5 Reaping Value from Storage Networks

The competitive business climate demands increasing data storage capabilities ranging from availability and recovery, to capacity management, to vendor aggregation. Multiprotocol storage networks serve all of these requirements in the form of block-based SANs or file-based NAS. As an enabling platform, networked storage naturally assumes a greater role in the cost and control of the overall storage infrastructure. Chapter 4, "Storage System Control Points," covered the control aspects of the storage fabric, outlining the areas of intelligence for storage services and the importance of balancing the fabric layer with the host and subsystems layer. This chapter covers the cost component of the storage networking layer by looking at the strategic reasons to combine both defensive and offensive measures and the value achieved by doing so across a common networking platform.

The Internet took the world by storm. The mad dash to put anything and everything digital onto a single network, whether for educational, government, commercial, or experimental reasons, led to data storage requirements and capacity not previously anticipated. Today, many commercial elements of the Internet have reworked business models and adjusted storage capacity requirements. Have you noticed all of the storage capacity restrictions on "free" Web site services, such as online photo sharing and Web-email boxes? Have you noticed how many times you are offered a chance to "upgrade" to the monthly fee option with more storage? Managing storage on the Internet, or for that matter, on any networked environment, includes capital and operational costs that hit the bottom line.

In industries where storage availability and protection drive revenue-generating businesses, the networked storage budget grows as a function of the overall operating budget. To harness these costs and drive ongoing returns from the investment, companies must broaden the metrics for measuring returns. This comes through merging defensive strategies like data protection with offensive strategies like platform consolidation.

5.1 Balancing Offensive and Defensive Strategies

The race to digitized information, which requires 100 percent uptime guarantees, coupled with the world political climate, has driven the role of defensive storage strategies in almost every medium to large corporation. Data storage availability and protection have become the hot topics of the last five years, serving to keep applications up and running, and to restore capabilities at hand if needed in the event of a site disaster. From a budgetary process, these requirements often fly through approval processes compared to other requests. Few executives are willing to tolerate the costs associated with downtime for e-commerce-related business or the costs of losing critical business information that cannot be recovered.

Given this preoccupation with data protection, the build-outs in many organizations have focused on these defensive approaches. Networked storage environments, as the very backbone of data availability and protection mechanisms, are often categorized under this umbrella. In many cases, this provides for adequate project justification. But companies that consider only a defensive approach to storage networking cannot reap the full benefits provided by this infrastructure.

Offensive strategies for storage networking fit hand in hand with defensive strategies but also further maximize the value of a networked storage environment. By looking beyond traditional concepts of data protection to entirely new methods for handling storage, offensive strategies help companies "change the game" and uncover opportunities for operational agility and flexibility that directly impact both capital and operational costs. The primary advantage of a dual-pronged approach to SAN deployment is that the underlying principals of the networked storage environment are similar across both strategies. For example, the same SAN plumbing used to facilitate more efficient backup operations also fits effectively within the larger context of corporate networking, particularly with the flexibility of IP SANs.

Offensive and defensive strategies often overlap. Depending on individual corporate planning processes, the lines between offensive and defensive approaches may vary. Even with a potential gray zone between strategies, the model helps IT professionals evaluate options beyond those traditionally considered for SANs. Figure 5–1 outlines some general distinctions between offensive and defensive strategies.

Defensive Strategies	Offensive Strategies
• Risk management	• Operational agility and flexibility
• Short-term cost savings	• Medium - to long-term cost savings
• Focus on current assets	• Focus on current and future assets
• Conventional platforms	• Emerging platforms
• Data Preservation	• Enhance enterprise market position

Figure 5–1 Comparing defensive and offensive storage networking strategies.

With defensive strategies, cost savings frequently relate to short-term objectives, typically the greatest pain points in the process. For example, a company unable to complete regular backups due to excessively long backup windows may adopt a SAN to alleviate the problem. In the race to solve such pressing issues, other considerations may be left out of the picture. For example, will the backup solution also help with storage consolidation? Is it replicable at other offices and locations? Does it fit with requirements for off-site storage in addition to simply reducing the backup window? These questions generally fall into medium- and long-term savings categories associated with offensive strategies.

Asset focus also differs between approaches. The defensive approach focuses on maximizing the use of existing assets, such as extending the life of a tape library by sharing it across multiple servers or using storage resource management to help grab additional capacity from inefficiently used RAID devices. The offensive approach looks at both current and future assets, such as what devices are likely to be part of the infrastructure over time, how they will be managed, and what the best options are for building an infrastructure to accommodate them. For example, balancing a combination of current block-accessed SAN devices with new file-accessed NAS devices requires a platform consolidation approach that is best achieved with a common networking infrastructure such as Ethernet and IP.

Platform choice differs between offensive and defensive approaches. Defensive strategies lean towards conventional platforms, taking incremental moves towards SAN deployment. The typical scenario is a company that has several Fibre Channel servers with DAS devices that moves towards a Fibre Channel SAN. While this deployment will provide SAN benefits, such as higher availability and more efficient backup operations, it still leaves gaps for solutions such as remote backups and integration with NAS. An offensive approach would be to move towards an IP storage network. This leapfrog step provides all the benefits of a SAN, but also gives the ability to keep all the Fibre Channel servers and storage devices with a SAN primarily based on IP networking. While IP as a SAN platform may fall in to the "emerging" category in the storage world, IP and Ethernet have longstanding maturity and robustness from decades of use in the networking world.

5.1.1 Risk and Total Cost of Ownership

Along the lines of comparing deployment approaches, another view of offensive and defensive strategies looks at overall storage growth affecting risk and total cost of ownership (TCO). The proliferation of data storage capacity coupled with the corporate requirements to maintain effective storage management increases both risk and TCO. From a risk perspective, the increase in the amount of data translates into exposure to potential loss. For example, companies relying on customer databases to deliver products and services face potential revenue loss if that information is lost or becomes unavailable. The primary concern for that operation is data protection and availability to reduce the amount of risk.

Increases in the total amount of storage also drive up the TCO. TCO typically includes the capital equipment acquisition costs plus the operational costs over a fixed time period. Companies that try to maintain traditional storage architectures, such as DAS, in the face of ballooning capacity requirements quickly find themselves in a never-ending race to add more storage to more servers while watching management and administration costs skyrocket. In this case, storage network deployment facilitates more rapid expansion of new storage capacity without directly impacting individual server or application operation. With the flexibility of a networked infrastructure in place, total costs decline.

Figure 5–2 shows the effects of storage growth on risk and TCO. In both cases, storage networking strategies—offensive and defensive—help corporations mitigate these effects.

The clear distinction between the approaches is used primarily as a thought framework for the chapter. Certainly, there are defensive approaches that reduce TCO and offensive approaches that reduce risk. However, by separating these two driving forces, IT professionals can more effectively position the project justification and return on the investment when considering storage networking deployment.

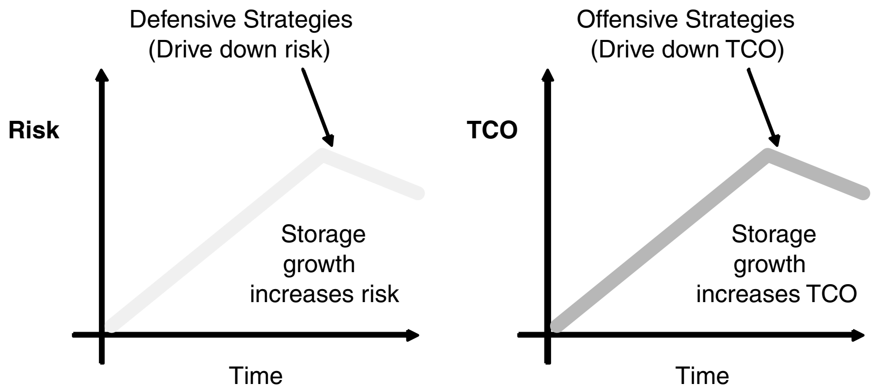

Figure 5–2 Storage growth increases risk and total cost of ownership.

5.2 Primary Defensive Strategies

This section covers several defensive approaches to networked storage. The objective is to show how the inclusion of a network topology for storage facilitates cost savings and return on investment, primarily from the standpoint of minimizing risk. In the case of defensive strategies, we define risk both in terms of potential data loss as well as the financial and human capital risk associated with managing storage, specifically budget reduction risk and reliance on storage administrators. Defensive approaches to network storage are part of an optimized storage deployment foundation, yet in isolation cannot provide the full benefits for long-term strategic deployment. The defensive approaches covered here also lead to the additional returns of offensive approaches in the following section.

5.2.1 Data Availability

High-availability SAN topologies reduce downtime for mission-critical applications by providing fully redundant paths between server-based applications and storage. For fully redundant configurations, dual paths ensure that loss of equipment or a network connection will not affect operation of the system or application uptime. With DAS, the simplicity of the connection made achieving redundancy straightforward. On the server side, redundant host bus adapters (HBAs) could be connected to dual cables leading to dual controller ports on the storage device. Since servers and storage devices typically reside within the data center, and more frequently within one or two adjacently located racks, the risks involved with connection loss are minimal.

Introducing a network to the architecture quickly doubles the number of interconnects between servers and storage, and requires more careful attention to the deployment of redundant paths. Let's take the case of a simple SAN, as shown in Figure 5–3. In this example, each server has dual HBAs that each connect to a separate SAN switch. Similarly, each storage device has dual controller ports that also connect to separate SAN switches. By zoning primary and alternate paths between the servers and storage devices, any failure in a server, HBA, SAN switch, or storage device can be overcome by using the alternate redundant equipment. There is no single point of failure in the architecture, which thereby enables maximum uptime for mission-critical server applications, keeping them running and generating revenue around the clock.

Once in place, the basic storage network infrastructure can be easily expanded beyond a couple of switches to incorporate dozens of switches around a central core. In the case of Fibre Channel SANs, director-class switches with up to hundreds of ports are deployed in the core. These directors provide high-availability features such as hot-swappable power supplies and cooling systems, redundant control processors, interchangeable modules for a variety of interconnects, and capabilities for nondisruptive firmware upgrades. They also support features to create large, scalable fabrics such as zoning, trunking, and end-to-end configuration of the storage network. The overall design of large director-class switches addresses unplanned downtime through these high-availability features. Additional serviceability features, such as redundant memory for firmware images, and a variety of diagnostics tools to monitor the health and operation of the SAN guarantee the maximum amount of uptime for the overall configuration.

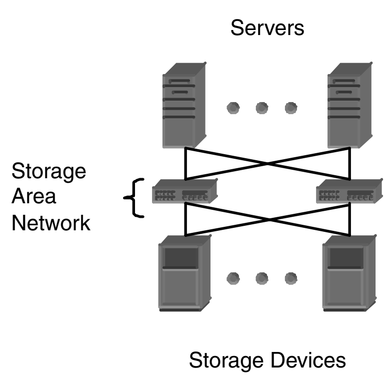

Figure 5–3 Data availability through redundant paths in a simple SAN.

Figure 5–4 shows the deployment of two director-class switches at the core of the storage network. These could be Fibre Channel directors, the more conventional approach to designing SANs. Gigabit Ethernet switches also could be used that support similar features of Fibre Channel directors, but do so using the mature platform of Ethernet and IP. This type of IP core fabric deployment is covered in the offensive strategies section on this chapter.

Similar to the simple diagram in Figure 5–2, redundant directors ensure that any server has access to any storage device regardless of equipment failure within the configuration. Multiple directors can be trunked together using 1-Gbps or 2-Gbps Fibre Channel. Alternatively, higher-speed connections such as new 4-Gbps or 10-Gbps Fibre Channel could be used for greater performance.

The previous examples covered data availability primarily from a local topology. Today's enterprises require availability that spans more than one geographic location. Fortunately, the network storage platform lends itself to such configurations, as outlined in the following sections.

5.2.2 Availability and Protection with Remote SAN Topologies

Today's around-the-clock business environment demands guaranteed data availability and protection that cannot be offered in single-site solutions. The potential for site disruption, natural or unnatural, requires that all organizations maintain remote site configurations of their mission-critical storage and applications. Once in a networked configuration, storage can be easily extended to remote sites. In the case of a pure Fibre Channel network, remote sites can be up to 10Km away with dedicated Fibre Channel connections or up to 100Km with dedicated fiber-optic extensions such as Dense

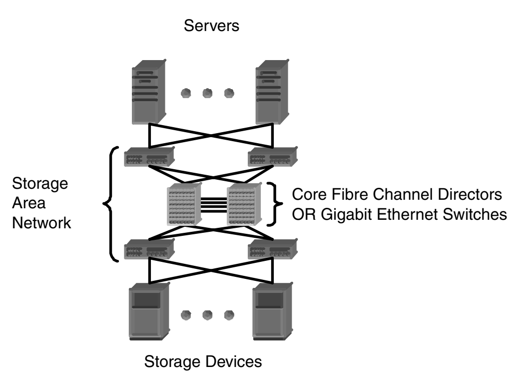

Figure 5–4 High availability through director-class switches and scalable fabrics.

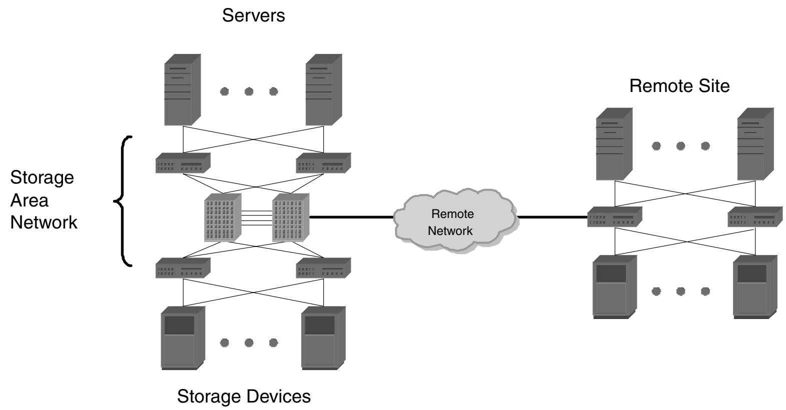

Figure 5–5 Incorporating remote sites to storage networks.

Wave Division Multiplexing (DWDM). With IP networks, SANs can be extended to virtually unlimited distances. Figure 5–5 illustrates a sample remote storage configuration.

Through the use of clustering and storage mirroring software, the remote site serves as a guaranteed backup in the event that the primary site becomes unavailable. Applications can continue to run, and customers can continue to be served, thus avoiding costly downtime. These are the primary drivers for remote storage configurations today, which frequently fall into the disaster recovery category. However, this incomplete picture leads corporations to lose additional SAN value in not fully realizing the power of the networked platform. Recognizing that availability and protection are only first steps to optimized deployment, companies can achieve greater returns on their storage investment and benefit from longer term strategic savings. This chapter covers these options under offensive strategies.

5.2.3 Data Availability and Remote Site Storage User Diagram

Figure 5–6 shows a sample configuration where IP switches are used to create a highly available core, and a remote site is connected directly to that core via an IP network. Centralization on an IP platform allows users to consolidate network technologies across local and remote topologies.

5.2.4 Budget Reduction and Human Capital Protection

Defensive strategies go beyond data risk to address the business risks of dealing with limited budgets and constraints on human capital, specifically trained storage professionals. Almost every IT manager struggles with the "do more with less" mandate permeating corporate landscapes. But not every department has exponential storage growth requirements like the IT

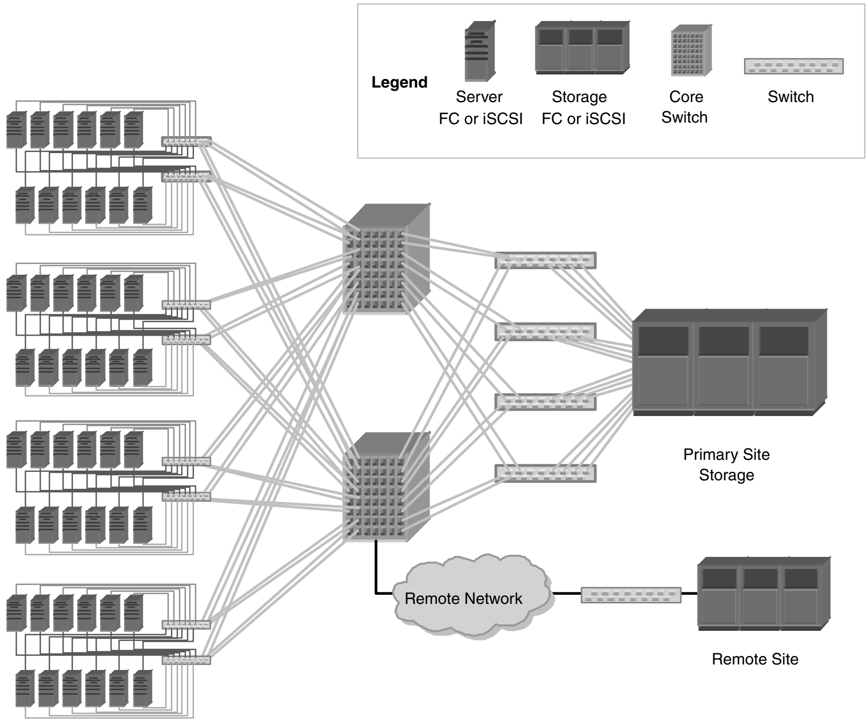

Figure 5–6 Sample customer configuration with a redundant core and remote storage.

group. "Do more with less" combined with exponential workloads lends to precarious corporate competence.

Budget reductions for IT professionals and storage managers present insurmountable obstacles with traditional storage infrastructures such as DAS. For example, with DAS, each storage device must be manually configured to work with each server. Since the storage devices typically are only available on a server-by-server basis, the configuration process can be time-consuming. Storage devices covering different models or different vendors may require specific skill sets beyond those of a single administrator. This leads to a direct relationship between the amount of storage in the overall configuration and the number of storage administrators. In fact, based on average storage growth rates, even keeping budgets at constant levels constitutes a budget reduction.

Figure 5–7 shows how a SAN dramatically reduces the storage management costs associated with DAS. By networking storage devices together and providing centralized storage management, a single administrator has the ability to manage a greater amount of storage from a single console. Further, all of the required storage functions, such as backup, archiving, and consolidation, can be initiated via centralized software functions.

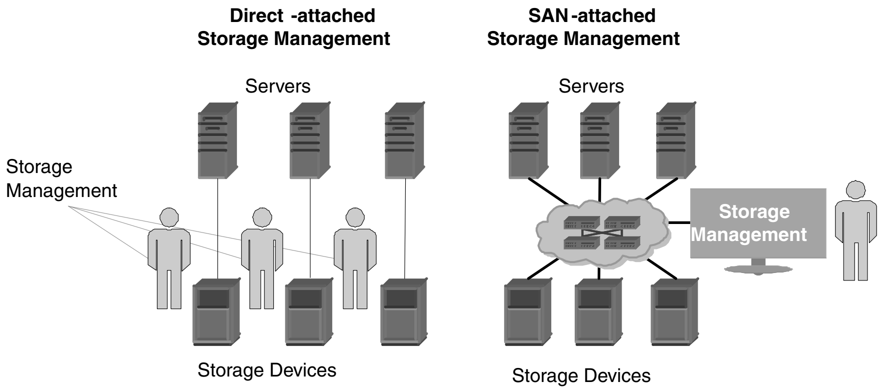

Figure 5–7 Storage networks facilitate storage management savings.

Storage networks help IT professionals grapple with escalating storage capacity and management requirements by minimizing the financial exposure to budget fluctuations. Additionally, the functionality of a storage network and the ability to automate many of the standard software functions helps IT managers and directors deal with staffing issues such as turnover and difficult-to-fill positions. By providing centralized functionality with greater automation, the entire IT department can accomplish more with less. This largely defensive strategy guarantees that user demands are met within the confines of corporate operating restrictions.

5.3 Primary Offensive Strategies

Effective storage strategies ride on the recognition that networked storage goes well beyond a set of required functions. Transitioning from the mindset of "We need this to protect our business" to "We have an opportunity to exploit a competitive advantage within our industry" means that technology deployment and business strategy meet to provide tangible, cost-saving benefits to the bottom line. Adopting an offensive mindset is the first step to realizing these gains.

Recent developments in the rapid progression of storage networking have made competitive advantage openings wider than ever before. Specifically, the merging of traditional network architectures, such as those based primarily on Ethernet and IP, with traditional storage architectures, such as those based on Fibre Channel and SCSI, has created enormous opportunities between requirements, capabilities, and solutions. The ability to connect traditional storage devices with common IP networks creates an entirely new distribution mechanism for storage. The power of that distribution mechanism cannot be underestimated, especially since IP networking represents the single greatest electronic distribution network in the world today. Granting ever-increasing data storage capacity access to that new distribution system fosters entirely new methods of handling data storage and management.

Companies that recognize IP networking as a new distribution mechanism for storage can rapidly transform their infrastructure and business processes to take advantage of it. The equipment exists today to seamlessly migrate from conventional storage architectures to those that embrace IP as a distribution mechanism. The resulting confluence of storage and networking, and the consolidation between the two, serves as the starting point for offensive storage strategies.

5.3.1 Storage Agility through Scalable, Flexible SANs

5.3.1.1 MEETING UNFORESEEN DEMAND SANs provide operational agility for storage through scalable, flexible architectures. Once servers and storage are networked, that network can grow and change with varying business and technical needs. One example of SAN scalability is the rapid expansion of new capacity. In the previous section on budget protection, we discussed defensive approaches to containing storage capacity costs through SANs. In the offensive view, rapid expansion, such as adding near-instant capacity growth to a successful e-commerce application, can be accomplished through a storage network. In a direct-attached approach, where each server has its own captive storage, adding new storage might require adding new server HBAs and new storage devices. Both of these time-consuming processes might require that the server be offline for the reconfiguration period. With a SAN, available capacity from underutilized storage devices could be reassigned as needed. Alternatively, a new storage device could be added to the SAN nondisruptively and quickly assigned to the appropriate server.

The ability to deal with unforeseen business changes mandated by underlying technology shifts makes storage competence and agility an integral part of any IT organization. Not only will networked storage solutions allow for added capacity, as described in the previous example, but they also allow for rapid deployment of applications on new server platforms. Either side of the network (servers or storage) can be tailored to fit the appropriate business needs. This growth and realignment capability ensures that unpredictable business requirements are met.

5.3.1.2 PROVIDING EQUIPMENT CHOICE SANs offer storage flexibility by being able to assign any storage to any server. Many administrators use this flexibility for storage consolidation applications, such as connecting a variety of disparate servers to uniform, centralized storage or creating pools of heterogeneous storage that can be assigned to individual applications. In either case, the underlying network architecture allows administrators to substitute one storage device for another, providing freedom to choose among equipment providers.

This is not to say that all storage devices are created equal. The internal design of a storage array or tape library can vary dramatically from one vendor to the next. For disk arrays, this might include the type of drives used, the size of the disk cache, or the capacity of an internal switching backplane. These characteristics directly impact the storage speed and reliability, resulting in some devices that can't easily be swapped for another. Yet the storage fabric linking servers to devices provides flexibility to substitute storage devices among each other, especially if they are within the same category of performance and feature characteristics.

This device flexibility provides an offensive approach to vendor management, allowing heterogeneous storage within a single configuration and providing more customer control. If one type of disk array becomes too expensive or can't provide the feature set required, another can be added without having to reconstruct the entire configuration. So, in addition to solving short-term storage consolidation needs that may be defensive in nature, customers build in an offensive approach to long-term vendor management with the installation of a storage network.

5.3.2 Network Centralization

Network centralization is the epicenter of offensive approaches to storage deployment. The ability to utilize the world's largest electronic distribution data network for storage implies that enormous discontinuities in current practices can be realigned accordingly. Specifically, companies that have DAS or Fibre Channel SANs can begin to focus on methods to handle data storage that leverage the global IP network.

In the early part of this decade, the storage networking industry debated the merits of different interconnect technologies, primarily IP and Ethernet as compared to Fibre Channel. While Fibre Channel has proven an effective edge interconnect for storage devices and SANs, it simply cannot compete with IP and Ethernet on a global scale. This discussion was covered in more detail in Chapter 2, "The Storage Architectural Landscape." More important than the technology is the size and scope of the industries at hand. IP and Ethernet have dominated corporate networking for years and served as an effective mechanism for LAN clients to talk to servers and NAS clients to talk to NAS servers. These applications have been well served with IP and

Ethernet, and the networking component has provided more than adequate performance, reliability, security, and flexibility.

With today's technology, customers have the opportunity to add storage networking to the larger network landscape of IP and Ethernet. From a storage perspective, this is likely to begin by linking Fibre Channel SANs across IP networks. Whether they are local, campus, metropolitan, or wide area networks, Fibre Channel SANs can be connected across IP networks to provide greater distance and scalability than pure Fibre Channel scenarios. Since almost every organization has an IP network in place, the extension of Fibre Channel SANs across this existing infrastructure makes business sense compared to deploying additional, separate Fibre Channel storage networking infrastructure for SAN connections.

New IP Storage switches allow storage networks to be built with IP cores, yet still retain compatibility with Fibre Channel devices. These configurations also have a natural extension to IP networks, further enhancing the value of that common technology infrastructure across a variety of networking and storage applications. Finally, the deployment of iSCSI servers and storage devices with native IP connections allows direct access to the IP network and the ability to exploit that rich and expansive resource.

As shown in Figure 5–87, IP networks provide flexibility and operational agility across all types of data networking and storage networking applications. The benefits of this uniformity can be categorized as follows:

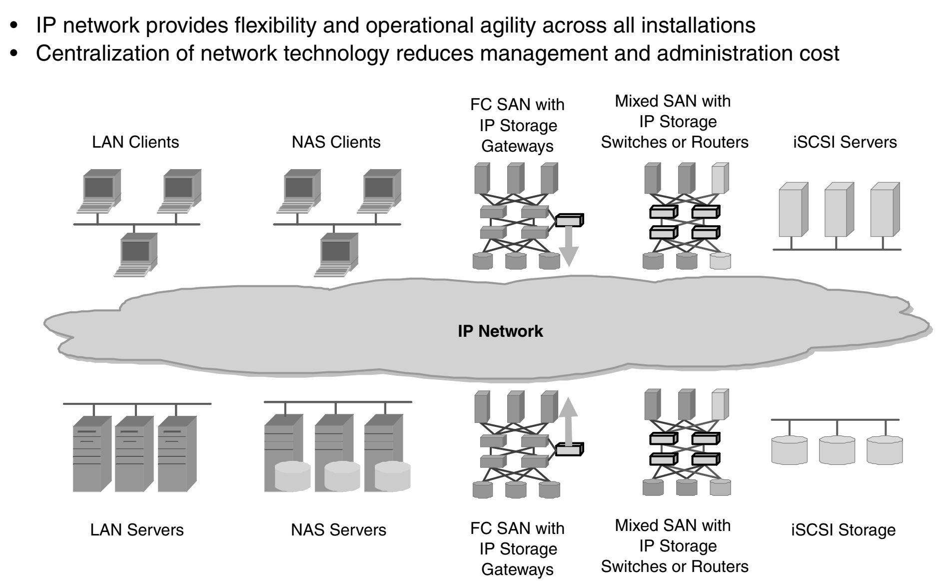

Figure 5–8 IP networking extends across traditional data and new IP storage applications.

Familiar and Ubiquitous IP Networking Technology. IP networks provide low, intangible costs in terms of management, training, and deployment. With years of industry use and the largest installed base in the world, IP networks are more familiar to and easily managed by people than are any other type of network. As such, the tools and training for IP networks are unparalleled in simplicity of use and sophistication, leading to more rapid and cost-effective deployment. The centralization of network technology greatly reduces management and administration cost

Enhanced Functionality. IP networks provide unrestricted topologies that guarantee interoperability across cross-vendor platforms. The industry has delivered advanced routing, management, and security features that power the most demanding of network environments.

Scalability. IP networks provide the utmost in scalability in terms of network size, speed, and distance. Network size is defined as the number of network nodes. Of course, no example comes close to the size of the Internet, the world's largest IP network. Ten Gigabit Ethernet provides the highest speeds available for common networking platforms and is delivered today both as interswitch links and switch backplanes. IP networks reach distances that span the globe, making any geographically point-to-point communication possible.

By adopting the network centralization approach, IT professionals can design architectures that leverage existing staff and technology to dramatically reduce overall cost. This approach embraces the open distribution channels of IP and places storage on the most pervasive networking platform available.

5.3.3 Platform Consolidation

The introduction of IP networking to storage enables consolidation among previously separate architectures of NAS and SANs. Historically, these two storage platforms have operated on completely different networks, with NAS using Ethernet and IP, and SANs primarily using Fibre Channel. As covered in earlier chapters, NAS operates using file-level commands, while SANs use block-level commands. Since both NAS and SAN architectures serve distinct and useful purposes, most companies support both platforms and, in turn, two networking infrastructures.

Stepping back, one can easily see how the build-out, management, and ongoing maintenance of two networks could result in excess equipment purchases and additional overhead for staff, training, maintenance, and support. Without the introduction of block-based IP storage, there was no other choice. To better understand current solutions and the path to platform consolidation, we'll walk through the example beginning with a typical configuration.

In Figure 5–9, the dual fabric of an IP/Ethernet LAN for NAS and a Fibre Channel SAN requires dual management systems, additional hardware, and potentially duplicate staff and training. These two network systems essentially perform the same tasks. Both run point-to-point, full-duplex, switched gigabit traffic, yet they cannot be shared. Additionally, a pure Fibre Channel fabric does not provide a transition path to iSCSI or other IP end systems.

The platform consolidation migration begins by adopting an IP storage fabric, as shown in Figure 5–10. Using IP storage switches or routers, the SAN core transforms to IP and Ethernet while retaining full compatibility with installed Fibre Channel devices, such as Fibre Channel HBAs or storage devices, or with Fibre Channel SANs. This allows existing applications to run without modification, yet prepares for the introduction of iSCSI end systems. These end systems, such as iSCSI HBAs and iSCSI storage devices, now integrate seamlessly into the IP storage fabric, driving more of the end-to-end storage connections to IP.

At this stage in the migration, the customer benefits are numerous. First, a common networking technology platform exists between the LAN and SAN. Even though these two networks might not be fully integrated into a

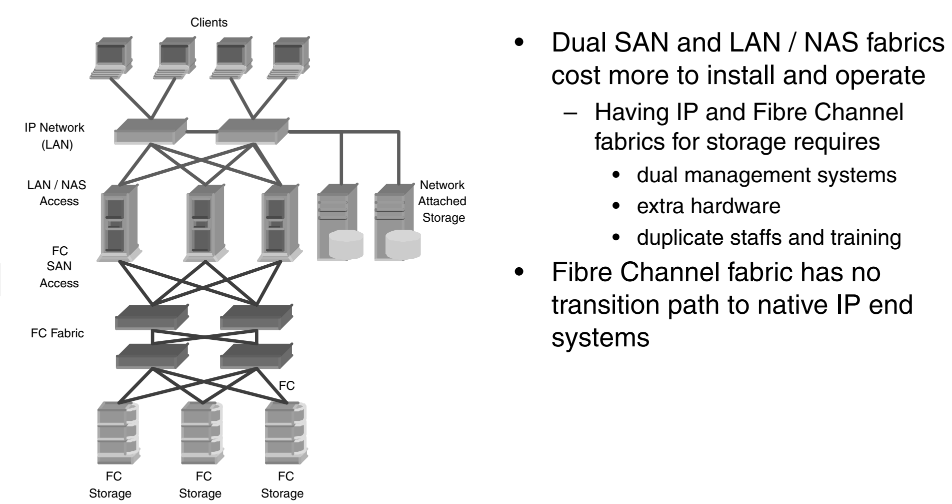

Figure 5–9 Conventional Fibre Channel SAN and Ethernet/IP LAN.

single network, they can be managed by common IP-trained staff members and share common IP and Ethernet management software, dramatically reducing overhead costs. Additionally, the introduction of the IP storage fabric provides access to extended metropolitan and wide area networks for a complete range of remote or distributed storage applications.

Carrying the platform consolidation migration through to completion, the Ethernet and IP networks can be combined to form a single, integrated NAS and SAN IP storage fabric. Integrated storage NICs (IS-NICs) running both block-level storage protocols like iSCSI and traditional TCP/IP protocols such as NFS or CIFS make this consolidation possible. Now, using a single fabric, servers have access to SAN and NAS subsystems, either Fibre Channel-based or IP-based. IP storage switches or routers within the fabric assist with iSCSI-to-Fibre Channel conversion when required.

Figure 5–11 demonstrates the complete platform consolidation configuration. Note that the NAS subsystems are now connected directly to the IP storage fabric and can be accessed by servers with IS-NICs or even end-user clients. Similar to the server-based IS-NICs that can access both block-based and file-based systems, the introduction of a consolidated IP storage fabric leaves room for similar storage devices. Hybrid subsystems that can handle both block and file protocols could easily attach to an IP storage fabric and provide a complete range of NAS and SAN services to applications. This greatly alleviates decision turning points for storage administrators considering the benefits of NAS and SAN solutions, eliminating the uncertainty and

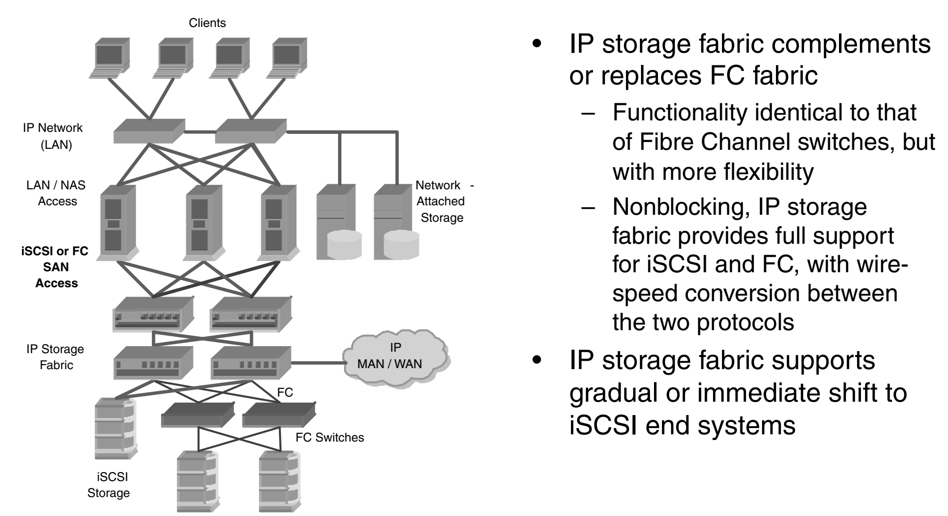

Figure 5–10 Introduction of IP storage fabric and iSCSI.

providing complete flexibility to tune the configuration to the appropriate platforms.

Server redundancy costs can be cut in half with IS-NICs. Since high-end servers require redundant storage and network adapters, a conventional configuration has two Gigabit Ethernet NICs and two Fibre Channel HBAs. With IS-NICs, full redundancy for LAN messaging and storage traffic can be provided with only two cards. One IS-NIC can run in LAN mode and the other in storage mode. In the event of a failure, a single NIC could cover both functions. Though performance is impacted temporarily during the failure, those costs may be significantly less than providing twice the hardware infrastructure for redundancy.

Many customers wonder about the benefits of NAS compared to SAN and where to invest precious budget allocations. The IP storage fabric coupled with IS-NICs and hybrid subsystems allays those fears through a single investment in IP networks. Let's take an extreme example and say that SANs disappear within 10 years. With an investment in IP storage networking, IP storage fabrics, IS-NICs, and hybrid subsystems, all of that storage equipment could be redeployed to serve NAS-oriented applications. The reverse situation would also hold. In either case, the investment in IP networking infrastructure serves as a flexible, redeployable resource both within an integrated IP storage fabric and within the entire global corporate network. The power of that asset redeployment cannot be underestimated. Companies stand to benefit from extended use of the network assets and the flexibility to redeploy staff as

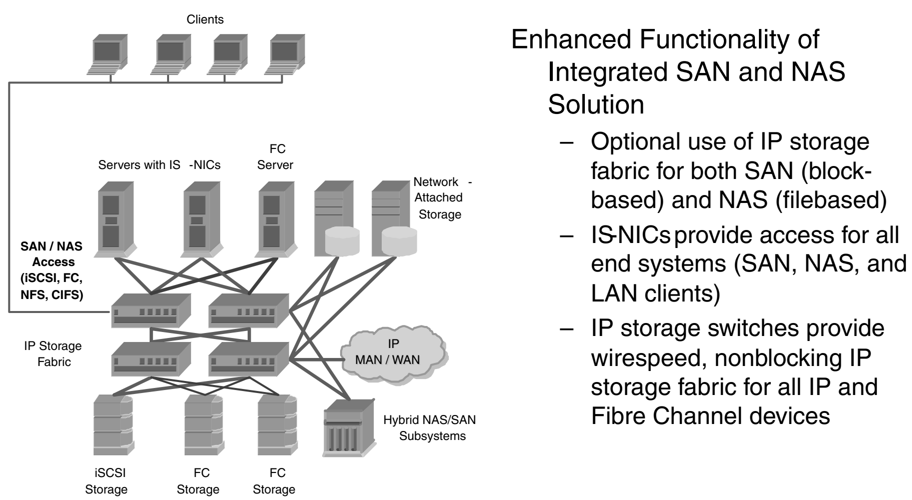

Figure 5–11 Integrated SAN and NAS.

needed to build, operate, and maintain IP networks, whether those networks are used for storage or traditional data applications.

5.3.4 Common IP Network or Common Technology?

Questions are often raised about IP storage networking and sharing storage traffic and data traffic within a common IP network backbone. Some people state that this implementation could lead to congestion bottlenecks. While combining both messaging and storage traffic on a single network is possible, initially a more pragmatic implementation is to segment the IP network infrastructure and move storage and data traffic via different paths. This approach enables customers to protect their investment in IP networking and maximize the efficiencies of moving both types of traffic over a common infrastructure. For example, familiar, standard technologies such as Virtual LANs (VLANs) permit the use of the same network equipment, yet partition the Ethernet network into separate entities.

Common network technology indicates that while deployment may be many physical networks from SAN to LAN to MAN to WAN, the underlying infrastructure is the same, providing benefits such as the use of existing IP networking staff, uniform network management, and common sourcing and maintenance of networking equipment.

Figure 5–12 shows an IP storage fabric in conjunction with a Fibre Channel fabric and an IP network backbone. In this example, the storage fabric

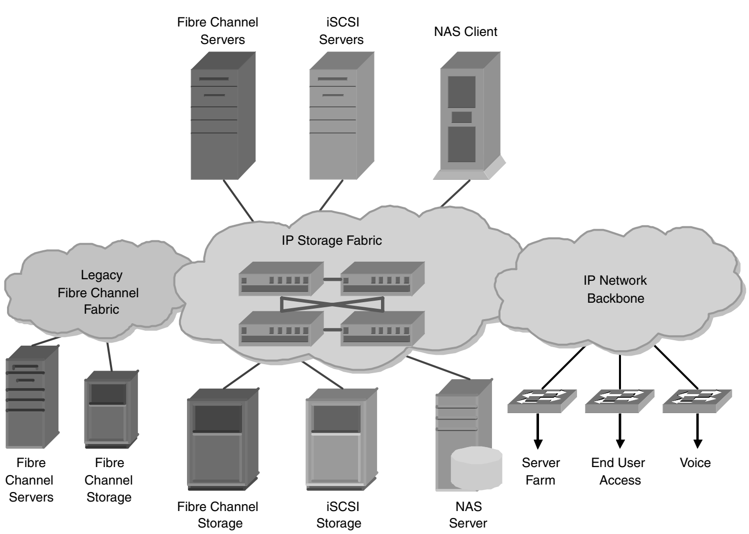

Figure 5–12 Segmenting the IP storage fabric from the IP network backbone.

remains independent from the network backbone that provides server farm, end user, and voice access. This segmentation allows for simplified traffic administration while still retaining the benefits of more IP technology throughout the enterprise.

5.3.5 Multilayered Storage Fabrics

Chapter 2 introduced the concept of a multilayered storage fabric centered on an IP core. Now, incorporating new iSCSI devices and multifunction devices such as NAS/SAN hybrid targets, we expand the model, as shown in Figure 5–13. This highlights the tremendous flexibility of centralizing all storage devices, whether Fibre Channel-, iSCSI-, or NAS-based, on a central IP storage fabric. Storage administrators have a flexible, shared resource that can be partitioned and segmented for each storage platform, yet can also be reallocated as needed. The degree of performance and fine-tuning within the IP core far exceeds the requirements of the average large enterprise customer, leaving ample network capabilities for each platform.

The flexibility of the IP storage fabric shared resource is shown in Figure 5–14. The primary IP storage transports include Fibre Channel devices or SANs connected across an IP fabric, iSCSI devices connected directly to an IP fabric, and multifunction devices, including NAS directly connected to an IP fabric. All three platforms take advantage of robust IP and Ethernet net-

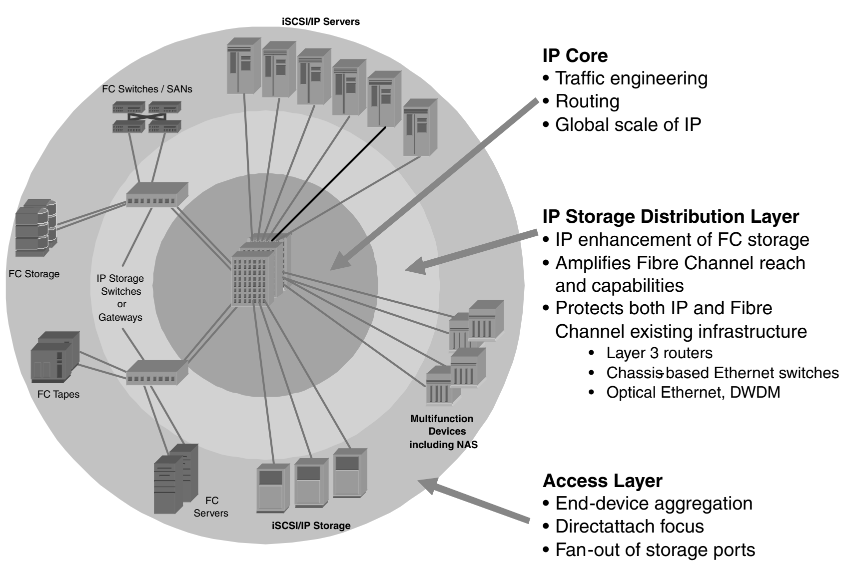

Figure 5–13 Framework for multilayered storage fabrics.

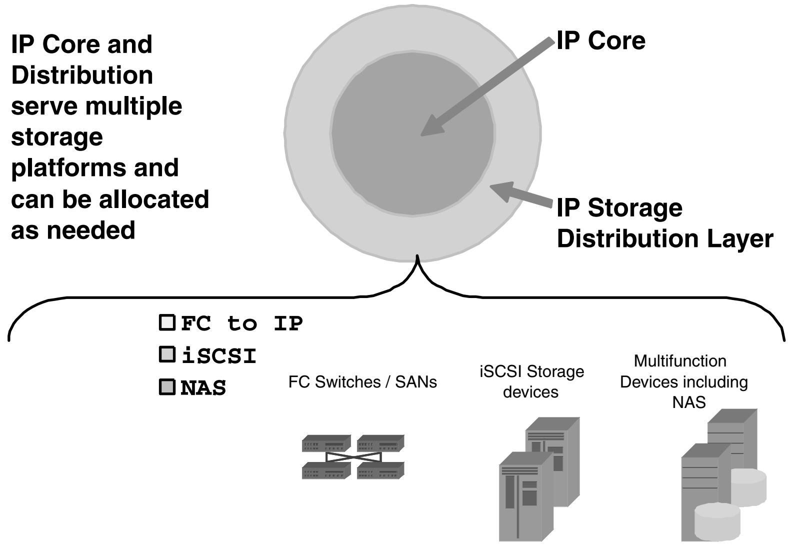

Figure 5–14 Allocating the IP storage fabric among storage platforms.

working features. If one platform emerges as a more economical means to conduct storage operations, administrators can easily reallocate the core network resource as needed to accommodate changes in the underlying storage choices. This flexibility protects significant network spending and ensures platform choice for storage professionals.

5.4 Measuring Returns

Measuring returns on technology investments can be a tricky business. The breadth and depth of large-scale computing projects leaves even the most intricate analysis open for debate. In the preceding sections, we covered both the defensive and offensive approaches to derive value from storage networking investments. Keeping both of these approaches in mind helps to better evaluate and measure the actual returns for individual companies.

This section covers some general guidelines for savings through networked storage, then outlines a couple of useful frameworks to keep both the defensive and offensive approaches at hand for further analysis.

5.4.1 Cost Savings with Storage Area Networks

Calculating returns for technology investments comes down to savings of both operational and capital costs along with incremental revenue from new opportunities. These added-value categories span both defensive and offensive strategies for networked storage. Common customer savings exist through the following:

Lower Costs through Capital Equipment Savings. SANs enable higher disk utilization, extending storage life and postponing new storage purchases. With the flexibility to share storage resources as a pool, administrators can use previously wasted excess capacity on underutilized devices.

Networked resources allows for backup strategies requiring less hardware. For example, where each server may have previously required its own tape drive for backup, networking resources can share tape libraries reducing the amount of total enterprise equipment required.

External NAS extends server life by providing room for applications to grow. Being able to accommodate larger storage capacities and data sets lengthens the usable life of a server and reduces purchasing cost.

Lower Operating Costs through Storage Management Savings. Since personnel costs comprise such a large portion of the ongoing IT budget, reducing intangible costs such as storage management trims operating costs significantly. With networked storage, centralized management eliminates the need for multiple software packages, facilities easier maintenance, and allows each administrator to manage more data.

Reduced Downtime through Availability and Protection. Section 5.2 covered the primary defensive strategies including clustered configurations for networked storage enabling reduced downtime to keep mission-critical revenue generating applications running around the clock. Additionally, from a data protection standpoint, SANs facilitate a host of backup and recovery options such as onsite or offsite mirroring in the event of a disaster.

Operational Agility through Flexible, Scalable Architectures. Section 5.3 covered the primary offensive strategies, including savings from the rapid capacity expansion model, and the consolidation across multiple vendors, providing more purchasing control and equipment choices to end users.

Use of IP networking technology also adds considerable offensive-focused strategies for operational agility such as the ability to use familiar and ubiquitous IP networks for storage. This prevalent and mature platform has lower intangible costs than traditional Fibre Channel networks, particularly in the areas of management, training, and time to deployment. The IP networking platform delivers enhanced functionality with unrestricted topologies, cross-vendor platforms, and advanced routing, management, and security. Scalability adds to cost savings through the ability to build SANs with large numbers of nodes, high-speed links, and long-distance connections. Most importantly, the investment in an IP fabric is well protected through the options of handling Fibre Channel, iSCSI, or multifunction traffic, including NAS.

5.4.2 Defining Information Technology Goals

The largest returns from IT investments come through correlating cost with business unit priorities. IT managers must keep these priorities in mind when calculating the return on the technology investment (Figure 5–15). The first priority is to defend, support, and expand current business. If the underlying technology isn't supporting existing revenue streams, approximate calculations can determine the amount of lost revenue and justify technology investments.

The second priority, developing new business, can be more difficult to justify, yet it is exactly this skill that can set one company apart from the next. Taking calculated risks on technology investments propels new business that can in turn develop ongoing revenue streams.

Finally, the third priority enhances IT capabilities and expertise. These investments should be made when the economic climate affords the opportunity. Long-term planning helps determine the timing for such investments, as it can take up to a year or more to develop a core set of inhouse skills that will then drive first and second priority investments.

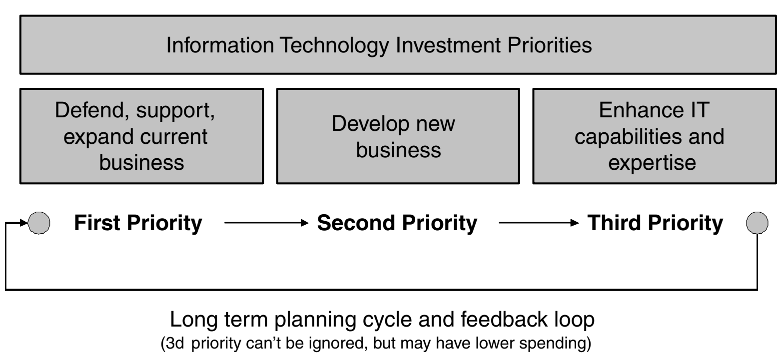

Figure 5–15 Setting information technology business priorities.

5.4.3 Tying Technology Capabilities with Business Processes

Far too often, technical capabilities are developed independent of business process and planning. Because of the ongoing strain on IT organizations, incremental technology investments typically focus on meeting immediate targets for current business functions. This logical step solves short-term needs, but lack of integral communication between the IT department and the business units dooms this relationship to a never-ending catch-up cycle.

Technology and business integration starts from the CEO down. By creating operational *and* strategic links, IT teams accomplish goals of meeting current requirements and designing service offerings that span existing and future needs.

Figure 5–16 outlines a basic framework for new technology offerings across business units. By accomplishing both immediate requirements and longer term strategic needs, the total cost of the technology investment can be amortized across a larger number of business units, generating sizable returns from integrating technical and business functions.

5.4.4 Storage Networking as Competitive Advantage

The intersection of storage and networking represents massive market forces. The data networking market and storage markets each measure in the hundreds of billions of dollars. The surrounding ecosystems add to the end-to-end solutions though applications, service, and diagnostics tools, training efforts, and certifications. This makes the market for networking equipment,

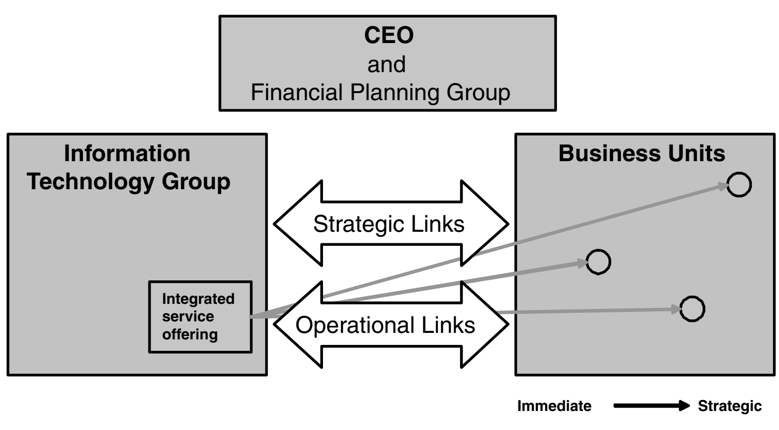

Figure 5–16 Creating strategic and operational links between IT groups and business units.

for example, larger than that of the product shipments alone. Similar market size escalation also exists for storage subsystems.

Regardless of technology merits, pros and cons, personal preferences, or ownership debates, the sheer size of integrating two multihundred billion-dollar markets opens windows of opportunity. Those opportunities come as investments for those tracking public company performance, market direction, and stock price; in terms of new product windows for startups and larger companies filling smaller integration gaps; in terms of cost savings for CFOs looking to negotiate among storage and networking providers; and in terms of competitive advantage windows for IT department to create sustainable advantages.

Companies that operate with mission-critical applications residing on large storage repositories will, by default, need inhouse storage networking expertise. As covered in later chapters, that expertise might be a small team supervising outsourced contracts to an IBM Global Services or EDS-like supplier. Alternatively, that expertise might be a dozen or more talented storage professionals who can construct, operate, and maintain the infrastructure to support business needs. When large market forces collide, those with the greatest inhouse expertise must adopt a strategy to maximize competitive advantage. Today, with the storage and networking markets in the first stage of overlap, those strategies require immediate formulation and deployment.

Figure 5–17 maps technologies to competitive strengths to help companies identify storage competence areas that can be exploited. On the vertical

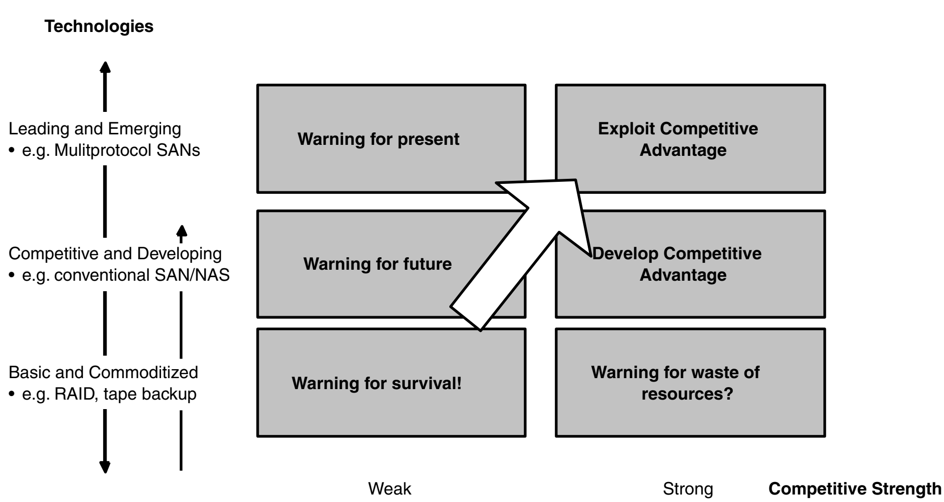

Figure 5–17 Storage technologies and opportunities for competitive advantage.

axis, technologies range from those that are basic and commoditized like RAIDs to leading and emerging technologies such as IP storage networks and mutliprotocol SANs. This simplified chart splits technologies into three categories, but a detailed analysis could include more segments. Competitive strength covers the horizontal axis, ranging from weak to strong, and the technology strategies to exploit competitive advantage fit accordingly.

Companies must place inhouse resources on projects most likely to develop into competitive advantage, while avoiding contributing too much time or effort to commoditized functions. The market windows opening for the storage networking market are wide and will reward those able to seize and exploit advantages of an optimized storage infrastructure.

5.5 Chapter Summary

Reaping Value from Storage Networks

- As an enabling platform, networked storage drives both cost and control of the overall storage infrastructure.
- In industries where storage availability and protection drive revenue-generating businesses, the networked storage budget grows as a function of the overall operating budget.
- To harness these costs, companies must apporach network storage with defensive and offensive approaches.

5.1 Balancing Offensive and Defensive Strategies

- Over the last several years, defensive strategies focused on data availability and protection-dominated storage deployments.
- Even in tight economic times, budgets existed for business continuity and disaster recovery applications.
- These deployments focus only on risk mitigation as opposed to including operational agility.
- Offensive strategies go beyond protection mechanisms to those focused on longer-term strategic storage deployment and TCO.
- Underlying SAN infrastructure enables defensive and offensive approaches.

5.2 Primary Defensive Strategies

- SANs provide redundancy for higher uptime and availability.
- SAN switches and directors include high-availability features for fabric resiliency.
- Core Fibre Channel directors or Gigabit Ethernet switches deliver scalable fabrics.
- SANs enable remote storage options for added protection and availability.
- Defensive strategies go beyond data risk to risks of dealing with human capital and trained storage professionals.
- SANs help reduce storage management costs by accomplishing more with less and reducing the number of administrators.

5.3 Primary Offensive Strategies

- Offensive strategies look beyond basic functions to exploiting competitive advantages.
- Merging of storage with networking fosters a new storage distribution mechanism.
- Offensive thinking harnesses methods to take advantage of the new IP distribution network.
- SANs provide for rapid addition of new storage capacity to meet unforeseen demand.
- SANs equalize the storage device playing field, providing more customer control of storage device choices.
- IP networks have served corporate LAN, MAN, WAN, and NAS applications for years and can now also apply to IP storage networks.
- Network consolidation on IP centralizes on a common technology resource.
- IP provides benefits of familiar and ubiquitous technology, enhanced functionality, and scalability in size, speed, and distance.
- Platform consolidation further supports long-term cost advantages.

- Introduction of an IP storage fabric for Fibre Channel and iSCSI uses common networking components.
- IS-NICs in servers allow for block-based and file-based storage access protocols from single interfaces to an IP storage fabric.
- IP storage networks can be integrated with corporate networks or kept separate via physical or logical segmentation.
- Multilayered storage fabrics provide for all end devices while maximizing use of the IP core.
- With an IP storage fabric, IP cores can be deployed across FC, iSCSI, and NAS platforms.

5.4 Measuring Returns

- Cost savings come from capital and operational expense reductions.
- Added revenue comes from new opportunities enabled by new technology.
- SANs lower capital costs by extending storage life, networking resources to require less hardware, and leaving room for servers to grow.
- SANs lower operational costs through storage management savings, reducing maintenance costs, and allowing administrators to do more with less.
- SANs reduce downtime through defensive strategies such as data availability and protection.
- SANs increase operational agility through flexible, scalable architectures.
- Successful IT groups will tie technology investments to business unit priorities.
- CEO oversight between IT groups and business units assures both strategic and operational links.
- With the hundred billion-dollar storage and networking markets converging, IP storage networking presents opportunities to develop sustainable competitive advantage.