

WHITE PAPER

HIGHLIGHTS

- NetWisdom's scope of capabilities allows a new level of diagnosis and prevention to be implemented in each SAN tier.
- NetWisdom's flexibility enables the construction of solutions specific to individual SAN infrastructure monitoring requirements.
- NetWisdom's architecture enhances dedicated SAN traffic analysis for top-tier applications and storage services.
- NetWisdom's architecture enhances SAN traffic analysis sampling and fabric monitoring for second-tier applications and storage services. Lower-level tiers can reduce costs by increasing sampling times between links.

Using NetWisdom in Multi-tiered Storage Area Networks to Diagnose and Prevent SAN Performance Problems NetWisdom Value Proposition In A Tiered SAN Architecture

DIAGNOSIS AND PREVENTION IN SAN PERFORMANCE MANAGEMENT

Diagnosing and preventing storage network slowdowns necessitates a set of analysis capabilities, particularly for IT organizations managing high levels of complexity in their Storage Area Network (SAN) infrastructures. Systems that are both complex and critical require powerful solutions with requirements beyond the capacity of industry-standard SRM tools. NetWisdom is the ideal tool for the vigilant SAN manager, providing the power and flexibility needed by the most critical business applications.

SAN complexity is being driven by the heterogeneity of storage subsystems, host bus adapters (HBAs), operating systems, fabric switches, Wide-area Networks (WANs), Metropolitan Area Networks (MANs), multi-site replication, storage and tape virtualization, and continued growth of data and bandwidth utilization. Consolidation of infrastructure and SAN services due to acquisitions and Information Lifecycle Management (ILM) architectures as well as additions of new technologies and infrastructure further complicates the SAN administrator's ability to characterize "normal" SAN operation. Large, heterogeneous, fast-changing SAN infrastructures require more sophisticated SAN diagnosis and prevention capabilities than are provided by standard Storage Resource Management (SRM) products.

High-vigilance SAN management involves three specific states:

- Acute Problem. Serious slowdowns and outages must be diagnosed swiftly and accurately, without waiting for appropriate analysis tools.
- Non-Acute Problem: Chronic problems must be proactively detected and resolved before they become acute.
- Normal operation. While the SAN is healthy, the wise IT professional actively seeks ways to keep it that way by recording normal operation baselines and then setting up monitors to automatically watch for negative changes, possibly with different responses programmed for different tiers of operation.

IT practices must include baseline comparisons of Input/Output (I/O) performance, bandwidth utilization, and average I/O completions to verify that changes in hardware, firmware or configuration do not adversely impact business critical applications or SAN services. Once baselined, daily SAN management involves looking for deterioration, finding root causes, and looking for ways to improve performance and fail-safe the operation.

In short, in high-vigilance operations, it is the SAN manager's job to monitor operations closely, to determine appropriate action in the case of difficulties, and to actively prevent problems by using baseline data gained during normal operations. The NetWisdom family of products addresses each stage of SAN management in ways that standard SRM products simply can't manage.

SCOPE OF SAN PERFORMANCE DIAGNOSIS AND PREVENTION

The diagnosis and prevention of SAN slowdowns are not simple features that a SAN management tool possesses or lacks. Rather, these are a range of complex capabilities that expand across the SAN or within business critical portions of the SAN based on the level of service required. These SAN management capabilities must be able to be implemented at different levels based on the business criticality of an application or criticality of a SAN storage service such as remote replication, backup, storage or tape virtualization products.

Finisar's NetWisdom family of products provides an unprecedented scope of diagnosis, and prevention capabilities for complex, heterogeneous fibre channel SANs. SAN administrators can use the NetWisdom family of products to address specific issues, verify service levels, and provide deep monitoring and analysis well beyond the capacity of standard SRM tools.

The unique benefits offered by NetWisdom are:

- Faster problem identification and diagnosis
- Prevention of SAN problems by early detection of slowdowns and failing devices
- Advancement of SAN management by predicting future bandwidth and storage requirements
- Verification of hardware and firmware changes before they impact production

NetWisdom examines every packet on the SAN at line speed (up to 4Gbs). NetWisdom detects protocol errors and faults, and correlates all of the packets of each storage I/O to report on absolute values of latency, read and write completion times, throughput speed, and percentage of utilization of SAN links. NetWisdom's deep analysis provides expert protocol problem identification with pointers to protocol traffic traces.

The NetWisdom family of products can access information that is hidden from storage, fabric, and HBA devices. These devices are unable to analyze every packet due to memory and CPU constraints, and can not see protocol errors and faults impacting the SAN due to use of storage I/O drivers buried in silicon chips.

NETWISDOM AND INFORMATION LIFECYCLE MANAGEMENT (ILM)

One of the most fundamental challenges to implementing an ILM strategy is the detailed understanding required about the application data in order to select the appropriate SAN tier and create policies. Information Lifecycle Management (ILM) is the practice of applying policies to the management of information at the time of information creation through to its final disposition. One approach to implementing ILM in a SAN is to create a tiered architecture where each tier's infrastructure reflects a cost-based service level defined by performance, replication, data retention, and security. Application data is then assigned to the tier that matches the business value of the data. Once classified, applications and data within the same SAN tier can share the underlying infrastructure to further reduce costs and allow IT organizations a business approach to managing explosive data growth in their SANs.

The data's access patterns, longevity, confidentiality, and impact to key applications must be understood to appropriately determine the appropriate ILM tier for the data, and what influences changing tiers. Storage infrastructure implements the requirements of each ILM SAN tier using technologies such as storage arrays of various performance and reliability characteristics, replication implementations, SAN fabric architectures, hierarchical storage management (HSM) or archival to tape, storage virtualizers and long term tape storage and data destruction. NetWisdom's scope of SAN performance monitoring capabilities allows the applicable level of diagnosis and prevention to be implemented in each ILM tier. NetWisdom storage traffic metrics also support characterizing application data in support of creating policies.

NETWISDOM FOR PRIMARY TIER BUSINESS-CRITICAL APPLICATIONS

Sometimes an application is so critical to an organization that even minor slowdowns can critically impact the financial performance of the business. In this case, dedicated monitoring of SAN packet traffic for impact to I/O performance and protocol faults is paramount to predictable SAN operation. Monitoring traffic and faults can predict impacts to the business-critical application (see figure 1).

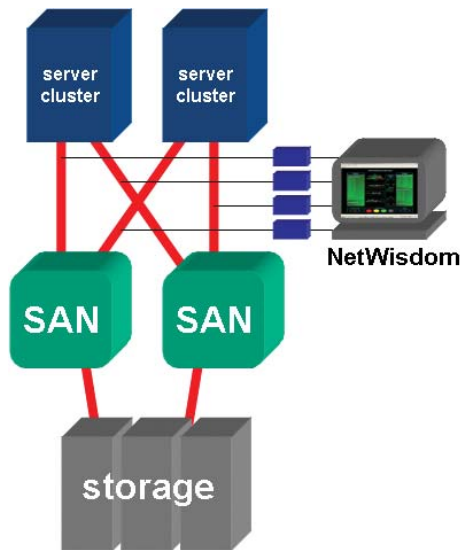


Figure 1: Tier One Dedicated Application Monitoring

NetWisdom provides the ability to monitor every packet to and from an application. In particular, NetWisdom can analyze the performance of every SCSI read and write exchange to determine if there are faults, slowdowns, unexpected or unauthorized traffic, failing devices or any other incidents that could impact the application.

For a top-tier business-critical application, the dedicated analysis architecture of NetWisdom analyzes storage traffic on every fibre channel link to the application's server. Every packet is analyzed, at line rates, transparently to the application. SCSI I/O conversations are correlated to determine the time from start to finish. Bandwidth utilization and I/O performance are calculated based on actual traffic and can be observed for each storage volume to application conversation, at the Initiator/Target/LUN (ITL)¹ level (see figure 2). Metrics and I/O performance information are saved in a database and summarized for reporting. NetWisdom monitoring is passive, causing no impact or risk to the application.

¹ Initiator - HBA port; Target - storage controller port; LUN - logical unit number of the storage volume.

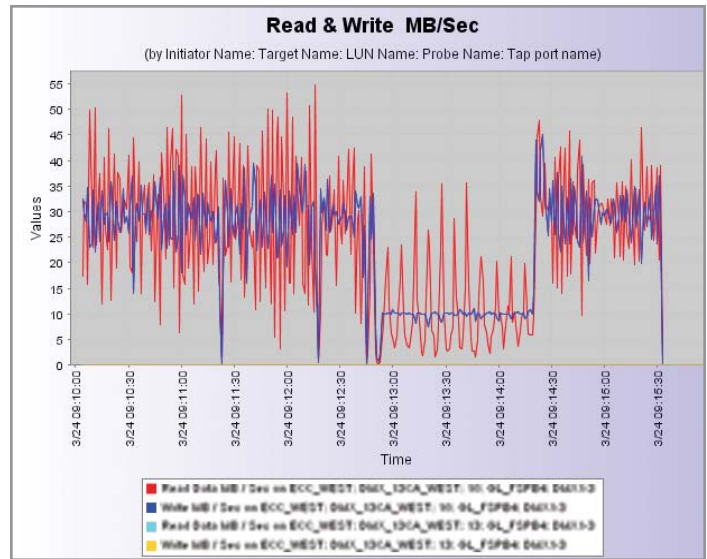


Figure 2: Application I/O performance

NetWisdom allows IT organizations to create alarms for overall fabric performance, specific application I/O performance, or specific faults. Alarms can notify an administrator or cause an in-depth problem analysis by automatically triggering and directing a protocol analyzer to an identified link to capture data for offline analysis.

SAN Managers can also use NetWisdom to verify that firm-ware upgrades or new devices do not impact the application due to additional traffic or newly introduced faults (see figure 3). Every SAN configuration change can be verified with performance comparisons to known-good baseline data.

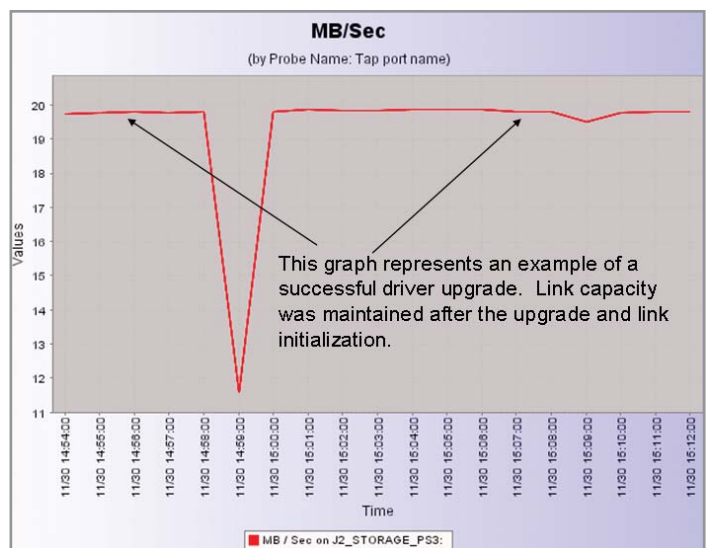


Figure 3: Before and After SAN Change

Dedicated NetWisdom monitoring provides immediate notification of protocol faults and errors that cause hard-to-detect SAN slowdowns (see figure 4). A database of previous readings is also available for historical analysis. Rich reports and graphs are available, and can be customized to track metrics specific to an organization, application, or Service Level Agreement (SLA).

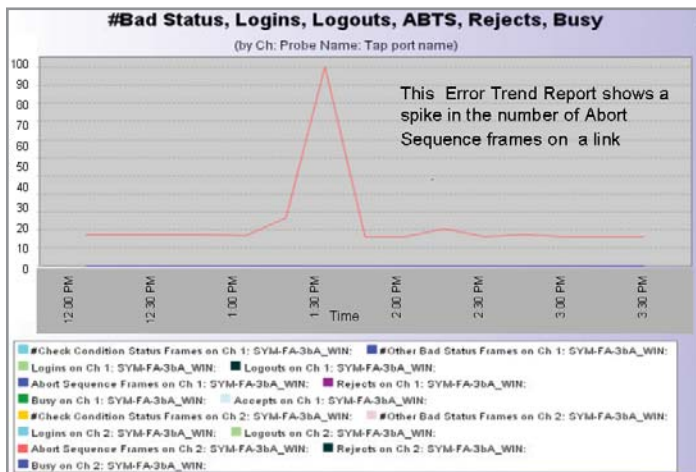


Figure 4: Identification of an Abort

Individual application I/O conversations are tracked by NetWisdom by measuring the SCSI Exchange Completion Times (ECT) of reads and writes for a particular ITL (see figure 5). ECTs encompass the time it takes for the server (Initiator) and storage subsystem (Target) to exchange all packets required to fully complete a read from a storage volume (LUN) or write to a storage volume by an application.

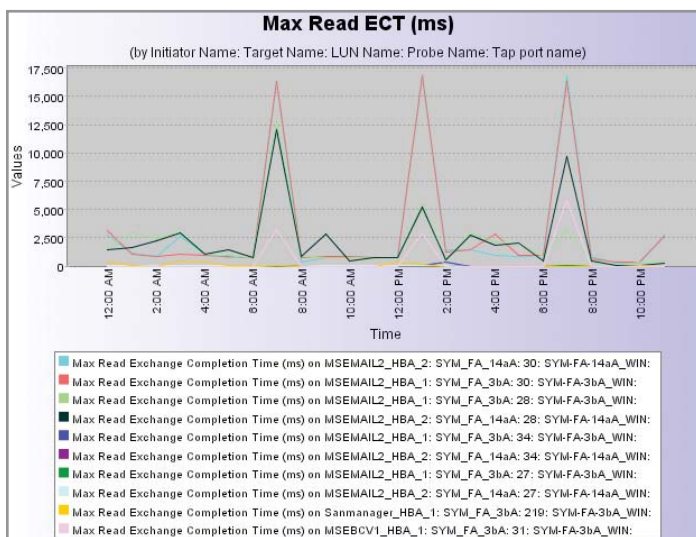


Figure 5: Exchange Completion Times per ITL

NetWisdom for Primary Tier Storage Services

Similarly to top-tier applications, sometimes a storage service is so critical to the SAN infrastructure that its failure impacts the survival of the business. An example of this is replication of data from a primary site to a remote site. Failure to keep a synchronized copy of critical data in a remote and safe location may result in non-compliance with federal regulations. Even worse, it may impact the performance of other critical applications using the same storage subsystem resource and jeopardize the fail safe mechanisms of the enterprise. A WAN or MAN connection may slow down replication, impacting the primary storage volume performance.

These impacts to remote replications can be grave enough to require constant and dedicated monitoring of traffic between the two replication storage subsystems. The ideal performance-monitoring solution to provide constant assurance of business critical storage services like remote replication is to implement dedicated traffic and protocol analysis on every fibre channel replication link.

NetWisdom provides the ability to monitor every packet of every link of the remote replication and analyze the performance of every SCSI I/O exchange to proactively spot faults, slowdowns, unexpected or unauthorized traffic, or failing devices that impact replication (see figure 6). NetWisdom can assure SAN managers that they are meeting their Recovery Point Objectives (RPOs) and appropriately using their WAN bandwidth.

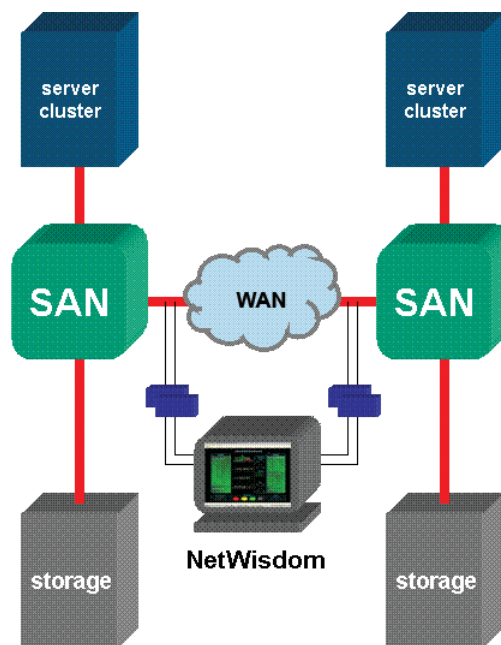


Figure 6: Tier One Remote Synchronous Replication Monitoring

With multi-million dollar investments required for high-end, long-distance remote replication infrastructure and software licenses, and with WAN multi-path leases up to a million dollars a month, it makes sense to maximize the remote replication investment by incorporating deep monitoring of the replication service to verify that replications are not being impacted by unexpected and unseen SAN complexities.

NetWisdom for Secondary Tier Applications and Storage

Although dedicated SAN packet analysis provides the most complete and timely performance and fault detection, in many cases this level of SAN performance and fault analysis is not required. IT organizations can reduce the cost of monitoring their secondary tier applications and storage services, by moving the NetWisdom capabilities across many SAN links rather than dedicating it to single links.

NetWisdom can analyze shared fibre channel SAN links (such as storage links or HBA links) to view more application storage traffic, and sample that traffic among multiple SAN links. A physical layer switch (PLS) allows NetWisdom to maximize connectivity for performance analysis. By adding a PLS, NetWisdom can rove from one port to another. The business criticality can dictate the number of links roved and the time spent to collect data from each SAN link. This NetWisdom architecture allows storage traffic performance and fault analysis on a SAN link to occur daily or multiple times per day for comparison against known good baseline data. Sampling storage traffic performance increases the ability to detect faults and problems before they impact the performance of the application.

A recommended implementation strategy to maximize the number of business applications being monitored by NetWisdom is to attach the roving capability to the storage links (figure 7). In this scenario, NetWisdom collects a sample of each storage link's traffic and analyzes the storage read and write performance, storage port queue depth, protocol faults, and latency times. Policy determines how long the metrics are collected before NetWisdom moves to the next link. Sampling of every link allows the SAN manager to monitor the health of all the applications using a storage sub-system and detect chronic issues before they become acute.

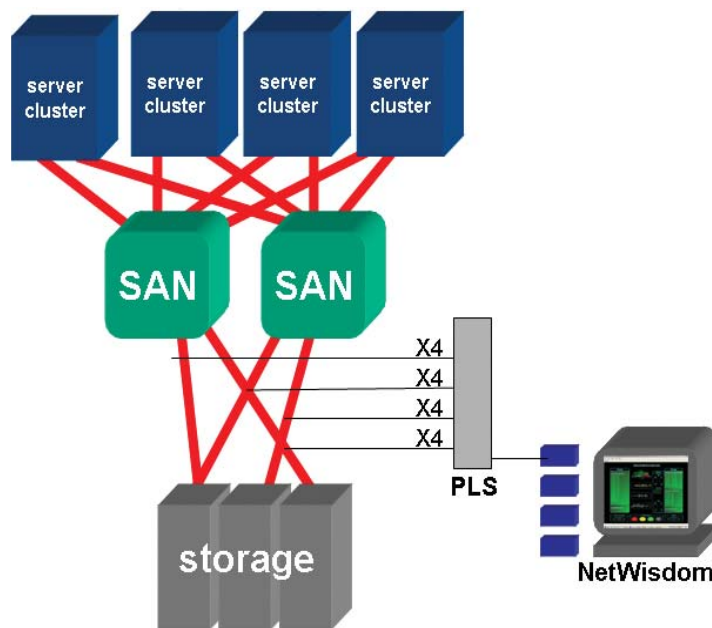


Figure 7: Roving Storage Link Monitoring

Another example implementation strategy is the monitoring of a storage virtualizer (see figure 8). In this scenario, NetWisdom can monitor the performance of storage virtualizer volumes through its links to the SAN. This can be achieved by roving across the server-side links or dedicated monitoring of every server side link. When performance I/O slowdowns of virtualized volumes are seen, NetWisdom can be switched or can rove between the back-end storage links to isolate where slowdowns or faults exist. In this way, hard-to-detect virtualizer slowdowns can be identified and the problematic back-end storage subsystem link can be isolated.

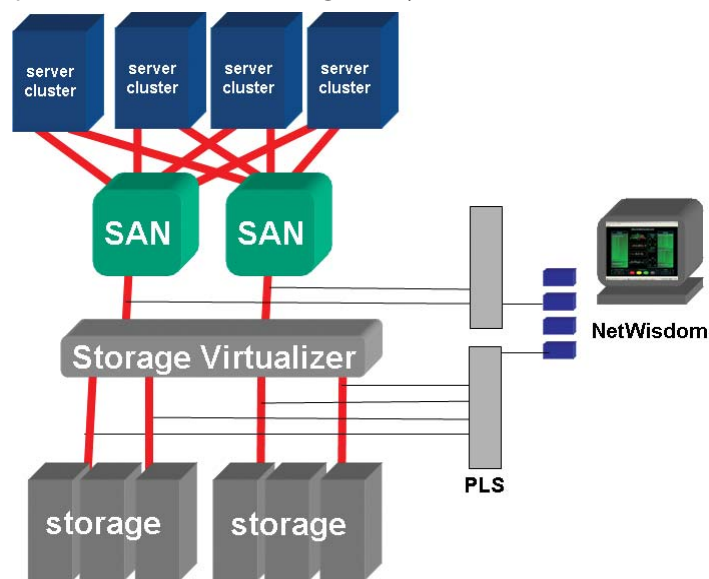


Figure 8: Virtualizer Monitoring

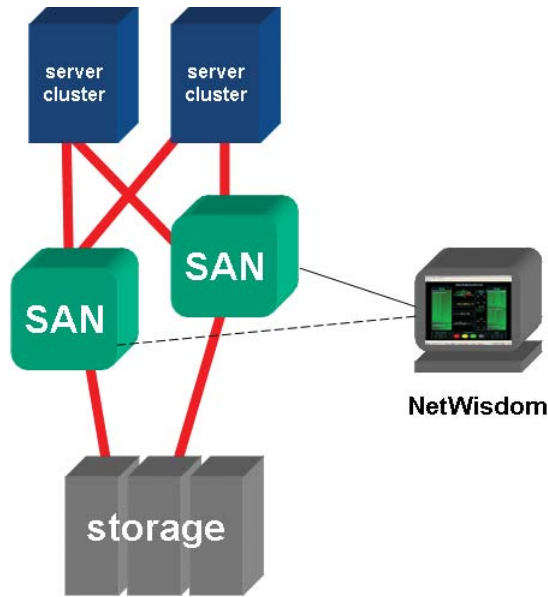


Figure 9: Fabric-only Monitoring

NetWisdom: High Vigilance For All Tiers

Administrators of complex systems require the ability to closely analyze the systems' inner workings in order to diagnose and prevent problems. NetWisdom sets a new industry standard for the quantity and quality of information in data flow analysis for fibre channel SANs. NetWisdom provides fully-realized data flow analysis solutions for critical top-tier applications, and enables companies to balance cost with vigilance in second-tier applications as well.

NetWisdom is a SAN management solution whose value far exceeds its cost of implementation, and helps data-centric businesses reach their primary goals: providing consistent data, quickly resolving problems, and improving the bottom line.

NetWisdom for Lower-Tier Applications and Storage

For the greatest reach with least monitoring infrastructure investment, NetWisdom has the ability to collect performance and fault information from SAN fabric switches through a standard internet protocol (IP) interface (see figure 9). The performance metrics for each switch port includes throughput (MB/s), percentage of bandwidth utilized, and fabric fault counters including CRC errors, dropped packets, loss of signal, loss of synchronization, link resets, and link failures. This implementation allows the furthest reach with the minimum amount of equipment.

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