

MASSIVELY SCALABLE, INTRINSICALLY SIMPLE: TINTRI'S LOW TCO FOR THE VIRTUALIZED DATA CENTER

TINTRI FIELD REPORT

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Fast-growing virtualized environments present a thorny storage challenge to IT. Whether mission-critical applications with demanding SLAs, VDI rollouts with boot storms, or deploying a private cloud for large dev & test environments: delivering virtualized environments and cloud deployments using traditional storage can stall or break a virtualization project.

Flash technology is certainly part of the solution to performance challenges posed by virtualized workloads, but can be prohibitively expensive to broadly implement across the environment. Although flash can be deployed in a number of targeted ways and placed in the infrastructure, the more it is tied down to specific hosts and workloads, the less benefit it provides to the overall production environment. This in turn causes more management overhead.

Recently Taneja Group ran Tintri VMstore storage through our hands-on validation lab and documented significant large factors of improvement over traditional storage. Those factors accrue through Tintri's cost-effective acquisition, simplicity and ease of deployment and data migration, effective high performance and availability and smooth expansion over time.

This Field Report validates our impressive lab findings with feedback from the field: six customers who have Tintri storage in production environments. While each customer has a unique own story to tell, we found that everyone documented a compelling value proposition based on TCO factors. Throughout our research we found that Tintri's approach provides significantly lower TCO than traditional storage solutions.

THE HIGH COST OF LEGACY STORAGE

Traditional SAN storage was designed to provide robust, high performance processing for server-oriented workloads, while traditional NAS filers were built for general access file homing and sharing. Both were valuable to their original use cases but server virtualization has brought many new challenges to solve.

For one, virtualization frequently causes performance issues by mixing up IO across multiple VMs. This so-called "IO blender effect" can thwart older storage technologies whose performance depends on taking advantage of workload specific read/write patterns. Virtualization departs from the specific workload model: when aggregated across VMs, the host-level IO primarily sends IO that the storage controllers read as large volume random read/writes.

Second, and perhaps more significantly, there are management inefficiencies inherent in mounting multiple VMs per LUN or file volume. The IO blender effect also creates a lack of visibility into individual applications running as VMs across traditional storage systems. This makes troubleshooting very time consuming for administrators who are forced to investigate problems using multiple and separate tools for applications and storage systems. Complex management tasks impose a large burden on IT, and can require separate storage domain expertise. Before there were viable options, this costly friction was seen as a normal cost of doing business.

But here at Taneja Group we've been predicting the end of storage managed at the LUN and volume level. There is no fundamental reason for managing storage resources using traditional constructs, such as LUNs and volumes that are a misfit, at best, for their end-usage: to serve VMs. In virtualized environments, storage should naturally be served in the way it's going to be consumed – at VM level per-VM.

This inefficiency and resulting high cost of legacy storage accrues across every TCO factor we've examined, both CapEx and OpEx. We uncovered several issues with virtualization and traditional storage in our research and company interviews:

Virtualization Issues with Traditional Storage	Why it Matters
Higher Acquisition Cost	Virtualization users with traditional storage must buy more capacity, more controllers, and more spindles than simple capacity planning would indicate.
Performance Bottlenecks	Because of high random IO, legacy storage either needs over-provisioned capacity to handle the performance needs or a lot of expensive bolted-on SSDs. Both these approaches add to both CapEx and OpEx.
Storage Domain Expertise	Legacy storage requires specific storage domain management with its own tooling, processes, and terminology. Training and building experience takes months of intensive effort.
Virtual Management Friction	Legacy storage is difficult to provision, maintain and grow for virtualized environments. Functions like easy VM migration, quick provisioning, performance troubleshooting and tuning and expansion are inhibited by having to work around storage-side constructs, such as LUNs or volumes.
Virtualization Mismatch	Scaling virtual desktops, private clouds and general servers can be very expensive, and is a major obstacle to wider adoption. Growing these virtualized environments can simply overwhelm traditionally designed storage.

Tintri's Low TCO

By aligning storage directly with virtual machines, storage features like performance and availability service settings, snapshots and thin clones and replication can be provided at a VM-level. Tintri VMstore systems either optimize or eliminate many TCO factors that are exacerbated with traditional storage.

For example, minimize the need for extra spindles or excessive flash by avoiding isolated or over-provisioned disk space. Management tasks, such as provisioning and troubleshooting, are greatly simplified, lowering ongoing costs of operations and staffing. In the rest of this report, we'll see how Tintri's improvements over traditional storage options stack up in actual deployments.

Key Enabling Tintri Architecture

Before we get into our field interview findings on real world TCO, it's worth reviewing Tintri's intentional designs for the virtualized data center. In hindsight it seems obvious: VMs are best served by storage resources that are fully aligned with the virtual machine construct. This approach eliminates the absolute need for a separate storage domain as admins can now administer storage in-band with other VM resources. In addition, it ends the need to align many dynamic VMs with hard-configured LUNs or volumes. The responsible admin can manage, monitor, plan, provision, recover, expand, and protect data at the naturally aligned per-VM level.

Key impacts of Tintri's flash- and VM-centric design include:

- **Per-VM enterprise-class storage capabilities.** The Tintri VMstore system is built for virtualization and allocates, provisions and operates at the VM-level for all storage services including snapshots, thin clones and replication. There are no wasted pools of reserved capacity, no misaligned expensive storage resources, no forced arbitrary aggregations of VMs to map into storage, and no need for complex external storage management.
- **Cost-effective acquisition.** Tintri's VMstore delivers flash performance. Combined with extreme efficiency, the CapEx cost of Tintri compared to legacy storage multiplies savings. We will expand on this statement later in this report. Several of the companies we interviewed considered this alone a sufficient TCO argument for adoption.
- **Simple to deploy and provision.** Once physically in place, Tintri VMstores can be fully operationally deployed in 30 minutes or less, versus the weeks or months for legacy solutions. Tintri requires little deep planning, physical setup or logical configuration, little to no training, and is simple to manage in production.
- **Simplicity of ongoing management.** Tintri's built-in storage management is intuitive and at the per-VM level. Administrators can quickly tackle any issues around performance, QoS, capacity, or other storage-related issues. This simplified management expands across multiple VMstores with Tintri Global Center, which enables administrators to manage up to 32 VMstores and 64,000 VMs from a single unified console.
- **High performance and availability.** VMstore's design intelligently auto-tiers flash SSD with HDD and efficiently shares those resources across VM's to ensure consistent IO performance. Tintri VMstore functions also include built-in automatic workload profiling and QoS management for maximal storage array utility while preventing perverse workloads from unduly impacting the rest. Per-VM snapshots and replication help ensure that designated VMs are protected as they each require.

- **Smooth Expansion.** In some use cases, customers have found that it's much harder to overload a Tintri box than they expected. For example, because of the built-in thin cloning and flash supported performance, VDI scenarios can expand to hundreds of VMs without noticeable drag. Because it's easy to migrate VM storage using the per-VM replication, actual expansion when necessary is smooth, non-disruptive, and easy for the virtual admin to do.

USAGE CASES

In this section, we present our field interviews with six IT organizations who have Tintri storage in production environments. Each has tackled different usage cases and presents unique perspectives of the particular value and benefits they gain from deploying Tintri storage, although there is an overall consistent theme of achieving significantly lower TCO than traditional storage solutions.

Customer #1: George Washington University (GWU)

- **Industry:** Education
- **Customer:** Brian Mislavsky, Manager of infrastructure services for virtualization and enterprise storage groups
- **Overall TCO focus: Lower OpEx costs.** CapEx is a consideration but ongoing storage support and management costs are the bigger concern for the university. Top OpEx concerns in the virtualization environment focus on provisioning, troubleshooting performance issues, simplified management, and gaining much better visibility. Mislavsky said, *"Tintri is a good example of OpEx savings. The key is what you do with it to gain the value they provide."*

Business Drivers and Adoption

GWU maintains 1500 servers across two data centers running Windows, Linux and Solaris. Legacy arrays hosted multiple workloads but growing virtualization was affecting performance. It was time for an enterprise storage refresh. The legacy arrays hosted all workloads, so GWU took the opportunity to split offerings into primary enterprise services, file sharing, and virtualization. Flash was an important element of the storage devoted to virtualization.

They considered VSAN for the virtualization environment but required high compression and dedupe. Instead they chose Tintri for its density, ease of operation, performance and simplified management. Today Tintri provides storage for VDI and soon for vCloud Director and vCAC. Currently they are seeing a site's 10TB active working set use only 1.1TB on each array (and that means it's served entirely by flash).

VMware admins manage the Tintri directly with zero maintenance and management problems. This is direct contrast to legacy storage with LUNs, sizing, mixed workloads, and health checks.

Usage Case: VDI

GWU first deployed Tintri in their large VDI infrastructure. Scale-up on the legacy storage was a big issue. Before adopting Tintri, the IT team had to linearly scale performance and capacity to VDI storage by adding additional controllers and disk.

Solution: With Tintri, the team can choose to incrementally scale either capacity or performance, which grants much more flexibility in the VDI environment. GWU has also seen savings on power, cooling and space needs. Capacity planning is highly simplified due to Tintri's management insight.

While Brian said that “we see far better VDI performance on Tintri, and their ability to support [Citrix] XenDesktop is very attractive,” he also indicated that “flash should be judged on more than just performance, instead of just a faster way of doing old business, [you] have to do business differently. Tintri is a good example of that.”

Additional Benefits

- **Flexibility.** They are a VMware environment today but appreciate Tintri’s multi-hypervisor support including the upcoming Hyper-V support.
- **Support.** “Tintri support is awesome. We had some drive and controller failures and Tintri was highly communicative and knew what they are doing. We also like their proactive version notification.”

Customer #2: Ungaretti & Harris

- **Industry:** Legal
- **Customer:** Charlie Altenbach, Director of Information Systems
- **Overall TCO focus: Lower operational and licensing costs.** Projected TCO savings played a huge role in the law firm’s decision. While there were big CapEx savings involved, the firm identified two primary issues: significant time savings from simplified operations, and an all-inclusive agreement for technology, services, software, and licensing keys.

Business Drivers and Adoption

The data center environment is heavily virtualized, including all workloads on servers and desktops. The legacy storage array had substantial performance problems with these workloads. Historically the solution was to add more spindles but that was costly and left the IT team with unusable capacity. Complex installation and deployment were also big issues taking considerable money and time. The IT team took advantage of a technology refresh and retired their major vendor array.

Solution: Ungaretti & Harris looked for a storage system that would maintain high performance over time, and that was VM-aware with all-inclusive pricing. The law firm decided on Tintri and purchased a VMstore T540. The retiring array took up 16U of rackspace and housed 75 disks to keep up with performance and capacity demands; Tintri took up 3-4U and housed 16 disks. Altenbach said, “You want to talk about cost savings? It’s absolutely absurd how much money we saved by making the switch to Tintri. I just did a report for my technology committee. We’re expecting a 3-year savings of about half a million dollars in CapEx alone.”

The T540 was so successful that Ungaretti & Harris bought a second T540 for replication in the DR site and then a T620 to support a major legal eDiscovery application. Today Tintri is deployed for 350 VMs. IOPs range from 2500 to well over 10K, the flash hit ratio is consistently 93-94%, and average latency is 1-2 milliseconds.

Usage Case: Simplified Administration

In addition to the expense of additional spindles, legacy storage was complicated to deploy and upgrade. The IT team had to carve up LUNs, provision disk, connect the backend, and do multi-

pathing just to present the storage to VMware. The system also lost performance when managing mixed workloads.

Solution: “Other solutions might take a week and a half, two weeks, 50 cables, and lots of components. With Tintri we unboxed it, racked it, plugged in 4-5 things.” The Tintri array replaced storage management tasks by presenting a single datastore to the VMware environment. Previously the team had to juggle and rebalance workloads among at least 15 different datastores. With Tintri’s single datastore view, this is no longer an issue. Now it “takes only a couple of seconds, right click, to clone and create a machine, right click to replicate or protect a VM”.

Usage Case: Simplified Troubleshooting

The IT team had limited visibility into the virtualized environment. If a VM was running slowly, it took multiple steps to troubleshoot and some problems went unsolved.

Solution: Tintri granted the IT team excellent insight into the VM including but not limited to host, disk and network views. Tintri’s Web GUI presents a dashboard of array stats with a clear holistic view of metrics. Ungaretti & Harris did not have to purchase a 3rd party monitoring software or vCenter Operations Manager to solve troubleshooting problems. The dashboard also tracks capacity by reporting on free space and how many days until capacity fills to threshold.

Usage Case: Litigation Team Software

The IT team was evaluating a major eDiscovery platform for the litigation support team. Most platform users choose the hosted version because storage requirements for an in-house deployment are daunting. The IT and Litigation Support teams both preferred to host the application in-house but were told it was not possible to do so for their preferred cost per GB. The IT team purchased a Tintri VMstore T620 for an in-house eDiscovery support environment, which returned “an extraordinary” low cost per GB that the firm was hoping for.

Additional Benefits

- **Fast data protection.** Ungaretti & Harris found that Tintri increased data protection and replication performance. One right-click protects and replicates to the DR site, and strong dedupe and delta-only changes accelerate replication.
- **Tintri support.** Ungaretti & Harris also reported that Tintri support is highly proactive and maintains troubleshooting access to the systems from their global NOC. Altenbach remarked, “One of the most impressive things about Tintri is their support team. The presales engineer is great. Every time I open a ticket he calls or emails me immediately. Based on some of the other companies I’ve dealt with, that’s almost unheard of.”

Customer #3: AMD

- **Industry:** Manufacturing
- **Customer:** Ross Alaspa, Application server architect
- **Overall TCO focus: Business-critical application performance.** A testing application is fundamental to AMD’s profitability. Success required high performance in a repeatable small form factor that would save significant money and time on global deployments.

Business Drivers and Adoption

AMD's multiple storage arrays were not meeting performance requirements for a critical application: a global testing database serving international manufacturing sites. AMD needed higher performance and they also needed a smaller footprint that traditional array makers could not provide. Since the highly virtualized testing application operates across remote sites, AMD required an efficient and repeatable small form factor with high performance. Capacity was also an issue as the sites keep 18 months of detailed testing data in the database.

AMD adopted Tintri VMstore T540s for their high performance in a small 2-4U footprint, and for its worldwide monitoring ability through the Tintri global NOC. Alaspa commented, "The ease and happiness of the rollout is one of the most pleasant experiences I have ever had with a hardware vendor."

Usage Case: Support Critical Application

The business-critical Oracle application stores testing results from every manufacturing test across the company. Every part tested throughout AMD accesses this application through every step of the manufacturing process. The application is installed at 6 worldwide manufacturing sites. Every site maintains its own version of the database for the parts they test on-site. Each database performs analysis, optimizes test times and procedures, and ensures data quality. Most of these databases run between 6 and 10TB with an average growth rate of 15-20% a year. AMD needed a high performing, efficient and repeatable storage layer for the remote sites. Storage performance here can be directly tied to business unit productivity.

Solution: AMD chose Tintri for its high performance and flash caching in a small form factor. Each site uses the same configuration of 2 Tintri boxes for consistency, performance, and failover redundancy.

Consistent high performance was also an issue. A common bottleneck in Oracle applications is the redo logs that store all changes made to the database as they occur. Tintri enabled the IT team to dedicate a separate VM to the redo logs and pin it to flash, resulting in consistently high Oracle performance.

Additional Benefits

- **Simple deployment.** Initial deployment was light years better than the legacy array. AMD reserved a week to set up the Tintri system but it only took 2 days to deploy and migrate data (and most of that was application related). The IT team also appreciates Tintri's dedupe and compression rates to fit their database into 2-4U (actually getting 5/6:1), simple expansion procedures, and the management dashboard for insight and simplicity.
- **Application Failover.** Failover was a nightmare with the legacy storage arrays. With Tintri, the IT team can simply shut down a bad-acting cluster and bring it right back up again without impacting performance.
- **Sharing management data.** The IT team created a virtualization application group for all Tintri players, including the Oracle DBAs. The group has access to the management dashboard so they can monitor, report and share on performance. The dashboard melds data from databases, virtualization and storage, resulting in a consistent look across the Tintri environment. "Site admins (that wear many hats) are impressed by how easy it is to administer."

- **Easy expansion.** Before the Tintri deployment, several sites were running out of capacity. Expanding storage systems required time-consuming management steps and detailed LUN sizing. Tintri came in at 3U footprint with a much larger capacity, and the IT team immediately expanded the database. The DBAs asked Alaspa what they needed to do on the storage side. His simple answer was, “Nothing.” With Tintri, it was already done.
- **Support.** The IT team was testing Tintri’s failover and deliberately pulled some plugs to create a failed environment. They immediately received a call from Tintri support telling them something was wrong. The AMD team was happy to reassure the engineers that everything was right.

Customer #4: Broker-Dealer

- **Industry:** Financial services.
- **Customer:** Director of infrastructure
- **Overall TCO focus: Lower price per GB across storage lifecycle.** Lower prices include both CapEx and OpEx.

Business Drivers and Adoption

The company owned a large SAN from a storage industry leader and it was time for a technology refresh. The team required an enterprise-caliber system with lower CapEx and OpEx for an overall drop in price per GB. They also needed virtualization-aware storage in their 90%-plus virtualized environment, and operational ease was extremely important.

Purchase price entered into the TCO calculation, but for the team it was mostly about operational procedures and dispensing with intensive training and support issues. Once the IT team was certain that Tintri was an enterprise storage system, they looked carefully at it for its performance, capacity, and simplicity.

The IT team undertook a feature comparison between Tintri and another storage system. The team calculated \$700K in savings in a 3-year period with Tintri just on \$/GB. They’ve purchased five 540s (and two 650’s on order) for their growing virtual environment.

Usage Case: Troubleshooting

It’s common for a non-storage team to blame storage systems when something goes wrong in the application path. Storage teams must spend a good deal of time analyzing storage devices even if the problem is not storage-related, or must invest in very expensive and complicated troubleshooting tools.

Solution: When a non-storage team blames storage, Tintri makes it easy for the storage team to identify the issue. If it is storage they will fix it; if it’s not they’ll notify the other team and point to the cause. This saves a lot of money from not having to purchase analysis tools. “The insight into per-vm performance is priceless, being able to push off support to the right team when its not storage.” They also are avoiding needing “other tools that [storage] professionals use at \$100k’s”.

Usage Case: Simplicity

The IT team is charged with supporting the complete architecture, which requires broad knowledge above narrow expertise in a specific domain. The more storage management was simplified, the better efficiently the IT team could train for and support it. The team also wanted to simplify storage procedures such as capacity utilization. Capacity planning was crucial to optimizing the data path but was hard to track, and impacted other teams. Four years ago they decided that “they didn’t want LUNs anymore” and went to filers. Now they wanted to get away from even the management burden of NAS.

Solution: Tintri’s per-VM approach simplified management across the board by dispensing with intensive storage tasks such as LUN carving. And Tintri Global Center (TGC) gave the storage team a central console for administration, and allowed them to provide capacity utilization services to other teams. The information is dynamic and continually updated, so the IT team went from hours of manual information gathering and reporting to minutes. This represents an OpEx saving around IT resources, and from not having to purchase monitoring and reporting software. He remarked, “One of the reasons I really like Tintri is its simplicity.”

Additional Benefits

- **Simplify deployment.** Tintri is simple to install into a data center and VM migration can begin “within an hour”. Fewer operational procedures make it simple to manage throughout its lifecycle. “There are lots of specific tasks we no longer need to do”. He said, “It’s so easy to manage once you’ve tuned it up and moved the VMs. There are a lot less operational procedures.”
- **VDI performance and protection.** The company’s VDI implementation placed a heavy load on data center servers and storage. Tintri enabled efficient VDI performance and supported smooth data migration. Tintri replication to a remote site allows the IT team to protect virtual data. “DR used to have a lot of manual steps, now the most complex thing is deciding which VMs should be replicated, actually doing it is simple.”
- **Power and cooling savings.** Lower energy costs substantially lowered TCO.
- **Support:** Tintri understands enterprise level support and knows how to provide it, especially for a financial services company. When the team calls it is with an advanced question. They quickly get the help they need, whether advice or parts.

Customer #5: Large Software Developer

- **Industry:** Legal software
- **Customer:** Infrastructure manager and system architect in the IT department
- **Overall TCO focus: Increase revenue with accelerated VM performance.** The company was primarily focused on getting the features they need now to increase customer satisfaction and decrease test dev build cycles for a faster go-to-market. Capital cost was a consideration but they planned to spend what they needed to get the functionality they required.

Business Drivers

This company's training and application build divisions are heavily virtualized and growing. The company was not seeking new storage per se, but needed fast and efficient VM cloning and performance to support both groups. Tintri fit the bill and the company reached out.

Because their need was so feature-specific they carried out intensive testing, including putting VM cloning through its paces. Tintri was supportive throughout the process. The company purchased a Tintri VMstore T540. The company remarked, "Tintri was already on top of the market when other vendors were just coming in." Tintri remains a proactive partner and the company continues to work with their sales engineer.

Usage Case: Training

The company runs frequent training sessions for law firms, corporations, government, and resellers. Training resources are intensive and include certification programs, as well as specific trainings in infrastructure, analytics software, machine learning, and more. The company runs 3-5 training classes per week

The software platform contains multiple applications that deploy on separate web servers, so the training classes had to run on multiple VMs, usually 20-40 VMs per class. The applications produce high I/O and application load times were taking 4 minutes and up. In addition, the cloning source was a 120GB VM, which had to be separately cloned for each of the 20-40 VMs per class. This painful and cumbersome process occurred over and over again.

Solution: With Tintri, the cloning process went from hours through VMware (and 8TB) to a few minutes (and remain deduped). Full application query loads took 2 minutes instead of 4 minutes with better customer satisfaction as the result. Today Tintri has 450 training VMs running on a Tintri 540, with a flash hit ratio of 99%+. Since the VMs are not in simultaneous service, the IT team has leveraged Tintri to serve additional virtualized workloads. This increases its value to the company. Overall, "the amount of time we save is pretty huge".

Usage case: Application Builds

The company retains 15 standard build servers dedicated to 15 development groups. Several times each day groups run build processes on VMs, which requires fast cloning for availability and high I/O performance.

Solution: Tintri enables the application build administrators to quickly clone (and tear down) relevant VMs and to significantly decrease build times. Faster development build times leads to more efficient go-to-market cycles.

Additional Benefits

- **Visibility.** The customer appreciates Tintri's end to end performance visibility thanks to deep hooks into vCenter. He said that they get "better insight as to where performance issues are with Tintri – network, storage, etc. – that saves time" versus their existing LUN based storage. He also thinks highly of the overall performance (in testing they saturate the 10GbE link before the array itself slows) and its management simplicity.
- **Support.** The company values the relationship they have with Tintri executives and sales engineers, which have continued from pre-sales into the present. Support is knowledgeable and proactive.

Customer #6: Electronic Design Developer

- **Industry:** Electronic Design Automation (EDA)
- **Customer:** Technical architect
- **Overall TCO focus: Bring down cost of storage ownership.** Purchase consistent performance, scalable capacity and simplified management.

Business Drivers and Adoption

The company uses NetApp and Hitachi NAS systems for database, application and file system storage. However, the company needed greater performance and capacity for its high IO virtualized environments, which were growing at a rapid pace. The company could have added more spindles to the disk systems for higher performance, but extra spindles are expensive and produce unusable capacity.

The company's IT team decided to approach innovative vendors who built their flash arrays from the ground up. Tintri was the winner with its combined high performance and capacity. Eventually the company would purchase three Tintri VMstore T540s and three VMstore T650s: two for redundancy in different data centers and one for a business unit that is now back with IT. Today they use Tintri specifically for virtualized workloads.

Although the CIO was solidly behind them, other IT workgroups pushed back on the idea of buying startup flash storage. After the IT team deployed Tintri, the team estimates that it took 6 months of operation before these workgroups stopped expecting the systems to fail. The systems did not fail, and today the virtualization and storage operations teams are very pro-Tintri.

Usage Case: Performance and Capacity Gains

The IT team and CIO needed to increase performance and capacity without adding even more extra spindles to their NAS arrays, so decided to turn to flash. The IT team reviewed their current vendors' flash offerings. In both cases the storage makers had replaced some disk with SSDs and/or added a flash cache. Yet both did it without optimizing the data path, so read/write performance was less than impressive.

Solution: The virtualization environment made excellent performance gains with the VMstore T540 unit (with 900 VMs doing 40k IOPs) but the IT team was not certain that it could match the capacity of the deduped NetApp NAS. The VMstore ended up working well for both factors. The IT team next purchased Tintri VMstore T650s for even greater capacity gains. The IT team estimates that the equivalent CAPEX cost of the (slower) NetApp system would be 2-3 times the cost of the VMstore T650s.

Usage Case: VDI

VDI customers run large regression tests in the company's vCloud Director Environment. IO processing was a big issue with significant overloads on system performance and a corresponding impact on customer satisfaction.

Solution: The VMstore T650 supports vCloud Director, static VMs and VDI environments, which returned a big performance improvement along with easy VM cloning. He commented, "Customers

were doing big regression environments, and being able to do this was great. They experienced better operation and customer impacts because they weren't overloading performance all the time. This was much better than what we had before."

Additional Benefits

- **Device simplicity.** Tintri is simple to configure and manage. This lightens the management burden on the operations team, which frees them up to solve problems elsewhere. The IT team would like to expand Tintri to support all new VMs. "Tintri is a much simpler device to configure" almost but "not quite a toaster" with "not that many settings to worry about compared to NetApp and HDS arrays".
- **Support.** The company went 6 months operating the VMstore T540 and the T650. They only had 2 devices in operation and went 6 months without anything happening. That was great but did not give them a chance to test Tintri support. After that time period a couple of things happened and Tintri gave them a good response.
- **Predictable capacity for virtualized environments.** Prior to adopting Tintri, the company's biggest virtualization issue was managing virtual storage for performance. IO spikes were difficult to plan for and remediate to meet growing application service levels. Tintri performance is highly efficient, automatic, and flexible, leaving capacity as the factor to watch. Since capacity is far more predictable and easier to manage than performance, this has profoundly simplified performance/capacity matrix management.

"CAPEX IS GREAT FOR MY CFO, BUT I CARE ABOUT THE OPEX"

In the recent Taneja Group Validation Lab testing of Tintri, we documented extremely impressive improvement factors comparing Tintri with traditional storage. In the preceding field interviews, one of our goals was to further validate that those factors were actually experienced by real Tintri customers in production environments. Here is a quick review of some of the most significant items in light of what we've just heard.

Performance (6X) - In the lab, we saw pure performance gains over comparable mid-range storage (that included SSD). From these interviews:

- "performance was much faster"
- "flash performance on 350 VMs and a key large eDiscovery database"
- "performance of bigger all flash arrays in a 2-3 U form factor"
- "a 50% acceleration over other existing [hybrid] enterprise arrays"
- "faster performance for VMs than [our] flash enabled NAS"

While these results aren't quantitative, when combined with other details from the interviews (like reported IOPs, numbers of VMs, results of internal benchmark and testing, etc.), we are confident that the tested 75k IOPS (and low latency) from our lab is similar to what the Tintri user base can expect to experience in virtualized scenarios.

Capacity (6x) - Similarly, when it comes to capacity optimization and relative density, Tintri has set a high bar. From our interviewees -

- “10Tb to 1.1 TB”
- “75 disks to 16 disks – (16u to 4u) with room to grow”
- “6-10TB [Oracle] database in 3U easily – 5or 6:1 ratio”
- “Capex \$/GB swayed the COO to move to startup Tintri from traditional storage”
- “Tintri’s dedupe and compression saves us on Capex and performance”
- “1/3 to 1/2 the \$/GB compared to our NetApp or HDS NAS”

One customer was emphatic that not all dedupe solutions were the same, and reported from their internal testing of certain other storage and backup solutions that the difference can be easily 20-30%, not to mention how much time and processing it might take. Another customer showed that the Capex reduction in \$/GB alone paid for the Tintri’s they bought during a storage refresh cycle.

Opex management – deploy and provisioning (52X) –We heard many statements supporting the speed of deployment and ease of ongoing provisioning. While CFO’s looked for the hard upfront Capex savings, every one of the actual hands-on users we talked to praised the utter simplicity of Tintri storage:

- “essentially management down to zero”
- “takes only a couple of seconds [to provision a new VM]”
- “we were juggling workloads around 15 different data stores before, now just one – no re-balancing or anything needed”
- “space expansion by DBAs doesn’t require [any] storage [admin]”
- “[fully operational] within an hour”
- “big savings as we setup/tear down classes and build environments daily”
- “we use vCloud director to check out VMs and throw them away with no worries”

The comparisons to traditional storage included many horror stories of endless consulting, months of planning, inflexible deployments, difficulty in scaling, and the many “best practices” in LUN masking/zoning, etc that one had to adhere to “in the old days”. While 52X may seem large on the page here, in practice the factor is likely higher, especially as a site’s storage complexity and dynamics grow.

Time to troubleshoot (min v days) – While troubleshooting as a large task can encompass many processes, when it comes to the specific troubleshooting of performance issues in the storage layer, Tintri really does reduce the effort in many cases to a quick check of their single management GUI.

- “VM level insight eliminates the time we wasted troubleshooting virtual issues to storage”
- “can instantly see stats by machine/workload, hosts disks networks”
- “no troubleshooting needed yet”
- “[VM] insight is priceless” – can prove its not storage”
- “only way to screw up is not install VAAI plugin“

Annual management time and effort (60X) - When it comes to overall management Opex, the whole design of Tintri with per-VM storage, performance optimization built-in, and policy based management is that specific storage management overhead dwindles towards zero.

- “zero time spent on management”
- “Don’t really admin it (except for troubleshooting larger issues)”
- “zero management, really”
- “lots of specific tasks we no longer need to do”

- “amount of time we save is “pretty huge”
- “our operations man-hours are back to a simpler capacity focus”
- “not that many knobs to turn”

Is it 60X or actually down to zero? That might be splitting hairs, but the key takeaway here is that the Opex factor is so significant, it should cause everyone looking to upgrade or improve their storage strategy to consider it.

TANEJA GROUP OPINION

The industry is moving past the simplistic cost/per-GB equation for measuring the value of storage products. It might work in simple, limited environments where there is a straightforward relationship between GB cost and storage. But with data shooting skyward in volume and complexity, how many environments are left like that? Not many, certainly not in the mid-size and enterprise space.

The number shrinks even lower for storage dedicated to virtualized environments. Cost per GB is ridiculous in this complex space. The only way to measure TCO is to understand CapEx and OpEx benefits – or the lack thereof. Customers need to know their true CapEx costs: not only the equipment price tag but also the cost of pilot projects, deployment, integration, training, and documentation. The simpler that process is, the lower the CapEx. Yet simple is rare in the virtualization storage world where many vendors make their money on purchase-related support.

OpEx is hugely important as well, since ongoing expenses over the lifetime of the asset will be many times higher than CapEx. Upgrades, ongoing maintenance costs, IT management overhead, integration, power and space in the data center: high OpEx will zoom the true cost of virtualization into the stratosphere – while low ongoing OpEx can save hundreds of thousands of dollars over the lifetime of the asset.

Virtualization initiatives will stall if high storage costs and complexity undercut hoped-for savings. Tintri makes a dramatic difference to virtualization success with low CapEx and OpEx due to its simplicity, power, functionality, and efficient management. The result is a massive positive impact on the virtualization environment and initiatives.

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