projects with more intensive study and more iterations accomplished before deadline, improving E&P decision-making. Alternatively, more projects can be addressed within a given period of time. Either way, the IVE's ability to enhance understanding and intuition is more fully utilized, adding value to the enterprise and increasing return on investment.

Placing high performance storage systems on a company's local area network (LAN) can yield benefits by itself. But deploying a SAN adds to the speed advantage.

Also, burdening a conventional LAN with rapid transfer of multi-gigabyte seismic data sets can bog down traffic for everyone on the network — potentially hundreds or thousands of users. It's like asking the family sedan to haul truckloads and, at the same time, leave room for passengers. By contrast, storage area networks have the speed and capacity to readily handle enormous transfers without bogging down — and without clogging the company's main data highways, its LANs.

Other benefits follow. SANs give all connected devices equal access to E&P data sets. Data doesn't have

## application**brief**

to be cloned onto local systems, then re-synchronized with enterprise-level files after being modified. Many version control problems are eliminated, simplifying data administration and easing the “data chase” that can sap the productivity of E&P professionals.

All data sets remain readily available to all authorized users. E&P groups can leap on new projects or revive old ones with much greater speed and flexibility, improving leverage with industry partners and increasing competitiveness across the board.

## Conclusion

Exploration and asset management decisions are best guided by recommendations from geoscientists and engineers who have a strong intuitive grasp of the subsurface target zone. Immersive visualization environments strengthen links between intellect and geoscientific intuition while enabling asset teams to refine interpretations and share ideas in interactive group settings.

E&P companies gain the full power of immersive environments only when these environments are supported by high-performance storage systems residing on storage area networks. This combination optimizes interaction and the flow of ideas to improve business decisions while reducing and eliminating significant costs of ownership, thereby returning maximum value to the enterprise.

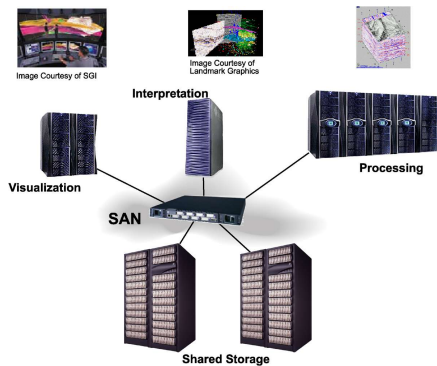


Figure 1. High performance MetaStor systems from LSI Logic Storage in a (SAN) give users equal access to all E&P project data, improve productivity by reducing the “data chase”, ease data administration and make immersive visualization environments more flexible and effective.

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