EXECUTIVE SUMMARY

This white paper explores some of the challenges that have slowed the adoption of iSCSI and discusses several ways to optimize iSCSI SANs. It also details several policies that can be created to maximize the reliability, security, and performance of iSCSI SANs. The paper concludes with a brief overview of NetApp® SANscreen® and provides specific use cases that show how SANscreen 5.0 can help IT teams effectively manage an iSCSI SAN.
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2 Why Visibility and Manageability Are Critical to the Adoption of iSCSI
1 INTRODUCTION

To cope with increased demand for storage and declining budgets, IT managers must thoroughly evaluate all of their enterprises' storage costs—from initial equipment acquisition and resource management to capacity usage by each business unit. Most importantly, they must ensure that all service-level agreements (SLAs) are met by minimizing storage system downtime. To achieve these goals, IT managers need solutions that can drive down capacity and operational expenditures by leveraging existing infrastructure and consolidating personnel—using the same tool, the same people, and the same equipment.

In previous years, increasing storage capacity meant adding more storage appliances and other infrastructure directly to the server—a relatively simple, but costly and inefficient, way to allocate storage. This one-to-one, storage-to-server model (also known as DAS, or direct-attached storage) results in large amounts of capacity going unused. To address this problem, IT is rapidly adopting storage area networks (SANs)—high-speed networks that connect multiple storage devices so that they can be accessed by all servers in a local area network (LAN) or wide area network (WAN). SANs are definitely improving storage efficiency, but are also adding new complexity to the storage environment, resulting in increased operational costs.

SANs are often created on Fibre Channel (FC) networks. But the dedicated infrastructure and added management complexity of the FC world has placed FC-based SAN solutions out of reach for many enterprises. In contrast, the Internet Small Computer System Interface (iSCSI) protocol extends the benefits of SANs while minimizing cost and complexity. With iSCSI, IT can create storage networks via existing Ethernet technology and infrastructure; similarly, IT can leverage its existing network staff instead of hiring additional high-cost, specialized FC personnel.

Currently, the only available iSCSI storage management tools are device-oriented products. These tools provide information on each individual storage component, but do not deliver end-to-end visibility into the network. To achieve success with iSCSI, IT needs tools that can extend visibility from the device into the entire storage network, enabling the team to manage the iSCSI storage network as a service. They need to move beyond point solutions to understand the impact on critical applications when something happens within the storage network. They need to know where the data is located, enabling them to reduce operational expenses by better utilizing lower storage tiers. They also need tools that enable automated provisioning and troubleshooting and lower administrative overhead.

2 ISCSI NETWORK CHALLENGES

iSCSI provides a very cost-effective way to connect servers to storage resources. It is less expensive than FC since it is deployed on TCP/IP and Ethernet hardware. The economic advantages of reusing existing infrastructure are what drive organizations away from expensive, dedicated FC devices. And, likewise, FC domain experts prefer the more commonly distributed Ethernet protocol. IT can also use iSCSI to provide access to FC storage from application servers, which further lowers the cost per port of accessing existing FC storage arrays.

iSCSI SANs are inherently easier to manage than FC infrastructure, but the overall complexity increases in an exponential fashion once the storage environment starts growing. Storage administrators quickly lose the ability to see where the data is physically located. They cannot determine the impact of taking something off the network—a switch, a host, a storage device, or data. Without end-to-end visibility into the network, the storage environment quickly becomes unmanageable.

There are many things that storage administrators must do to provide quality service to end users. They need to ensure that storage is available, reliable, secure, and resilient. There must be sufficient visibility into the infrastructure so that the correct level of service is delivered to each business unit, application, or host. Administrators also need to verify that the application meets designated service levels and guarantees adequate performance. And all of these capabilities must be delivered cost effectively and efficiently.
Questions storage administrators must answer include:

- Is the storage providing the right service to the application or host?
- Is it the right tier of storage?
- Does it have sufficient bandwidth?
- If something happens, is there enough information to troubleshoot the problem?
-Exactly how much capacity is there and where is it located?
-Is there enough capacity to grow when needed?
-Is the storage in the right place?
-Are all the storage devices configured or tuned to this service?
-Does the network support this service?
-Is there enough redundancy?
-What happens if one interface to the host fails? Will the host still run?
-What is the availability of this service?

To answer these questions, administrators need end-to-end visibility into the storage infrastructure to size the storage and plan and forecast future needs. The ideal storage network also should have powerful incident management capabilities so that whenever something bad happens—a deviation from the main policy or the service policy—the administrator has a way to quickly detect the deviation, determine its root cause, and monitor the resolution of the incident.

MOVING FROM A DEVICE VIEW TO A SERVICE-CENTRIC VIEW OF STORAGE

What has inhibited organizations from adopting iSCSI to replace or coexist with FC? The answer lies in the lack of technologies that enable end-to-end visibility and manageability of storage networks. With iSCSI networks, IT has historically focused on managing storage devices as individual assets. At best, this has meant making large investments in storage resource management (SRM) software solutions. More often, however, storage administrators have simply relied on a combination of out-of-date spreadsheets, SRM data, and data generated from homegrown scripts to represent the current configuration state of storage resources.

The problem for IT is that no matter how well storage is managed as an isolated asset, only a limited value can be derived from the device. Asset properties and the state of storage devices are not sufficient to address the challenges associated with delivering IT support as a business service. In fact, most IT organizations lack a clear set of links that tie storage resources with applications and business value—and that creates a gulf between IT and corporate executives.

Corporate executives think in terms of business processes. When it comes to the services they need to support those processes, they expect IT to address issues of availability, business continuity, performance, and security. This requires IT organizations to automate data center processes for building, maintaining, optimizing, and auditing storage networks. That means IT must be able to create policies and procedures that can effectively support an SLA for storage—IT’s most costly asset.

To define and support an SLA for a business process, storage administrators must understand all the interdependencies among storage devices, hosts, and SAN switches for each application that is part of the process. The lack of such an overall understanding negatively impacts IT’s ability to deliver processes for building, maintaining, optimizing, and auditing storage networks.

A storage service is the end-to-end connectivity between a host and a volume—and their level of resilience (i.e., the required security, sharing, minimum sessions, minimum connections, etc.). The problem with managing a service is that there are many different elements that must be correlated to determine if the service is working as planned. Unfortunately, the task of developing a service-centric process all too often burdens IT with costly labor-intensive tasks that require detailed application, data center, and business process knowledge.
To provide quality service, storage administrators need visibility into the storage network. This visibility must show where and how infrastructure components are associated with each other and how they use each other's resources. Armed with this insight, administrators can start understanding the impact of network events on the business. That’s when an IT team can begin shifting from managing individual storage elements to managing the business and service levels.

3 CREATING EFFECTIVE ISCSI SAN POLICIES

Policies are the internal laws that govern the operation of a storage network. Developing effective policies requires an understanding of the individual business unit's goals and application requirements. Such policies serve as the foundation for setting SLAs for end users. Tactical policies are the ones that spell out how to put the overall business strategy into practice; they govern the management of the storage infrastructure. Tactical goals vary depending on technology and specific business needs. Some of the tactical policies that enable a successful iSCSI SAN implementation include:

CONFIGURING ALL PARTS OF THE ISCSI SAN AS FULLY REDUNDANT

It is important to provide redundancy both at the host level and the storage level. Storage administrators need the ability to discover all the network end points and understand how they connect to each other. Users can then specify the number of interfaces (network portals) that are required from the host to connect to the network to maintain the right level of service. Users can also specify the same thing on the storage side. As an example, the policy could state, "There must be two network portals at the host and two at the storage level." This policy provides redundancy.

Policies can also specify the length of a session. A session is like a discussion composed of sentences. A session can start and stop, and then start over again. Policies can also specify:

- How many sessions are required for the service to maintain itself; this introduces another level of redundancy
- How many connections are required in a session; usually, someone who has multiple sessions already has redundancy in the sessions, so that person would probably use just one session
- The number of multiple sessions and multiple connections within a session

PROVIDING SECURITY

To keep the iSCSI storage environment secure, it is important to deploy management tools that enable the IT team to set administrative roles and limit the actions each person can take. Policies should be set to make sure that only authorized administrators can access the tools and the necessary infrastructure. If security is required and someone tries to access the systems without the security, it means there is a violation of the storage.

iSCSI networks utilize a security Challenge-Handshake Authentication Protocol (CHAP). Here’s how CHAP works:

- After the link is made, the server sends a challenge message to the connection requestor. The requestor responds with a value obtained by using a one-way hash function.
- The server checks the response by comparing it with its own calculation of the expected hash value.
- If the values match, the authentication is acknowledged; otherwise, the connection is usually terminated.
- At any time, the server can request the connected party to send a new challenge message. CHAP identifiers are changed frequently and the server can request authentication at any time.
Why Visibility and Manageability Are Critical to the Adoption of iSCSI

ENABLING MULTIPLE HOSTS TO ACCESS THE SAME VOLUME

With iSCSI networks, multiple hosts can access the same volume. This can be OK in some situations—for example, when there is a cluster and an audit requires multiple servers to access the same piece of data. In other situations, it can be devastating and result in downtime. The problem occurs when multiple hosts access the storage by mistake. For example, if a Windows® server and a UNIX® server access the same piece of data, the Windows application modifies the data and then the UNIX application can no longer read it. This results in downtime. To prevent such occurrences, storage administrators should create a policy to specify the scope of sharing that is permitted. The policy can state that only a certain server or application can access this LUN, and, if an attempt is made by another server or application, the storage administrator needs to be notified.

USING PERFORMANCE ANALYTICS TOOLS

It is also extremely important to use performance analytics tools. With these tools, administrators can better understand all server workloads to determine the most effective network architecture. These diagnostic tools enable IT to create accurate cost models to evaluate the benefits of iSCSI and to decide which network is right for each application and workload.

Sometimes the best solution is to create a hybrid SAN in which the enterprise’s most critical servers are placed on a FC network, while other less strategic applications and servers are placed on the iSCSI network. By implementing a multiprotocol storage array that supports both FC and iSCSI, IT teams can build in redundancy to the network at a lower price point.

4 HOW NETAPP SANSCREEN 5.0 EXTENDS iSCSI VALUE AS A STORAGE FABRIC

Data center automation delivers significant benefits to server and network management, providing more efficient and agile operations by aligning the IT infrastructure to application, business, and service-level requirements. These benefits, however, have largely bypassed iSCSI networked storage—until now. NetApp SANscreen software delivers data center automation for storage by automating the core processes used to manage storage services, many of which are currently manual, device centric, or spreadsheet driven.

An iSCSI storage service is the end-to-end connectivity between a host and a volume and their level of resilience (i.e., the required security, sharing, minimum secessions, minimum connections, etc.). SANscreen provides real-time, multivendor, multiprotocol (FC and iSCSI) service-level views of the storage environment. It enables organizations to manage storage as a true end-to-end service, dramatically reducing capital and operational costs and improving application service quality by driving storage efficiencies.

With a single console for FC and iSCSI information across multivendor storage environments, SANscreen provides actionable service-level information that is leveraged by both storage teams and IT management, effectively integrating storage into the entire IT service delivery chain.

The SANscreen product suite includes Service Insight, Service Assurance, Application Insight, Capacity Manager, and VM Insight.

Service Insight is the baseline SANscreen product. It provides visibility into the storage environment, including host-to-storage access paths, storage availability, and change management. Service Insight operates without agents, out-of-band, in near real-time, and across all major storage vendors’ platforms and protocols. It continuously discovers storage devices, along with their configuration—identifying volumes, mapping and security, network protocols (NICs), and more.
The Service Insight technology is based on the notion of service paths, representing the relationship between a particular application on a given server and its data on a storage device. Service Insight provides the information IT teams need to manage iSCSI storage services proactively, resulting in increased service quality, prevention of application failures, and improved recovery time by immediately identifying an incorrectly implemented change. With proactive management, IT can reduce operating costs in the data center by decreasing the time and effort required for troubleshooting.

Included in Service Insight is an open enterprise-class data warehouse that provides a central repository for all inventory information. This warehouse enables IT teams to roll up multisite environments, gain global visibility across distributed infrastructures, and access critical analysis and reporting capabilities. Additionally, the warehouse facilitates integration with third-party applications and processes such as configuration management databases (CMDBs), financial accounting systems, and asset management systems. Service Insight reporting capabilities provide a centralized portal for querying and viewing critical information from the data warehouse. The Service Insight reporting solution empowers IT teams to make operational, strategic, and tactical storage-related decisions.

- **Service Assurance** builds on the service path modeling of Service Insight to manage and deliver storage as a true end-to-end service. Service Assurance defines iSCSI global, application, or host-based policies based on parameters such as security, sharing, minimum sessions, and minimum connections. In real time, it then validates changes against the service model to determine whether there was a policy violation that could lead to latent quality issues or outages.

- **Application Insight** discovers near-real-time performance data from the storage environment (including fabric and storage devices) and maps it to applications, hosts, and service paths. Application Insight empowers IT organizations to proactively perform load balancing in the SAN or on the array to avoid SAN congestion or array contention in the context of affected hosts and applications.

- **Capacity Manager** provides real-time visibility into global iSCSI SAN resource allocations, rule-based service-tier management, and a variety of capacity-related issues. In conjunction with the SANscreen storage data warehouse, Capacity Manager aggregates relevant storage and switch information from multiple SANscreen instances. The enterprise-class data warehouse enables access to an open database designed to facilitate capacity-related reports such as chargeback, consumption analysis, and forecasting. To handle the dynamic state of the storage environment, as well as ever-changing business requirements, Capacity Manager provides a flexible report-authoring solution that allows custom reports to support capacity planning, purchasing, storage tier analysis, storage service catalogs, trending and historical usage, audit, chargeback, and much more.

- **VM Insight** builds on SANscreen service path awareness and change management technologies to create cross-domain visibility from the virtual machine (VM) to the volume, allowing both storage and server administration teams to more easily manage their storage and server architectures.

**SANSCREEN BENEFITS**

With NetApp SANscreen, storage administrators can now:

- Reduce capital expenditures by identifying and reclaiming unused storage resources in the environment.
- Gain global visibility of storage network assets to quickly understand their availability, relationship, and usage at the data center or enterprise level.
- Improve service quality by proactively discovering the storage services delivered to applications.
- Manage and audit changes over time to enable technical review, compliance, and IT governance.
- Drive service quality improvements in the storage environment.
- Accelerate migrations and consolidations.
- Provide server administrators with visibility into which services were provisioned by the storage team.
5 SANSCREEN 5.0 USE CASES

NetApp listened to the challenges facing its customers when managing iSCSI SAN environments and developed a set of use cases to solve these problems. Some of the use cases delivered in SANscreen 5.0 include:

GAINING END-TO-END VISIBILITY INTO STORAGE RESOURCES AND SERVICES

To effectively manage an iSCSI SAN and provide the appropriate iSCSI storage services at the lowest possible cost, the first step is to gain visibility into the entire iSCSI SAN infrastructure. Administrators need to understand the resources available and the associated services. SANscreen 5.0 provides storage service visibility into the iSCSI SAN (a storage service is the end-to-end connectivity between a host and a volume) and their level of resilience (i.e., the required security, sharing, minimum sessions, minimum connections, etc.).

SANscreen 5.0 provides the ability to view and manage all storage resources and services (see Figure 1). With iSCSI, this means viewing all NetApp arrays that support iSCSI and their internal configuration, such as volume configuration, mapping and security configuration, network portals and network portal groups, and more. This information is presented together with other technology resources, such as FC arrays, all within a single pane of glass.

![Figure 1) Visibility into multiprotocol, multivendor storage estate.](image)

ENABLING SERVICE-LEVEL MANAGEMENT AND TROUBLESHOOTING

To enforce service-level resilience (i.e., the required security, sharing, minimum sessions, minimum connections, etc.), SAN administrators need the ability to specify the required iSCSI policies. SANscreen 5.0 provides operations teams with the ability to set service levels and identify service violations and vulnerabilities across the storage environment (see Figure 2). If an iSCSI problem occurs, Service Assurance alerts the enterprise’s help desk personnel and provides automatically correlated change information for fast triage and root-cause analysis (see Figure 3). Service Assurance provides near-real-time verification of iSCSI policies, enabling IT to bring operational efficiencies to storage monitoring. In addition, storage managers can drive service quality improvements by proactively removing latent quality issues that increase the risk of performance problems or outages.

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9 Why Visibility and Manageability Are Critical to the Adoption of iSCSI
MONITORING AND MANAGING ISCSI SAN CHANGES
SANscreen 5.0 tracks all of the changes that take place in the iSCSI SAN. Whenever someone modifies the configuration of the storage environment and reconfigures something, SANscreen 5.0 captures these changes and records them forever. If a policy or service violation occurs based on a change, storage administrators are notified of the violation and see what the changes were that led to the violation.

INCREASE USAGE EFFICIENCY
The effort required to compile iSCSI SAN utilization information across a multivendor environment is manual, time consuming, and error prone. Therefore, organizations often resort to inaccurate guesswork and expensive over provisioning to deal with uncertainty. With Capacity Manager’s real-time usage and trending information, IT can reduce capital expenditures by decreasing the required safety capacity. Capacity Manager extends the definition of tiering beyond the basic tier-by-vendor model, providing the ability to allocate the most appropriate tier of storage service to an application and improve enterprise-level tier resource utilization.

ACCELERATE APPLICATION PROVISIONING
Capacity Manager provides near-real-time information about available iSCSI resources to accelerate application provisioning with an accurate, repeatable, and end-to-end provisioning process that minimizes rework. IT can manage this process with best-practice assistance from SANscreen, including flagging violations and highlighting incorrect changes.
6 CONCLUSION

iSCSI over Ethernet is a viable alternative to FC as a SAN interconnect that reduces cost and complexity. But obtaining end-to-end visibility across the storage network is the first and most important step toward increasing the adoption of iSCSI SAN technology.

iSCSI is now changing the economics of storage networking and NetApp is leading the way with a wide range of proven iSCSI solutions to meet the needs of organizations, from midsize companies to enterprise-level data centers. NetApp’s iSCSI storage solutions provide the performance expected from FC, plus the familiarity of an IP management environment. Along with their powerful SANscreen solutions, NetApp’s iSCSI storage solutions provide the best of both worlds: reliability and performance plus the familiar IP protocol.

NetApp brings over a dozen years of experience to deploying IP-based storage. Today, more than 13,000 enterprise customers rely on NetApp’s iSCSI solutions. They’re enjoying higher data availability, simpler data and storage management, and better storage utilization. For more information on NetApp SANscreen 5.0 or other NetApp products and technologies, please visit www.netapp.com.