TANEJA GROUP
TECHNOLOGY ANALYSTS

STUDY REPORT

Virtual Instruments Field Study Report

March 2010

Taneja Group conducted in-depth telephone interviews with a set of Virtual Instruments (VI) customers, of varying sizes and across several industry verticals, over a five-month period in late 2009 and early 2010. We sought deeper insight into the primary storage-related challenges these customers faced, and the most valuable benefits provided by VI's storage monitoring and optimization solutions. Our key findings include:

Consistently, customers described the NetWisdom product and VI Probes and TAPs as industry-leading technologies, as essential diagnostic tools for experienced and highly-knowledgeable storage engineers and administrators, and often as the only solution they considered. Users reported that VI products were especially well-suited for complex, multi-vendor, dynamic, high-performance and/or growing environments.

Most users had no experience with any comparable product and indeed, didn't believe there was an equivalent product available. Instead of providing direct competitive differentiation, most compared VI products to vendor SRM or fabric management tools and made it clear that VI has staked out an independent, agnostic, and highly valuable position as a neutral, complementary solution—adding significant value to these vendor-provided products.

Our interviews revealed that savvy storage engineers and administrators consider VI Probes and TAPs to be "best practice" components of an optimized SAN architecture, providing invaluable performance data that is both deep and fine-grained. The comprehensive dataset is deftly presented in the NetWisdom dashboard, along with extensive filtering, drill-down, and reporting features.

Several key storage challenges were consistent among the customers interviewed. The most commonly cited were: the desire for greater insight into SAN and application performance characteristics; the need to proactively identify and rapidly troubleshoot performance problems; the struggle to optimize storage tiering in order to manage costs as well as performance; the need to minimize the impact of data protection (backup) operations; and the strong desire for a cross-vendor and vendor-independent source of performance metrics.

The latter challenge is at the core of customers' views of the value of the VI solution: it provides cross-domain, protocol-level performance data that not only allows users to validate the claims of individual storage component vendors, but to broker more effective communication *between* vendors, minimizing finger-pointing and communication inefficiencies during problem diagnosis and troubleshooting. VI lowers both operating costs and capital expenses, by speeding problem resolution and enabling more efficient use of existing storage infrastructure.

Detailed Field Study Results

For each of the seven customers we interviewed, we first describe interviewee's role and responsibilities, and then outline the scope and scale of the storage environment under management. We then group the customer's reported storage challenges and related server and application challenges into use case categories, followed by a detailed description of how the VI product suite was deployed to address each challenge. In conclusion, we summarize the customer's experience with VI products and personnel and include illustrative quotes.

Customer 1: Large US Retailer

We interviewed the Technical Lead of the storage group for a large, national retail grocer. This user has been with his firm for five years, manages a team of eight, and has responsibility for all enterprise storage for open systems and mainframes, including backup, NAS and SAN environments.

The environment consists of approximately 2 PB distributed between two datacenters (Eden Prairie, MN and Boise, ID). There are approximately 2000 ports on their SAN switches today. Primary storage vendor is EMC; storage virtualization provided by IBM SVC; Brocade SAN switches. Other storage monitoring and management tools used in the environment include EMC Control Center, NetApp SANscreen, IBM TPC, & Brocade DFCM. Over the past year, the storage group has been heavily focused on seeking ways to "do more with less" across the storage infrastructure, with storage tiering being at the center of their efforts.

Challenges and Drivers

- **First challenge: Optimizing storage tiering**. The team is exploring all possibilities for moving all production data to as low a storage tier as possible. However, before they move any production data, it's critical to validate performance characteristics on the target, and NetWisdom provides the equipment and software to perform reliable validations. First, they do a deep dive into what the arrays are capable of and what their applications are actually using, e.g. cache utilization & IOPS. In parallel, they evaluate read and write latency across the SAN with NetWisdom. They watch all of these performance metrics over time –at least 3 months, ideally – and make sure to include known demand peaks. Since their storage is fully virtualized, they can then move data overnight easily, and they are also considering doing temporary re-tiering for applications that have cyclical demand peaks.

- **A second challenge**: **Storage performance troubleshooting**. The team has deployed TAPs (Traffic Access Points) throughout the SAN, so they are able to start data collection with Virtual Instruments ProbeFCXes or with a Protocol Analyzer as soon as they identify an issue. It is very rare for application performance problems to be storage related, but when they are, the team can resolve almost any issue within hours. For example, in a recent

situation, users reported a performance problem on a host attached to a Symmetrix array during a period when more hosts than normal were attached to the array (during a migration). The team quickly identified the problem as an oversaturated channel director.

- **A third challenge: Evaluating new vendor arrays & technologies.** The team is currently looking at alternative vendors for each storage tier, and they need to compare performance characteristics of each array using a standard set of benchmarks and data collection methods.

NetWisdom Experience

They can use NetWisdom to validate performance requirements prior to moving any critical production data, to make sure they place data in the proper tier. It has also helped them to determine what various tiers (1, 2, etc.) mean with respect to their unique application mix (aka: Performance-based storage tiering). To date, the team has successfully identified and moved over 100 TB off Tier 1 storage. In addition, NetWisdom helps them analyze data protection options; for example, whether it makes sense to switch from RAID 5 to RAID 6 for a particular application.

The customer "TAPs everything" as a best practice, and keeps historical data to track the impact of data migrations and to evaluate project success. They started with a few TAPs and an analyzer and grew the VI tools to match their storage growth (from a couple of hundred TB to 2 PB in six years). During this time of rapid data growth, the storage team has actually shrunk, but they are able to maintain high service levels given the rich data from NetWisdom.

The Technical Lead wishes every team member was fully trained – currently only one person is an "expert" on NetWisdom – but everyone can understand the reports he produces. He has not had to rely on VI for support very often, except for the engineers that originally helped them configure the system, and he was completely satisfied with the skills they brought to the table.

This customer couldn't provide hard dollar or time savings, but finds it easy to justify additional SAN monitoring solutions each time he's able to deflect a performance problem from being pinned on the storage team. He did estimate that NetWisdom saves him 5-10 hours per week in SAN troubleshooting and problem resolution time. For testing and evaluation of new storage technologies, using NetWisdom might add a small amount of time to the process, but provides results they could only guess at without it.

He is able to immediately deliver the *facts* about performance problems, not opinions, and that dramatically shortens problem resolution times. Except with Microsoft, he added jokingly: they challenge everything.

Key Quotes

"*This really helps us with our metrics. You can get the 90,000-foot view from other tools, but you're still guessing. NetWisdom gives you root cause.*"

"There's no DBA in this company that knows as much about his application as we do."

"When we looked around, you could find the TAP hardware, but no one had the software, the NetWisdom solution, to make sense of it all."

"If we didn't have NetWisdom, we'd be spending all our time chasing ghosts. It eliminates ghosts in a hurry."

"The charts are worth a thousand words: senior management gets it right away."

Summary

This user stressed tiering optimization and faster problem diagnosis as his primary use cases, and called out the depth of knowledge his team gained through NetWisdom. Building on this knowledge foundation, the team can run meaningful competitive testing between array vendors and make "apples to apples" comparisons to verify and evaluate competitive vendor performance claims.

Customer 2: Global Financial Services Firm

In this interview, we spoke with the Manager of Global Storage Ops for Governance, Compliance and Audit at a large, global financial services firm. This manager leads a team of individuals that drive processes, tools and methodologies that are used by storage administrators. In his prior role, the interviewee had managed backup storage for another of the company's divisions.

The storage installation consists of approximately 4 PB spread over some 50 arrays. The SAN includes switches from multiple switch vendors, all eventually acquired by Brocade (McData, Inrange). The company was an early adopter of NetWisdom – they have been using the product for more than three years, and employ it to monitor more than 30,000 switch ports.

Challenges and Drivers

- **A challenge: Identify SAN impact on application performance.** Database application users noticed sub-optimal performance, and contacted the firm's DBA's, who in turn notified the storage ops team. The storage team ran some tests and observed generally poor performance within the storage environment. The degradation in application performance happened erratically but repeatedly. The storage ops team did some analysis of what was going on in their EMC Symmetrix array, but they couldn't find anything wrong, despite the fact that users continued to see poor performance.

  Following a quick survey of third party storage tools that might be able to address this issue, the storage ops team narrowed the field down to a few choices and created an RFP to document their requirements. Based on the RFP responses, NetWisdom became their tool

of choice. They brought NetWisdom in for testing, and were quite satisfied with what they saw. NetWisdom enabled the storage ops team to understand what was happening at a wire (protocol) level, and to trace the performance issues back to individual SAN components.

- **A second challenge**: **Determine whether an open source SAN monitoring tool was providing accurate data.** The IT team had brought in an open source tool to monitor the SAN, based on recommendations from other users. This tool appeared to be the only option at the time for low-level monitoring of the storage network. Unfortunately, they suspected the tool might be giving them bad data, and so they decided to use NetWisdom to see whether their hunch was correct.

  The team checked out utilization of some 1 Gbit InterSwitch Links (ISLs), which the open source tool indicated were running at 50% utilization. When they measured the ISLs with NetWisdom, they found to their dismay that the ISLs were running at 100% utilization. By using NetWisdom to validate the metrics provided by the open source tool, they discovered a major data discrepancy, which could have led them to make some costly configuration mistakes in their network. As it turned out, NetWisdom saved them this embarrassment and expense.

NetWisdom Experience

The storage ops team uses NetWisdom extensively to monitor the health and performance of their SAN infrastructure. They like the ability to monitor a large and heterogeneous storage environment, including multiple vendors' storage systems, from a single pane of glass; this is a luxury compared to the multi-tool monitoring approach they had to take in the past. The team appreciates having the historical trending data, as it allows them to reconstruct problems as they initially developed. The storage ops manager also likes the various reports he can generate from NetWisdom.

Overall, NetWisdom has allowed the storage ops team to significantly reduce the staff time needed to troubleshoot and identify problems in the SAN. The product provides them with deep metrics that they never had before, which enables them in most cases to stay one step ahead of users, ensuring their sustained happiness. NetWisdom has also improved the effectiveness of the team's tiering strategy – they now know what data should be on what tier of storage.

Key Quote: "*Moving to full instrumentation gives me a very easy ability to quickly identify how to best tier data in our SAN.*"

Summary

This customer views NetWisdom primarily as a SAN performance monitoring and problem diagnosis tool, but they have found other uses for the product as well, such as employing NetWisdom to improve the effectiveness of their storage tiering.

Customer 3: US Government Agency

We interviewed the Manager of the System Performance Management for a large US government commerce-related agency. His responsibilities span capacity planning and performance management for servers, networks and storage (reporting to the CIO) and he's been in his current organization for over 13 years. His team includes 6 full-time staff and 5 contractors. Within the team, the manager is considered the "storage expert" for all Fibre Channel issues and he has one other team member focused solely on storage.

Challenges and Drivers

- **First challenge: SAN/Application problem diagnosis.** The customer described in detail the challenge of widespread server and storage virtualization: he says he is dealing with more layers of abstraction every year. When a performance problem arises, they can start investigation at either the server or storage tier, but it's often not clear which approach is optimal. The server might have a busy disk or might have a queuing problem, for example – they need a "rapid drill-down tool."

  Recently, the customer upgraded a production server (doubling CPU capacity) and implemented data replication to a backup server. The new production server was more powerful than the original, but I/O performance dropped by 25% - the team was baffled. They first explored the problem from the operating system vantage point and found a mismatch between logical and physical I/O operations. Using a SAN sniffer (Virtual Instruments ProbeFCX), the team traced I/O traffic on the FC network between the server and logical volume manager (HP/Veritas) and discovered an I/O packet size mismatch (8k vs 16k). With hard evidence, they were able to prove to the LVM vendor that it was a configuration error on their part: they had not tested for 16k I/O packets.

- **A second challenge**: **Identifying configuration errors that impact SAN performance.** In another situation, a virtual server farm (cluster) was regularly failing and refusing to boot. Server and hypervisor diagnostics couldn't identify the problem, and failure meant moving 13 hosted virtual desktops to another server. By tracing the FC network, the customer determined that the target device was issuing an abort sequence upon touching the LUN, and the virtual machine OS was improperly handling the valid FC alert – it wouldn't boot until the LUN was masked. An improperly configured driver on the server was to blame.

- **A third challenge: Better insight into performance.** This storage team wanted better I/O performance metrics than they were able to collect from their existing SRM tools (EMC Control Center). In order to improve service response and track SLAs closely, they needed finer-grained data collection and as little smoothing (time averaging) as possible. Control Center's coarse-grained monitoring often masked spikes, and from a probe/TAP perspective, the customer wished to be "agnostic": to collect data directly at the protocol

level rather than viewing a filtered data set via a storage vendor-supplied management product.

- **A fourth challenge**: **Identifying over-provisioned SAN links.** Finally, the customer also faced "overburdened" switch links and needed to first identify them, and then determine what the overall impact of running "hot" was on their service delivery capacity.

NetWisdom Experience

The I/O performance problem was a "flagship" use case for this customer with respect to NetWisdom. It took over 3 months of negotiation for the storage vendor to acknowledge the configuration problem. Frustrated during this time, the customer nearly resorted to adding additional LUNs to boost server performance, which would have cost nearly $1 million. Facing such a high cost, the customer was determined to provide an independent, auditable view of I/O subsystem behavior to prove his case to the vendor: NetWisdom provided that neutral view.

When the virtual server cluster boot failure problem surfaced, the customer immediately turned to his FC Probes and analyzers and resolved this problem in much less time. They were able to send traces to both NetApp and VMware and encourage the vendors to work together immediately; NetWisdom significantly reduced the time required to explain the issue, and provided solid evidence that sped the remediation process.

The customer called particular attention to NetWisdom's real-time and fine-grained data collection. He claims that it allows him to see what's actually going on at the protocol level, while other tools seem to want to mask or average everything out, smoothing the data too much to be useful for him. NetWisdom also helps the team with fan-in ratio planning. By giving insight into FC queues, it helps the team evaluate the impact of higher fan-in ratios (5-to-1 or 10-to-1) on application performance.

Key Quotes: *"NetWisdom gives me deeper insight, more data granularity, and near real-time data collection – this is more than I can get from any vendor SRM tool."*

"Virtual Instruments' staff knows Fibre Channel better than most vendors that sell it."

Summary

This customer has deep FC protocol experience, and considers himself an expert on the subject. He went out of his way to compliment Virtual Instruments' staff on their efforts to remain an "independent arbiter" for tough FC performance problems, and for continuing to deliver information the way he wants it. In sum, he views NetWisdom as an essential item in his diagnostic toolkit. It's particularly well-suited to solving tricky performance problems hidden within the layers of abstraction produced by widespread server and storage virtualization.

Customer 4: Regional Health Care Provider

We interviewed the SAN Storage Team Lead, who manages all storage operations for this large regional health care provider in the Southwest US. The environment includes a 550-plus bed hospital, outpatient care center and a psychiatric services facility.

The storage team, including the Team Lead, consists of 3 engineers responsible for a 200+ TB SAN environment which is growing at close to 100% per year. All storage is currently in one facility in Fort Worth, TX, and the team is evaluating and planning for a DR facility in North Dallas. The DR site will likely eventually become primary.

Storage is spread across 3 primary arrays, with a fourth for radiology data (considered a secondary array). All storage is modular. Data types include electronic medical records, billing system data, open systems data shared with mainframe environment, databases, file servers, e-mail, and more.

Challenges and Drivers

Storage is currently based primarily on IBM and Hitachi Data Systems (HDS) arrays, with Brocade switches (over 300 FC SAN ports). Before the team lead arrived, the customer had some older IBM equipment (legacy equipment), no storage experts on site, and older firmware. The team lead sought out Virtual Instruments' NetWisdom proactively, to act as a "second set of eyes" when he was the only storage expert and planning for some major upgrade work.

When the team launched the enterprise SAN upgrade, he included NetWisdom as an integral component of the new environment to watch every port, every HBA – in sum, to help identify problems before they arose.

- **First challenge: Proactively identifying SAN performance problems before users are affected.** The team needed to identify cabling problems, firmware problems, HBA problems, etc., proactively, before the application teams discovered them. They had experienced system outages in the past that were unacceptable: the team lead stressed that, as a medical facility, they cannot tolerate "any downtime at all," and must try to identify potential problems well in advance of a cascading problem that cases application failure.

- **A second challenge: Communication with storage vendors and eliminating finger-pointing.** The customer reported that the vendors of the major arrays only look at their own internal devices. EMC, IBM, and HDS "will help you fix it, but the problem is getting them to acknowledge the problem, which is often in the connectivity layer between the array and the rest of our components." The customer needed an independent solution that would keep the vendors "honest".

- **A third challenge: Optimizing performance-based storage tiering.** As medical records retention requirements continue to increase (over 20 years in many cases), the

customer's future capacity requirements are expected to grow exponentially and, along with them, the scope and scale of problems with access and tiering. More and more, they need to examine a particular disk array's performance to make sure they've deployed data on the optimal tier.

NetWisdom Experience

Typically, and before using NetWisdom, the team would have to wait for problems to appear, at which point the urgency of the issue made diagnosis more difficult and error-prone. With proactive monitoring, they might see a high level of CV (code violation) errors and a particular LUN will show up over and over again, for example; NetWisdom highlights the issue and allows the team to iteratively drill down until they identify the particular ports responsible. Now, the team implements TAPs everywhere they can, and relies on the ProbeFCX device on a daily basis.

In one case they discovered a firmware problem on certain HBAs, causing weekly failover. The server team thought it was due to internal controllers, but replacing one didn't eliminate the periodic failure. The storage team was already seeing the problem via NetWisdom and this insight enabled them to help the server team avoid unnecessary additional reconfiguration work.

For the second challenge, the team has used SRM tools from the array and switch fabric vendors, but is not satisfied with them in general for mixed-environment management. These tools are seen as very vendor-specific and the team doesn't have the manpower to learn and integrate multiple tools to create a "big picture" view. NetWisdom has become the "baseline" management system, delivering agnostic performance metrics. The team does rely on vendor SRM tools as needed for specific management tasks (Brocade and HDS SRM tools, in particular), but sees them more as reporting than as troubleshooting tools.

With NetWisdom, daily performance reports are now "standard operating procedure," and are produced automatically. The team also sends these reports to IBM and HDS proactively, to speed problem resolution times. The team lead likes the simple-to-use GUI, called out the dashboard as particularly useful (he watches it all day to identify any strange spikes), and appreciated the quick turnaround time on customization requests.

To help with tiering, the customer typically observes performance in detail for 5 minutes every 45 minutes, but for specific tiered disks he adjusts the NetWisdom reporting schedule to either expand or contract the collection window. While it took some time initially to become familiar with the product GUI, he's now confident that he can adjust data collection windows quickly, in order to make the best decision about whether to tier a disk up or down.

Virtual Instruments Experience & Results

Training was comprehensive and implementation was straightforward—the Virtual Instruments team took care of everything and stayed on site until every team member was comfortable operating the solution. Virtual Instruments even ran a follow-up telephone training session as part of their QuickStart service.

The team lead has allocated over 10% of his $2.5 million project budget to Virtual Instruments hardware and software, and sees this as a reasonable investment, given that "we've found 4 problems before they had an impact on production, and the solution is basically like having an extra member of the team." He expects NetWisdom to be even more valuable as he splits data between his primary and new disaster recovery location.

Key Quotes

"We can't really be down – ever – and we need NetWisdom to stay ahead of these problems and avoid anything close to a major meltdown."

"Communicating with my array vendors is so much easier now: I send them all the data they need, before they know they need it."

"I consider NetWisdom as my 'fourth man,' and sometimes my fifth and sixth as well."

"My team learned more about storage in a week than they had in the previous 3 years."

"Everyone should deploy TAPs. They're like the valve for checking tire pressure."

"All the storage vendors will help you to fix problems, if you can identify the problem—that's the trick."

"This thing reports on everything!"

"My VI sales engineer is in the area whenever I need him, and always spends extra time if I ask him to."

Summary

This customer values the NetWisdom solution first as his "eyes and ears" to alert him and his team to issues proactively—before they become serious problems. He relies on NetWisdom to provide vendor-neutral performance metrics at the hardware level, metrics he feeds back to his storage vendors to dramatically reduce the time it takes to start resolving a problem. With detailed performance data, he can quickly decide whether to move a disk up or down a tier.

Customer 5: Global Financial Services Firm

We interviewed the SAN Operations Manager at a major global financial services company. The manager leads a team of four IT operations specialists who are responsible for maintaining the SAN, including storage frame, switches, and NAS heads—everything up to the Host Bus Adapters (HBAs) on the server side. The manager has been in his current role for approximately 18 months, and reports to the head of IT operations, who has responsibility for proper operation of the entire infrastructure—servers, storage, networks, and operations such as data protection, disaster recovery, and more.

This shop is based almost entirely (95%) on EMC storage; they maintain a total of 500 TB within several DMX3 and DMX4 arrays, and deploy a small Fujitsu Eternus system for tape backup. The team also supports an EMC Centera archiving solution in the environment. They have a single Clariion storage processor, purpose built for the Celerra NAS heads, which collectively store on the order of 15TB. The team manages 1200 switch ports, mostly Cisco-based (the manager inherited a Cisco environment).

The servers have relatively small configurations, but are heavily virtualized, running multiple IBM AIX OS sessions.

Challenges and Drivers

- **First challenge: SAN/application problem diagnosis.** The SAN operations team's first challenge was to diagnose a performance issue that was occurring somewhere between some Oracle 10g data warehousing applications and the SAN. This problem had arisen over time and directly affected Oracle database application owners, who had begun to see their query response times deteriorate. The application owners approached the database administrators (DBAs) to address the issue, and after doing some preliminary analysis, the DBAs in turn went to the SAN operations team, since they believed the problem was rooted in the SAN storage configuration.

  More specifically, the company had set up two Oracle 10g data warehouses. When the DBAs first came to the SAN operations team to report the problem, they were seeing 25-30+ millisecond response times for their queries, which resulted in an average wait time of 3 hours for some of the more complex queries to complete. Unfortunately, given their current toolset, there was no way for the SAN operations manager to diagnose the problem, because they couldn't isolate the issue to a specific data warehouse, let alone to specific LUNs. There was basically no hard data at a level of granularity that would allow them to understand the problem. As a result, as the department residing at the bottom of the internal IT "value chain" – furthest removed from the application owners and users – the SAN operations team had to own the problem, and try to come up with a way to determine the root cause.

To address the issue, the SAN operations team installed NetWisdom. As a first step, they checked out the SNMP trending tools (ProbeV) from the switches and then TAPed and put ProbeFCXes on all the storage ports that the heavy-hitting database applications use. They had three fully-populated ProbeFCXes – for a total of 24 probe ports, connected to a total of six IBM VIO Server boxes with 24, 4GB HBAs. Next, they created filters all the way down to the LUN level, and identified which data warehouse each LUN was associated with. They then used NetWisdom to generate reports of vital statistics, such as the response time (ms) over time; the read block sizes over time; and the volumes of data (Mbytes) they were sending down the pipes over time. These metrics enabled them to fully separate the two data warehouse environments, so they could isolate the effect of specific queries and ultimately determine what was responsible for the high latencies.

In particular, the SAN Operations manager noticed that when data warehouse 1 would start a batch job, it would cause a significant slowdown in warehouse 2. Using the NetWisdom reports and some sensitivity analysis, he determined that queries with large read block sizes – some as large as 1MB – generated very long wait times. He advised the DBAs to reduce their read block sizes significantly, to eliminate the wasted space (the reads weren't nearly using the whole block).

This was just the breakthrough needed to solve the problem. With the more efficient read block sizes, the response times dropped from 25-30 ms to sub-10 ms, and the overall wait times for queries were reduced by more than one-half. So the complex queries, that had previously taken 3 hours to complete, now had wait times of less than 1-1/2 hours. The DBAs were ecstatic, and the application owners were again satisfied with IT service levels.

- **A second challenge**: **Finding the best backup window.** This challenge involved understanding why application backups were taking so long during designated off hours, and determining a better timeframe in which to perform the backups. This challenge surfaced when the IT team introduced a new application, gave it 4 TB of storage, and asked the application group to test it. The application owners then asked the DBAs when would be the ideal time to do backups – incrementals daily, and level 0 weekly – in an effort to avoid the window in which resource-intensive batch operations would be running. The DBAs advised the ops team to perform the backups between 6 pm and 12 midnight, after the majority of users had gone home but before the heavy batch operations commenced.

  They started doing backups during this window, but after three weeks noticed that the backup performance was quite poor. In fact, in some cases, the nightly backups did not successfully complete. The application owners immediately blamed the SAN for the poor performance. The SAN operations team decided to use NetWisdom to give them a better picture of what was really happening. By running NetWisdom and collecting statistics on a night when backups were not run, the Ops team was able to determine that the target backup window was actually the time of day when SAN utilization levels were highest. To

figure out why, they used NetWisdom to trend usage data over time and filter it down to one server.

What they discovered is that users had batched up a series of huge queries on this server, and left them running after they left for the day. These queries typically took 4-5 hours to complete, which put a lot pressure on SAN storage resources between 6pm and 11pm every weekday. By observing additional NetWisdom data, the SAN Ops team determined that the quietest, lowest-utilization time of day was actually between 11pm and 2am, up until the time that the standard, scheduled batch jobs started running. As a result of this analysis, the backups were rescheduled to begin at 11pm, which reduced the load on SAN resources from 6-11 pm, during what turned out to be a peak time of the day, and significantly reduced the average backup windows. Application backups were able to run completely during the allotted window, making the application owners happy once more.

- **A third challenge**: **Detecting problems in the replication network.** The company recently started using EMC SRDF for replication, which was a new technology to them. Every once in awhile, the SAN Ops team observed a complete link drop, even during the middle of the day, which lasted from 20 seconds up to over 5 minutes. After a few minutes, replication would completely cease.

  Why would the Symmetrix be doing a link reset in the middle of the day? To determine that, the SAN Ops team installed a Protocol Analyzer, using the TAPs they already had in place. An EMC technical specialist showed up to take a trace, and told the SAN Ops manager that he would need to take down some of the links first to make this happen, which the EMC rep expected would need to happen over several days.

  Instead, using the NetWisdom solution and existing TAPs, the EMC rep walked away with a trace after a few hours, which he used to diagnose the problem. It turned out that the fabric extender was sending jumbo packets to the switches, and the inter vlink was not configured to handle them properly.

  With NetWisdom, the company was able to save weeks of troubleshooting time.

NetWisdom Experience

The SAN Operations manager finds the NetWisdom trending reports to be extremely useful, because they allow him to anticipate and predict developing issues in addition to diagnosing existing ones. When he sees irregularities in the trending data, he can use NetWisdom to perform "what-if" analysis, for example by tweaking one variable in a query or the network and then reviewing the "before" and "after" picture of the data on a single graph to see how that particular change affects response times, throughput, etc. Unlike with alternative vendor-supplied products that merely provide red, yellow or green bars or splotches to indicate the fitness of a specific metric, NetWisdom delivers the actual data, which over and over again has proven invaluable to the SAN Operations team.

In fact, the NetWisdom reports provide him with the hard data he needs to do root cause analysis of new problems and to deflect the finger-pointing that traditionally came from other parts of the IT organization, such as DBAs who would assume that the SAN was responsible for specific performance issues. Now, with the NetWisdom reports in hand, the manager can point directly to relevant data and avoid speculation about what's really happening. In the daily 8:45 Ops team meetings when the SAN is mentioned, the manager has all the info at his fingertips. The DBAs have grown so accustomed to the reports that they now ask to see specific data when troubleshooting issues, and the manager has given more of his colleagues read access so that they can check out the reports independently. In this way, NetWisdom has helped the SAN Operations team to elevate their standing within the IT organization, and be given the technical respect they deserve.

Overall, the SAN Operations team really likes the scale of the NetWisdom data, which they find to be "infinitely deeper" than what they get from other tools. The team also really appreciates the historical data, since many problems are not discovered right away and the best clues as to what's really happening are in the historical logs, especially for intermittent problems. The in-place TAPs and Probes are viewed as an extremely valuable resource, because they provide a pre-instrumented toolset for spotting and diagnosing a large number of technical issues. Finally, the manager has high praise for the quality and responsiveness of NetWisdom support personnel. He often gets responses to questions within 10-30 minutes, which he "could only dream of getting" from larger vendors.

Key Quotes

"By lifting the "SAN skirt", NetWisdom has for the first time allowed us to show metrics that everyone else in the organization – including DBAs and application owners – can understand."

"NetWisdom has become the deflector of problems for me."

"In dealing with our DBAs, the cold, hard facts I get from NetWisdom will overrule their what-if statements every single time."

Summary

This customer sees NetWisdom primarily as a problem diagnosis tool in the SAN and broader application environment. But the SAN Ops Manager told us that there are "a million other things" the product can be used for. In fact, he originally sold his management on functionality that would allow him to identify and clean up issues in his SAN, such as automated alerts and class 3 discards (to help flag Fibre Channel objects that no longer exist). NetWisdom helped him to quickly verify that his SAN was already quite clean. As another example, he has already used NetWisdom to diagnose a SQL cluster problem that had nothing to do with his SAN. Overall, the customer's NetWisdom investment paid for itself within the first few months, and is consistently demonstrating new ways to deliver value.

Customer 6: Large Health Care Technology & Services Provider

We spoke with a Storage Engineer in the Storage Implementation Group (SIG) at a large health care technology and services provider. The engineer is responsible for building the storage infrastructure, configuring new servers on the SAN, and SAN backup processes. The engineer's responsibility includes configuring storage for physical and virtual servers, and most of the storage is for Windows hosts. He also gets involved in provisioning ESX hosts. Once the SAN infrastructure has been built and configured, the SIG hands it off to an operations group, which oversees and manages the storage in production. The engineer has been in his current role for almost two years.

In addition to Windows hosts, the server infrastructure includes HP-UX and AIX based UNIX Servers, and a number of physical and virtual server (ESX) clusters. Many of the company's web and application servers have already been virtualized, and run on ESX clusters, with an average of 20 VMs running per host. The engineer is responsible for backup on both physical and virtual servers, and handles physical-to-virtual (P2V) migrations as well. At the time of our interview, the SIG team had been using NetWisdom for about 10 months.

Challenges and Drivers

- **A challenge: Planning storage capacity needs.** One of the primary challenges the SIG faced was to stay ahead of user demand for new storage. They needed to provision enough SAN capacity to satisfy near-term needs, but the large number of virtual servers running in the environment uses the SAN for all of their storage needs, making it difficult to keep up with demand. When the SIG team did fall behind, they had to play catch-up, even as demand grew further.

  This internal struggle pointed out the need for better capacity planning. Although it was not originally brought in for this purpose, NetWisdom ended up being a natural choice to assist the SIG in forecasting future capacity needs. The trending data in NetWisdom allowed the team to more accurately assess current usage of SAN resources, and to project the level of resources they would require in the future. This, in turn, enabled them to provision the required storage capacity and other SAN components in anticipation of user demand.

- **A second challenge: Identifying VM backup issues.** The SIG was responsible for backing up all the physical and virtual machines in their environment. But virtual machine backups using traditional agent-based backup in the guest operating systems proved disruptive to other applications, as these backup processes required CPU and memory cycles on the host. With an average of 20 VMs running on each physical machine, backups heavily taxed system resources. To overcome this issue, the SIG team decided to try VMware Consolidated Backup (VCB) for VM backups. This worked well at first, as VCB offloaded backup processing from the VMs, thereby reducing the CPU and memory impact.

However, the team soon encountered a new problem: after VCB completed a proxy backup of a mounted snapshot, in some cases it didn't release the snapshot properly, causing the backup job to hang. Unfortunately, this issue often didn't manifest itself until the backup cycle the next day, when the next set of backups failed.

To address this problem, the SIG team's first approach was to try to trigger an alert when VCB failed to release a snapshot, and automatically issue a Remedy trouble ticket. Unfortunately, this approach could not be implemented at the individual VM level. Their next idea was to write custom scripts to monitor the backup process and try to determine when a virtual server experienced a backup failure. Though this approach was feasible, it would be costly in terms of administrative effort and ongoing support.

The SIG team decided to discontinue use of VCB, and return to the original approach of agent-based backups in the VMs. The team took this step knowing that NetWisdom would allow them to see right away when they had a backup reliability or performance issue – often before their users saw it. NetWisdom helped the SIG to detect problems like this much more quickly, and often take action before service levels were affected.

- **A third challenge: Identify over-provisioned and problematic ISLs.** Prior to bringing in NetWisdom, the SIG experienced some failures between core and edge switches that were extremely difficult to diagnose. These failures sometimes affected application owners, who noticed a reduction in throughput, and immediately assumed it was a storage-specific issue. The SIG could identify failures between core switches and storage frame, but had no visibility into issues occurring between two switches. It could therefore take days to diagnose problems in the InterSwitch Links (ISLs). This was the original motivation for the SIG's acquisition of NetWisdom.

  With NetWisdom, ISL failures became a non-issue. Using SMARTS alerts triggered by NetWisdom data, the IT team was readily able to determine which ISL had a problem, and in many cases, inform the application owners proactively before they even noticed a performance impact. NetWisdom allowed the SIG to "get visibility into the interior of their switch fabrics", and identify ISL bottlenecks they had never seen before. Specifically, NetWisdom-generated alerts informed the IT team when an ISL pair was saturated, which allowed them to add another pair of ISLs to the trunk before a failure occurred. This approach saved the IT team days of troubleshooting effort, and enabled them to maintain application service levels, keeping both users and IT managers happy.

  But once NetWisdom was installed, the team soon saw additional benefits of the NetWisdom data. For instance, the data gave them insight into available switch capacity, taking the guesswork out of this exercise, and allowing them to more accurately plan their future requirements for new ports and new switches.

NetWisdom Experience

This customer initially found NetWisdom to be easy to configure, and it basically worked for them out of the box. The company is using the software probes only, which allowed them to avoid interrupting their environment at the time of installation. The company uses both the NetWisdom dashboard and reports extensively, and has found both to be quite helpful. The SIG team called on the Virtual Instruments support organization a number of times early on, and the support reps helped the engineer to set up custom reports – e.g. showing min/max/average throughput over time. SIG team members have found the skill level of the NetWisdom support team to be well beyond what they've needed, and have also found the support staff to be quite responsive to ongoing requests for technical help. The NetWisdom reps have demonstrated a willingness to stay as late as required to help the customer work through and resolve support issues.

The customer uses NetWisdom's data extensively to monitor the health of their SAN and to address backup and performance issues, often before they become visible to users. In particular, the product allows them to view data transitioning through the fabric, and gain visibility into overprovisioned ISLs before they become bottlenecks. This type of low-level data provides insight that they never had before, and could not achieve through the use of vendor-specific tools. As a result, the customer believes it has achieved a significant return on its original NetWisdom investment.

Key Quotes

*"NetWisdom allows us to identify bottlenecks we could never see before, such as in InterSwitch Links. Whereas before NetWisdom we had to **guess** at the cause, now we **know** it with confidence."*

Summary

This customer sees NetWisdom primarily as a SAN problem diagnosis tool, but made a point of calling out the benefits for SAN capacity and performance planning as well. The SIG team has continued to find new uses for the data and insight that NetWisdom provides.

Customer 7: Global Consumer Packaged Goods Company

We spoke with the IT Director for Enterprise Computing at a large global consumer packaged goods company. Also on the line were two of his staff members: an Enterprise Hosting Manager responsible for most of the company's production platforms, and a manager of the SAN, backup and UNIX environments.

The company runs a SAN infrastructure with 5+ PB of storage, along with approximately 2000 Wintel servers and 1000 UNIX servers. They employ IBM SVC systems as a front end to virtualize storage, which allows them to standardize server builds, deploy multi-pathing between storage and servers, and present a uniform view across their SAN environment. The storage virtualization layer reduces their storage footprint, but also increases complexity, making it more difficult for them to manage the environment. They run VMware on their servers, and are using IBM's VIO Server on IBM PCs to "consolidate I/O requirements on LAN and SAN". A staff of six IT professionals manages this entire environment, so the company strongly relies on standard platforms and processes to help them achieve management efficiency.

Challenges and Drivers

- **A challenge: Detecting failing SAN device(s).** The first challenge – and the reason that the company brought NetWisdom in – was to diagnose an insidious, recurring problem in their SAN fabric. The IT team determined they had a bad switching fabric, but with the large number of switches and the virtualization layer, it was very difficult to see what was going on under the covers. They discovered badly formed packets, but the fabric reacted differently to them each time, so they couldn't trace the problem to its source.

  Early on, they attempted to guess at the cause of the problem and make changes to try to remedy it, but when these steps didn't work, they had to go through the process all over again the next time the issue surfaced. At one point, they blindly added more storage capacity, but this did not overcome the issue. The problem would occur only irregularly, and the IT team felt they needed to gather historical data and get it all in one place to analyze it.

  To really see what was going on, they needed a tool that allowed them to peer all the way down to the fiber layer, and then collect and trend key data points over time. One of their suppliers, HP, had recommended that NetWisdom was the only offering that would enable them to do that. They installed NetWisdom ProbeFCXes with TAPs, which gave them visibility down at the wire level and finally allowed them to isolate the problem to a slow draining device. NetWisdom eliminated the guesswork and gave them the data required to diagnose the problem.

- **A second challenge: Identifying SAN impact on application performance.** The team's ability to understand performance issues became especially difficult with IBM SVC, given the complexity added by the virtualization layer. To try to mitigate this issue, IT management standardized SAN configurations as well as builds and components, in an attempt to reduce variability and increase predictability in the network. But unfortunately, given the dynamic and growing IT infrastructure, this was not enough to help them solve the problem.

  NetWisdom provided the toolset they needed to diagnose SAN-related performance issues. By tapping at the network connections leading to/from the SVC and relevant switches, they were able to see what was happening in the paths to and from the storage arrays and servers. This gave them the visibility and trend data they needed to address the performance issues.

- **A third challenge: Reducing SAN/application downtime.** Given their experience with the bad switching fabric, the IT team was especially concerned about potential SAN outages, and decided to take concrete steps to prevent these outages from happening. This was especially difficult for them, because much of their storage environment was basically invisible behind virtual layers. Once again, NetWisdom allowed the team to analyze and monitor trending data, so that when issues would arise, they could quickly determine the root cause, and significantly reduce the probability of SAN – and ultimately, application – downtime.

- **A fourth challenge: Better understanding SAN storage utilization.** Before NetWisdom, the IT team had no way to see through the virtual layers to understand how array storage was really being utilized. Once NetWisdom was brought in house, they used the product to identify hot spots and cold spots, which allowed them to rebalance and/or re-tier volumes to increase utilization. NetWisdom has allowed SAN management to better understand their utilization thresholds, so they can optimize load balancing per server. The product has also enabled them to determine the most opportune times to do new releases, which might otherwise affect the availability or performance of primary storage.

- **Additional challenges.** The company has used NetWisdom to help them overcome some other storage related problems as well. For one thing, it has allowed them to optimize storage tiering, giving them the intelligence needed to assign specific storage volumes to the appropriate tiers to optimize availability, performance and cost. Second, NetWisdom has enabled the IT team to more accurately measure backup utilization rates and find the best backup windows.

  Finally, the product has proven extremely useful in SAN infrastructure planning. NetWisdom trending reports and analysis help ensure that the SAN infrastructure is moving in the right direction. They can use the data to anticipate capacity and performance needs, and make sure these are satisfied through the right choice of storage systems and

configurations. In addition, NetWisdom, as a vendor-agnostic tool, has enabled them to validate technology choices, and help keep storage vendors honest in the process. For example, rather than take the word of a storage vendor that claims its product is ideal for primary, production storage, the IT team can use NetWisdom data to help qualify and validate the product before deciding whether and how to deploy it in production.

NetWisdom Experience

The IT director is happy that he can finally monitor and measure his storage infrastructure, which he did not have the ability to do before NetWisdom. The IT team really likes the depth of data in NetWisdom reports, which they have not seen in any other product. The trending reports allow the team to see what has gone on historically and not only address existing SAN-related problems, but also anticipate and take steps to avoid issues that might occur in the future. This has, on more than one occasion, helped them to redirect IT staff cycles that would otherwise be spent on diagnosing and fixing problems to more valuable uses. IT management also likes the multiple-vendor support coupled with the vendor-agnostic nature of the product, which allows them to use it productively across a heterogeneous environment.

Key Quotes

Here are several noteworthy quotes – some slightly paraphrased – made by the IT director and his staff members during our phone interview:

"*NetWisdom is quite intuitive and easy to configure. The reports are easy to read, and a very helpful and technically capable organization stands behind the product.*"

"*We've decided to make NetWisdom hardware (TAPs and Probes) a standard part of all new installations – it goes in at build time.*"

We've measured a large reduction – greater than 50% - in the number of internal, SAN-related support incidents since we've implemented NetWisdom."

"*The use of NetWisdom has led to less adverse impact (of technical issues) on the business, and more uptime for services.*"

Summary

This customer sees NetWisdom first and foremost as a SAN problem diagnosis tool, but clearly also recognizes its benefits as an ongoing storage and SAN optimization tool, to help them control costs, and anticipate and avoid issues that could lead to costly downtime. The IT team discussed a large number of uses for the product, which has become an essential part of the company's SAN toolkit.

Product Use Case Summary

The chart below indicates the top customer use cases by citation frequency:

Use Case	1	2	3	4	5	6	7
Speed SAN/Application problem diagnosis and Improve troubleshooting	+	+	+	+	+		
Optimize storage tiering	+	+		+			+
Gain deeper insight into SAN performance and related Application performance		+	+				+
Optimize backup windows					+	+	+
Identify over-provisioned SAN links			+			+	
Better capacity planning, trending, and utilization knowledge						+	+
Evaluate new vendor arrays and other technologies before deployment	+						+
Validate metrics produced by other SRM products		+					+
Improve communication with storage vendors to avoid finger-pointing				+			
Identify configuration impacts on SAN performance			+				
Detect failing SAN devices							+
Reduce SAN/Application downtime							+
Detect problems in a replication network					+		