

## AMD64 Technology: A Superior Foundation for Storage System Designs

---

### EXECUTIVE OVERVIEW

Storage has become a fundamental part of the enterprise datacenter. Enterprises are charged with maintaining an ever-growing amount of data, while users expect to access their content anytime and increasingly, from almost anywhere. From governmental compliance records, financial information and customer databases to individual employees' work stored on shared servers, today's businesses – whether they are enterprise class or small to medium sized - must have secure, reliable and easily accessible data storage.

With this increased pressure to effectively manage stored information and the growing diversity of customers requiring storage systems, OEMs are tasked with providing differentiated solutions. And there are technology-based market shifts in play that also impact how OEMs must innovate to meet this changing market. This paper will examine the new and diverging factors driving storage system development. It will also examine how AMD64 technology, the fastest growing computing platform for the enterprise data center, can lend processor-level innovations that help storage vendors deliver optimum systems for their customers.

### Market Shifts – Different Types of Storage Systems are Emerging

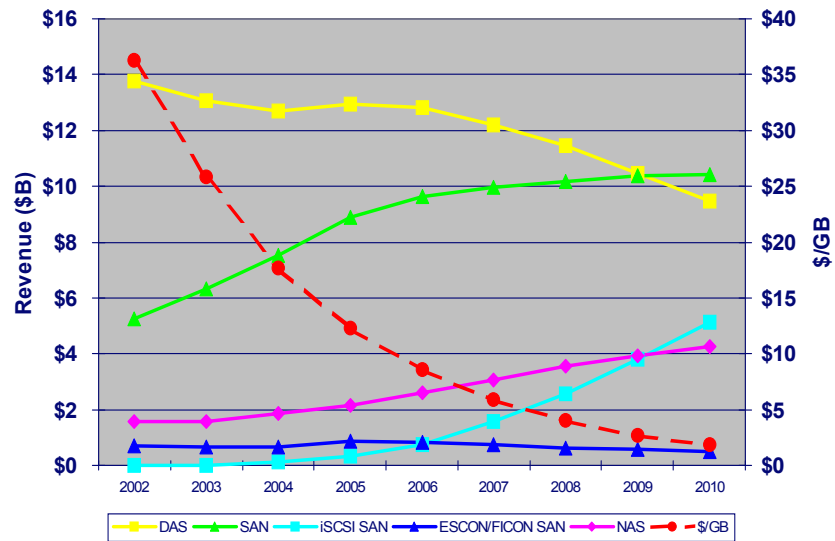
While there is increasing demand for storage, some vendors are seeing a decline in the average selling price for both internal and external storage systems. This is due to a number of factors including:

- A continuing drop in the cost per Gigabyte of storage
- The increasing availability of “entry-level” storage systems
- The cost effectiveness of archiving to disks instead of tape, where disk-based machines are less expensive than the legacy tape-based systems.

In fact, IDC, a leading information technology research firm, forecasts a growing demand for raw storage capacity and stated in its May 2006 forecast for

disk storage systems that networked storage capacity purchased by organizations will increase at a compound annual growth rate of 63% between 2005 and 2010.\* Their market data clearly shows a decrease in tape-based storage, while lower cost disk storage shows steady growth.

IDC Revenue Forecast by Installation Environment\*



SANs are based on the concept of taking storage devices, and therefore storage traffic, off the LAN and creating a separate back-end network designed specifically for data. These are high performance systems that are block I/O based and run demanding database applications such as Oracle and SQL. SANs are optimized using Fibre Channel (FC) host bus adapters (HBAs) for networking and storage connectivity.

There is another general evolution taking place as storage systems move away from internal access storage, where the storage device is connected internally to the host server. The shift is favoring network attached storage or “NAS”: a server attached to a LAN with an IP address and connected to hard disks and storage area networks or “SAN”: storage appliances connected to each other through Fibre Channel and to one or more servers which act as an access point.

One emerging trend is IP SAN – storage appliances connected to one another using IP, rather than Fibre Channel. While there is a pro/con situation between Fibre Channel and IP in terms of reliability (FC is generally viewed as a more reliable choice) and cost (IP is far less expensive to implement), each type of SAN is meeting the needs of particular customers and making use of the corporate network.

NAS appliances are also gaining ground. They are very cost effective and offer simple expandability—from adding one disk for a small workgroup, to terabytes of disk space for large enterprises.

This crossover from a market dominated by large, stand-alone, mainframe-type systems to a system landscape that looks more like common data cen-

**Monolithic storage.** Most large entities could not operate without a tried and true method of storing mission-critical data, using either storage systems attached to Storage Area Networks (SANs) or Network Attached Storage (NAS) systems. These types of systems are often called monolithic storage and deliver high performance and reliability to support mission critical applications.

**Modular storage:** These systems represent the largest and fastest growing set of storage systems shipped today.\* It is in this class of storage systems where vendors are incorporating low cost/high capacity disk technologies to support disk-based back-up and long term active data archiving. Modular storage is used in both large enterprises and small to medium-sized businesses for everything from email to databases and customer files.

**Specialty storage:** Also called "server-like" storage, companies buy specialized storage systems or appliances for specific applications or to address a unique scenario. This can include medical records archiving, Sarbanes Oxley compliance, simple back up of other storage systems, remote office data management, etc.

ter servers has **consequential system design impact and opportunity.**

The economic move toward commercial-off-the-shelf (COTS) platforms, including industry-standard x86 hardware and software, allows vendors to reduce system development costs. At the same time, it allows faster time-to-market than proprietary platform development. Using an industry standard base also allows system designers to focus on customer-specific differentiation or the OEM to concentrate on development of storage-specific applications. For example, while Windows® is now the predominant operating system for storage computing, with a 64% installed base, specialty software applications and I/O development is on the rise.

X86-based, server-like storage on the network also better accommodates the usage shift in the market, where it is no longer enough to simply archive data. The growing use of storage in everyday business must now account for both easy storage and easy retrieval, rather than simply filing information away for safe keeping. Growing numbers of businesses feel this scenario can best be accomplished by use of the corporate network and the industry-standard x86 architecture that is the building block of most networks.

### Common Performance Requirements

In the storage market today, there are at least three broad categories of systems and their basic uses. And while these distinct uses and needs in storage are leading to more varied systems on the market, in general, all of today's storage systems have basic and common performance requirements.

At the data center level, systems must demonstrate extreme reliability, scalability, and offer ease of implementation and management.

At the system level, there are two critical performance requirements: data throughput (which includes I/O bandwidth and reduced system bottlenecks) and memory performance measured by capacity, accessibility and low latency.

AMD has demonstrated its customer orientation and quality, in meeting the needs of the data center. Today, 90 percent of the top 100 and more than 55 percent of the top 500 of the Forbes Global 2000 companies or their subsidiaries are currently using AMD64 technology-based systems to run their mission critical applications.

Beyond being an efficient choice for the enterprise at large, the key for AMD customers developing and deploying storage solutions is the system level performance that AMD64 processors offer:

AMD partners with leading ODMs, OEMs, networking and storage hardware providers, and software providers to enable the complete storage ecosystem:

Processors: AMD64 family of processors, including a subset with available 5 year longevity

Chipsets: HyperTransport™ technology I/O-based chipsets

Platform standards to build storage infrastructure:

Storage: Fibre Channel, SCSI, SATA, SAS

Network: Ethernet (GigE, 10GigE), InfiniBand

Switches: PCIe™, Fibre Channel, HyperTransport technology

Software: MS Storage Server, Linux®, NetBSD

Storage Systems: DAS, NAS, SAN, IP SAN, Unified Storage

- Industry-leading bandwidth and I/O throughput with HyperTransport™ technology
  - *Each AMD Opteron™ processor offers up to three coherent HyperTransport technology links providing up to 24.0 GB/s peak bandwidth per processor*
- Direct Connect Architecture enables expansion and customizations, including an opportunity for direct attached FPGAs or co-processors
- Integrated DDR2 DRAM Memory Controller on-die offers available memory bandwidth up to 10.7 GB/s (with DDR2-667) per processor
- Board- and system-level scalability with single- to multi-cores in 1- to 8-way multi-processor systems
  - *Increase computing capacity without altering datacenter infrastructure*
  - *Top-to-bottom processor choice from ultra high-end enterprise class processors to mid-range to value*
- An industry standard architecture that enables mix and match of hardware and software on a single platform
  - *32- and 64-bit application support*
  - *Extensive x86 ecosystem optimized for AMD64, including OSs, virtualization solutions, chipsets, motherboards, etc.*

### Storage-specific Technologies

Underlying the common performance requirements, the surge in demand from varied customers means there is also a growing number of market-specific technology options that storage vendors must evaluate:

- Chipset options with extensive I/O including 10GigE, SATA, SAS, etc.
- Connectivity options including industry standards like Ethernet, Fibre Channel, InfiniBand, SCSI, SATA, SAS, and others
- Hardware fail-over solutions
- Storage-specific operating systems and middleware
- Market-specific applications such as disaster recovery, archiving, provisioning, SNAP and replication hardware/software.

AMD can uniquely address these storage-specific technology requirements through an extensive, cultivated ecosystem of partners whose chipset, motherboard, peripheral, and software solutions are optimized for AMD64 processors. By adding the high compute performance of an AMD64 processor with the other hardware and software components required for an overall storage system, vendors have an opportunity to give their customers a top notch system – one that is tuned at every level of the system for a particular storage need.

Support for standard server and storage virtualization – a high-growth trend in commercial markets – ensures that AMD64-based solutions will be ready to implement the next wave of computing efficiency. Similarly, the next gen-

One well-regarded participant in the AMD64 ecosystem, **Xilinx**, sees FPGAs as a key differentiator in the SAN market:

“Established companies and venture-funded startups see software services as a key enabler for SAN products. Solutions that require deep data inspection, such as security and storage appliances, firewalls, XML processors, and web-load balancers are an ideal choice for FPGAs or FPGA co-processing solutions.”

AMD's **Torrenza** initiative allows a myriad of players in the x86 computing world to take advantage of the open AMD64 platform and directly attach FPGAs or other co-processing solutions to industry-leading CPU's

eration of security and encryption enhancements will likely rely on extreme amounts of bandwidth unencumbered by system bottlenecks and a high-performance processor that can handle massive network traffic.

AMD's Torrenza initiative will further drive innovation, customization and collaboration in storage building. The AMD64 computing platform opens doors to unique, easy-to-implement features, where customers can be more in charge of tailoring their technology.

## CONCLUSION

An overall storage strategy based on AMD64 technology can help unify the enterprise (mobile, desktop, workstation, server, storage, security, telecom) on a single, easy to scale, easy to manage, high-reliability platform and can decrease power consumption and associated costs while providing scalability to meet the needs of the business.

As the market expands in multiple directions, the simple approach to storage systems is to apply server-based products, with special storage-specific operating systems, applications software, and enhanced I/O (such as Fibre Channel, SAS/SATA, 10 GigE) for NAS filers, SAN block-based storage, IP SAN, or NAS gateways.

The efficiency and flexibility of AMD64 technology, already a proven asset in the enterprise data center, provides an architecturally superior foundation delivering on performance requirements of the storage market. At the same time, AMD64 has features that make it easy for vendors to offer differentiated solutions and to do so in a time efficient manner, getting products to market quickly. AMD's solid computing performance based on a platform that favors customization can allow vendors to streamline the development of a broad product line - from various types of storage systems to their standard server and even client-level workstation, desktop and mobile products for the commercial market.

*\*IDC Study: Worldwide Disk Storage Systems 2006-2010 Forecast and Analysis: Expansion, Efficiency, and Economics Driving Growth May 2006 Doc #201596 and IDC's Worldwide Quarterly Disk Storage Systems Tracker, August 2006.*



**Advanced Micro Devices**  
One AMD Place  
P.O. Box 3453  
Sunnyvale, CA 94088-3453  
www.amd.com