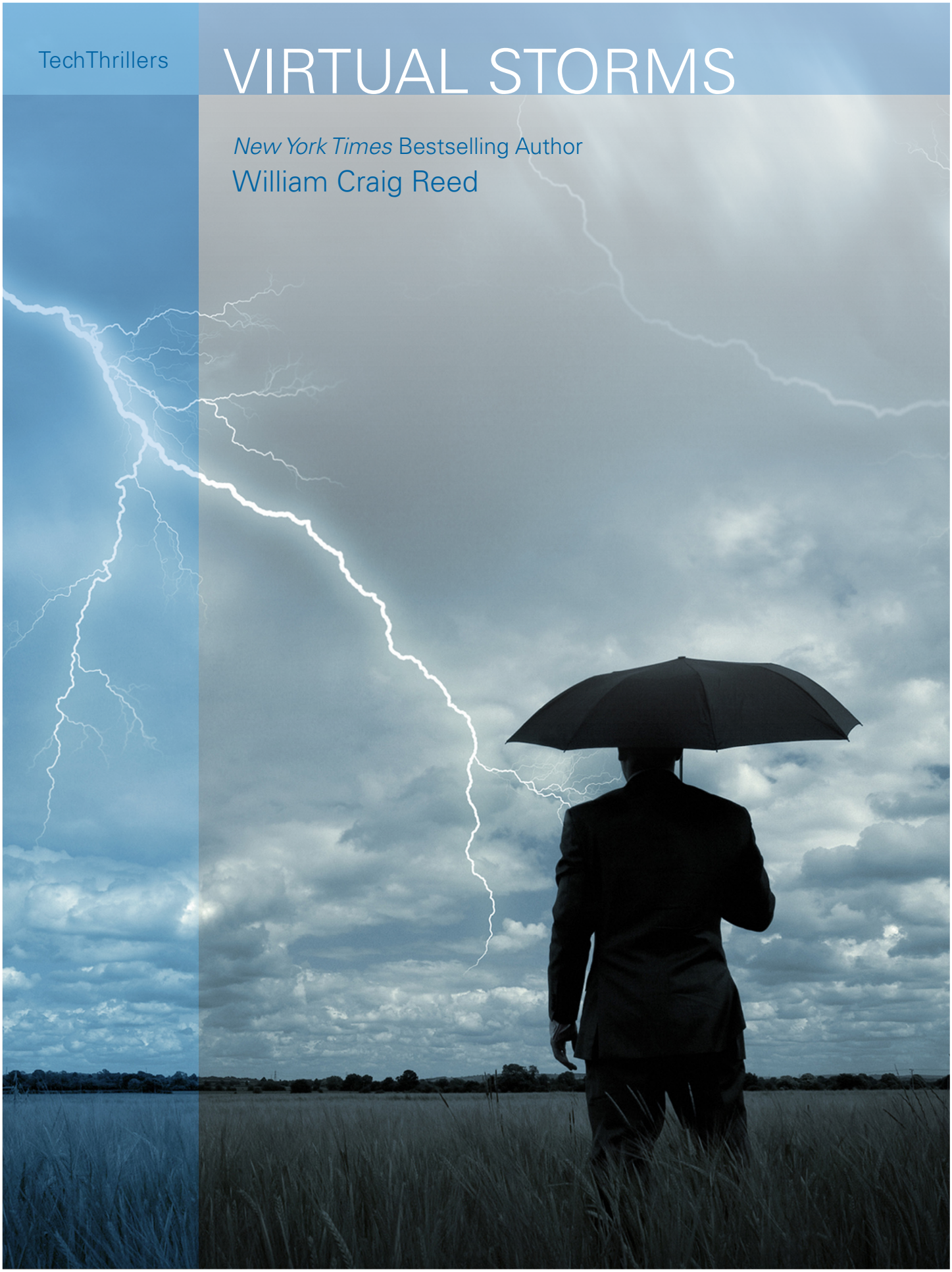
TechThrillers

# VIRTUAL STORMS

*New York Times* Bestselling Author

William Craig Reed



# VIRTUAL STORMS

by William Craig Reed
*New York Times bestselling author*

IT Director John Bettoni's hands shook as he stared at the monitor on his desk. His pulse quickened. One by one the green indicators on the screen blinked, turned yellow, then red. A Christmas tree gone postal. How had this happened? John tried to remember. Just a few months ago his colleagues were patting him on the back; high-fiving him in the San Francisco data center. At his prompting, the multi-billion dollar financial services firm he worked for had authorized the budget to move forward. Excited, John's team implemented his grand plan to further consolidate and virtualize. The advantages were clear, the return on investment appeared sound and the technology was proven. Initial results were promising. They reduced physical server count by tenfold. Provisioning time plummeted and resources were better utilized. Weeks later things turned sour. The worst possible scenario unfolded, and John had a bad feeling that his days at Henderson Financial might be numbered.

John had joined Henderson about a year earlier. His boss, Norman Gage, served as the company's Chief Information Officer. When John was interviewing for his job, Gage told him the company was a dynamic, high-growth leader in the financial sector. John would have the opportunity to leverage his many years of experience and make a difference. But success is always preceded by hard work fraught with risk. Henderson was not a forgiving environment. Mistakes here came with severe consequences. Underperformers never lasted long. A few weeks into the job, John screwed up. It was a minor thing but it didn't go unnoticed. Gage cornered John in the data center and told him that if he messed up again he should learn how to say "hold the pickles" into a microphone. Gage made the comment with a slight smile, like it was a joke, but John had never seen Gage strive for funny.

John was replaying the memory in his head when Gage came storming into his office. The man's pudgy cheeks were beet red and his forehead glistened with beads of sweat. His normally brown eyes were bloodshot crimson, like he was channeling a demon or something.

Gage crossed John's office in three strides. He stammered when he spoke. Spit flew off his lips. "What…you…you….what?" His breath reeked of bad coffee. A doughnut crumb clung to his chin.

"I've got it under control," John lied. He hated the lie, but he had a wife and two young daughters to feed. Last week was little Julie's fifth birthday. He'd promised her a new house with her own room someday. She hugged him tight, gave him a toothless grin, and said all she really wanted for Christmas were her two front teeth. She kissed his cheek and waddled up to bed. John's eyes filled with tears.

Gage calmed down enough to speak. "You've got one week, Bettoni. Understood? One week before we go live with the new service offerings and all heck breaks loose. If you can't get this fixed by then…"

"I know," John said, "I'll need to learn how to say 'hold the pickles…'"

Gage turned and marched out, cursing, snorting and shaking his head like a mad bulldog.

John picked up the phone and dialed. "Dwayne, I need your help."

"I'M HAVING A BAD DAY."

That afternoon, Dwayne Peterson stopped by. The late-forties district manager worked at a leading IT reseller called FusionStorm. The company had been around for decades, had an admirable track record, a line card of top IT vendors and most importantly, the expertise John needed to help him keep his job.

"Sounds bad," Dwayne said as he took a seat in front of John's desk.

John took a deep breath. He reached over and spun a world globe around on its spindle. The small ornament was a gift from his seven-year-old. Sherry said Angela had seen it at Target, ran over and said, "Mommy, can we give daddy the world?"

"Well?" Dwayne prompted.

"I'm having a bad day," John said. "We expanded our VMware project, consolidated servers and virtualized some desktops. At first, everything was great. Then we got a few storms. Then some tsunamis." John knew that Dwayne knew exactly what he meant. Virtualizing servers and desktops held a lot of promise. They could consolidate and reduce their server count, thereby lowering hardware, licensing and management costs. Provisioning and software update times could be cut in half. With lower IT "hands on" time required, they could reduce planned head count by one or two people this year. All of that added up to a sizeable savings. But all of that rested upon the premise that all of that actually worked. Right now, it wasn't working at all. Storms occurred when dozens of users pulled ERP or business intelligence data from the servers and storage arrays at the same time, thereby causing a bottleneck. Kinda like a dozen people trying to get through the door at the same time. Tsunamis occurred when the storms escalated out of control.

"How slow are we talking?" Dwayne said.

"Slow like my five-year-old reads Spot books slow," John said.

"I see."

"Slow like turtles on sleeping pills slow."

"Interesting picture."

"Slow like I'm going to be waiting in the unemployment line slow," John said.

"That's pretty bad slow," Dwayne said. "Let me ask you some questions."

"Shoot."

"Which applications are the slowest?"

"Mostly our legacy ERP and business intelligence apps."

"What's your physical server to virtualized machine count?"

"About twenty-five VMs per server, on average."

"How many terabytes on your storage area network and direct attached storage?"

"Our SAN has about a hundred terabytes. Almost none on DAS. We moved away from that when we virtualized."

"Smart move. It's not wise to have your virtualized data stores on the same servers along with your virtual machines."

"I figured that. If our servers went down, we'd lose our data and our VMs. Not a good idea."

"How many desktops have you virtualized?" Dwayne asked.

"About 300 so far," John said.

"Now let's talk about where it hurts," Dwayne said. He went on to ask several more questions

about John's pain points, then probed even deeper about potential consequences of inaction, or worse, wrong action. "How are your employees taking this?"

"Do you remember the movie *Airplane*?" John said.

"Vaguely," Dwayne said.

"There's a scene where most of the passengers line up with wrenches, knives and guns, waiting to pummel another passenger for screwing up. That's what it's like outside my office most days."

"Obviously some fair weather fans. How about your boss?"

John cringed, said nothing.

Dwayne nodded and stopped asking questions.

The two spent the next several hours analyzing performance logs, studying reports, staring at monitors and white boarding. They drew diagrams, batted around theories and explored potential culprits. Dwayne then said he wanted to take this information back to his technical team and get their input. He'd be back the next morning.

John stayed late, until he could barely keep his eyes open. Sherry called twice. Said the girls wanted to know where he was. John said he'd be home soon. By midnight he was. The house was dark and smelled of pine from the Christmas tree. He tiptoed into the girl's room. Blond curls draped across tiny pillows. Julie opened one eye. She flashed him a no-tooth smile, rolled over and snuggled into her pillow. John walked over and kissed her cheek. Her smile broadened. Angela slept nearby. He kissed her cheek too, left the room and pulled his weary body up the stairs.

"IT'S ALL ABOUT IOPS. YOU DON'T HAVE ENOUGH TO HANDLE THE STORMS."

Promptly at nine the next morning, Dwayne brought in three cups of Starbucks. The steam filled John's office with the scent of Italian dark roast. Dwayne handed a cup to John. The third cup belonged to Dwayne's colleague, Steve Tully. Dwayne introduced Steve as one of FusionStorm's top virtualization experts.

They sat.

Steve fired up his notebook and pulled up a spreadsheet. "We figured out what's going on."

John wanted to let his heart race, but he pulled back on the reins. He wanted to hope that Steve's words were true, that there might be an answer that could solve John's problems and save his job. But he'd heard other resellers give him that line before.

Steve flipped the notebook around. "It's all about IOPS. You don't have enough to handle the storms, let alone the tsunamis."

"But I ran an Input/Output Operations per Second test and didn't see any issues," John said.

"They lie," Steve said. "Most tests only give you a glimpse at any point in time or across a small portion of your potential problem children. The best way to determine your total IOPS requirement is to calc it like this." Steve pointed at the notebook screen with the tip of his pen. He went through the estimated IOPS requirements, including average operations and peak times, for almost everything. From their ERP and business intelligence apps to databases to servers to email to the virtualized desktop infrastructure (VDI). He had listed each application, virtual machine (VM) and virtualized desktop and calc'd the IOPS needed to keep them at top performance. The total came out to just over 100,000 IOPS.

"YOUR SERVERS CAN'T HANDLE THAT MANY VMS."

"Now let's talk about your storage," Steve said.

"Our Storage Area Network?"

"Right," Dwayne said. "You've got a fairly new SAN, from what I recall. About one hundred terabytes, right?"

"All together, yeah."

"You made the right decision going to a high-performance SAN when you virtualized," Steve said. "As you know, the input /output operations in your non-virtualized environment were serial, like a straight, predictable line. When you virtualized, all that became random and the data requests were unpredictable."

John twisted in his seat and pictured those dozen people trying to get through that small door at the same time. "I get all that, but our SAN should be able to handle virtualized IOPS."

"Maybe not," Dwayne said. "Your SAN has, what, around 200 half-terabyte disk drives? Each drive is limited to maybe 200 or 250 IOPS, even if you short-stroke them. That adds up to 50,000 IOPS at most. That's fine for normal operations, but as you just saw, you're peaking at 100,000 IOPs during storms, and even more during tsunamis."

"Turtles," John said as he gulped a sip of caffeine. The nutty flavor warmed his tongue, but when the coffee acid mixed with the fear in his gut, his stomach soured.

"Turtles," Dwayne echoed.

"You've also got another problem," Steve said. "Your servers can't handle that many VMs. They don't have the chops."

"I can't reduce my VM per server count," John said. "I don't have the budget to buy a bunch of physical servers. I need to consolidate even more, not less."

"Right," Steve said. "But you're going to need to replace some of your slower servers with ones that have more umph."

"Umph?" John said.

"Technical term," Dwayne said. "It means umph."

"Thanks for explaining. So aside from buying more servers, which I can't afford, what's the answer gentlemen? I'm on a short leash here."

"We recommend a no-cost virtualization infrastructure assessment to validate our numbers, and from there we can create a recommended plan of action."

John wanted to make the right choice, but he had doubts. What if the guys from FusionStorm were like so many other resellers he'd dealt with before who didn't really have any answers and just wanted to make a buck? He glanced again at the small globe on his desk and thought about his daughters. He wanted more than anything to give them a Christmas full of smiles, not tears.

## WHAT CHOICE SHOULD JOHN MAKE?

Try to solve the problem on his own without help.

Move forward with an assessment from FusionStorm

## MORE VMS EQUAL MORE HEADACHES

The benefits of virtualizing can be appealing to IT professionals: improved system utilization, asset consolidation, management efficiency and performance. Unfortunately, the pitfalls of virtualization can often overshadow the promises. You've virtualized, but your benefits appear to be throttled by performance challenges. You'd like to consolidate even further, and yet running more than five to twenty Virtual Machines (VMs) per server bogs down the system and the applications. Adding more memory, CPU cores or better Network Interface Cards (NICS) doesn't seem to solve the problem. You've virtualized your database, Enterprise Resource Planning (ERP), media, graphics, business intelligence or other process-intensive applications, but users grumble as performance begins to crawl. Database queries and reports tend to take hours instead of minutes, daily batch processes chug along for a day and a half and customers complain when transactions or projects are delayed. Management is upset when Service Level Agreements (SLAs) aren't met and they demand to know why the budget for new servers and storage capacity continues to grow.

On top of the challenges you already face, you're now asked to implement a Virtual Desktop Infrastructure (VDI) to save more money, and do so without grinding performance to a halt. The fundamental truth is that virtualizing at one layer often introduces more challenges than it resolves, and can actually increase costs if not implemented properly. It's important to understand that the network and storage infrastructure to which these VM's are attached must be considered as a holistic piece of the puzzle, and should be balanced against the unique requirements of virtualizing at the system level. The following addresses storage-bound random Input/Output (I/O) in a virtualized environment, and the need for performance VM datastores.

IDC's 2012 CIO research study revealed that the number two initiative for most firms is virtualizing and consolidating. A recent Forrester Research report shows that server virtualization has matured extensively and is now widely adopted for use in critical production level applications. These include mission critical databases, with deployments growing from 53% to 68%, and email servers, showing an increase from 29% to 51% year over year. Gartner Group estimates that by 2013, 60% of server workloads will be virtualized, and the average physical server will host no more than ten VMs.

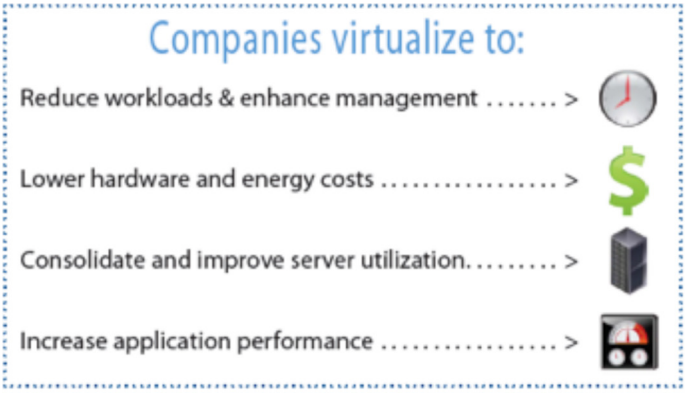
60% OF SERVER WORKLOADS WILL BE VIRTUALIZED BY 2013

AN AVERAGE PHYSICAL SERVER WILL HOST 10 VIRTUAL SERVERS

15% OF ENTERPRISE PCS WILL BE VIRTUALIZED BY 2013

GARTNER, 2011

Virtualization is showing all the signs of being mature and well down the path of adoption in the datacenter. Following suit, everything that surrounds the central function of processing is also maturing to support virtualization's unique requirements. Servers are delivering multi-core processors and improved capabilities that are intended to empower virtualization. NICS, network switches and "pipes," such as 10 Gigabit Ethernet, are taking a strong foothold in the datacenter to help provide the necessary increased throughput for virtualized infrastructures. What still lags, however, is adequate storage performance optimized for a virtualized, random I/O data center that won't break the bank.




## SAY GOODBYE TO SEQUENTIAL

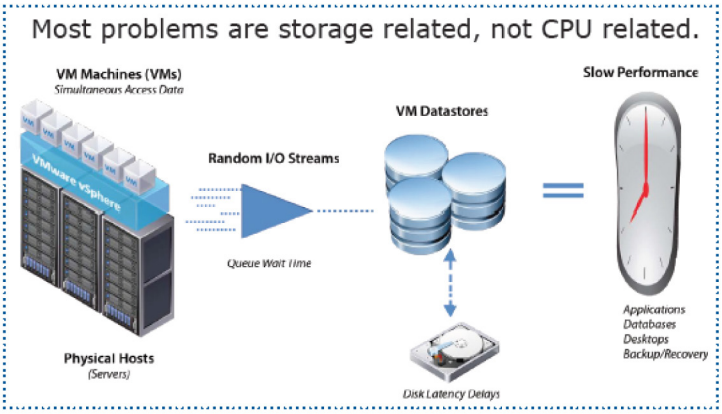
Almost every IT professional understands that while a VM sits on a host, or physical server, VM datastores—those repositories where the data resides—are housed on storage devices, most typically a Storage Area Network (SAN). Server consolidation simplifies the connection access to this storage, but server virtualization poses a significant challenge for storage performance.

Physical servers usually have dedicated storage I/O access to separate storage systems or specific allocations within a storage system. I/O requests for data residing on that storage is more sequential, or serial in nature. The performance required by each physical server, measured as Input/Output Operations per Second (IOPS), is often moderate. Storage resources may be configured to provide high throughput to particular servers that need it, and I/O bottlenecks are usually not an issue. Virtualizing changes all of that. Where sequential order and structure once ruled the day in a physical server data center, random chaos now reigns supreme.

Server virtualization increases resource utilization by running each application or workload in its own virtual server. CPU utilization goes up, while power, cooling and floor space are conserved. Each virtual server shares the system resources available to the physical server hosting the virtual servers. And, with all these servers requesting access to storage, available storage I/O becomes a major bottleneck. Adding a significant number of virtual servers to a physical server translates to a much larger storage I/O requirement and results in significantly more random data accesses—sometimes by an order of magnitude. Traditional hard drives by way of design do their best work in a sequential environment and struggle to keep up in a random environment. Even the best SAS drives running at 15,000 RPM still suffer from latency delays of more than three milliseconds, which is an eternity for a process-intensive virtualized application.

Although individual virtual servers may have modest storage I/O needs, when a dozen or so virtual servers are hosted on a single physical server, the demand for storage I/O skyrockets. Typically, a server hosting fifteen VMs may require, on average, 2,250 IOPS or more. As the number of virtual servers per physical server increases, so do the IOPS required. A midsize

data center with twenty-five physical host servers can require 56,250 IOPS for the hosted VMs, and maybe twice that to handle "storms" and "tsunamis." Other physical servers, not dedicated to virtual hosting but to a particular high I/O application, can drive these requirements even higher. Note that these assumtions do not account for high email traffic, or backup and other data protection activities, which are also tremendously IOP hungry.




Virtualizing desktops exacerbates this problem as VDI causes "I/O storms" when users log-in to their virtual desktops and overwhelm storage system performance.

## MORE VMS EQUAL MORE BOTTLENECKS

The upside of increasing the number of virtual servers hosted per physical server is that the cost-effectiveness of the virtualization environment goes up. The downside is that server hosts become more limited by available storage I/O. Anticipating the IOPS that a virtualized infrastructure will need, to help prevent performance issues, is a required prerequisite to any virtualization project. One of the best ways to accomplish this is to create an IOPS calculation worksheet like the one shown below.

## HOW DO WE SOLVE THE PROBLEM?

Attempting to accommodate ever-growing demand for storage capacity has come at the cost of performance I/O and throughput. Random data access, in particular, suffers under the strain of growing server virtualization, unstructured data, de-duplication and other technologies that have randomized I/O.

There are several techniques available that attempt to remedy the I/O bottleneck. These include:

- Adding more disk drives or storage
- Hard drive short-stroking
- Adding solid-state flash drives as a cache or "tier-zero" storage

## ADDING HARD DRIVES

The initial response for most IT professionals battling an I/O bottleneck problem is to load up on more and faster spinning disks. This seems logical, given that I/O's scale linearly with hard drives and bandwidth. The reality is that this fails to solve the need for improved random access, and is very costly in terms of power, cooling, and data center space. The performance gains from each additional drive are marginal and decreasing, especially as the storage controller starts to become the primary bottleneck, and the wasted non-utilized storage can be significant. Keep in mind that even a fast SAS drive can't achieve more than about 200 IOPS. If you have a deficiency of 50,000 IOPS, as shown in the example above, you'll need something like 250 hard drives.

| Item | IOPS |
|---|---|
| SQL Database | 1,800 |
| Oracle Database | 1,200 |
| ERP Application | 1,000 |
| MS Exchange | 2,000 |
| 10K Emails/Day | 10,000 |
| 6 Perf Apps | 6,000 |
| 1,000 Desktops | 25.000 |
| 75 VMs | 11,250 |
| **TOTAL IOPS** | **58,250** |
| | |
| **SAN Disks** | **IOPS** |
| **40 x 500GB (20 TBS)** | **8,000** |
| | |
| **IOPS Deficiency** | **50,250** |

| | |
|---|---|
| Number of Desktops | 3,500 |
| Launch Rate (in seconds) | 0.5 |
| Login IOPS (Win7=~100) | 100 |
| Workload IOPS (Login VSI Medium = ~5) | 5 |
| Desktop Login Time (in minutes) | 0.5 |
| Peak IOPS | 28,800 |
| Steady-State IOPS | 17,500 |
| Estimated Boot IOPS (+/- 10%) | 77,000 |

Sources:

- 1200 IOPS per Oracle DB from VMware Capacity Planner data
- 1800 peak IOPS per SQL DB from Sep 2009 Pivot Point study
- 2000 IOPS per MS Exchange from EMC Virtualized Architecture for Microsoft Exchange Server Whitepaper, July 2009
- 150 IOPS average per VM and 200 IOPS maximum per SAS 15K drive from Storage Switzerland article, Sep 14, 2010
- 25 IOPS per medium VDI user from Citrix VDI IOPS Estimate, Nov 2010
- 1000 IOPS per ERP or performance app from Aventi Group user study Q1 2011

Of course, your storage vendor would be thrilled to sell you an additional 100 or 200 terabytes (TBs) of storage to tackle your IOPS deficiency, but will your budget support all that wasted capacity? And let's not forget that storage management complications and hassles will increase. Bottom line: the ROI of adding more spinning disks just doesn't make sense.

## SHORT-STROKING

An alternative to buying more storage is hard drive short-stroking. The chief factor determining random IOPS performance in a hard drive is the random seek time due to mechanical latency. Short-stroking improves random IOPS by reducing the distance the head must move when seeking out random data. By limiting the number of tracks used on each hard disk drive to just the outer tracks on each platter, random IOPS can be improved by up to 50%.

However, short-stroking leads to a sizable reduction in drive capacity. Usually, only the outer third or less of the platter tracks are made available, reducing capacity by 66 to 90%. Power and cooling requirements remain the same for each drive, and as more drives must be acquired to meet overall capacity requirements, power and cooling costs will go way up, along with the need for more space, cables, etc. Ultimately, capacity is limited by the size of the storage system, which again puts the data center on the path to overbuying storage systems to try to defeat the I/O bottleneck. Although this tactic can work for some data centers, short-stroking's tradeoff equates to high cost and complexity.

## SSDS

High-performing Flash SSDs (solid-state drives) are ideal for random access I/O. They're fast, with random IOPS in the thousands or more, and by today's design standards are often more reliable than hard disks. In most cases, however, they're also lower in capacity and more expensive than hard drives on a dollar per gigabyte (GB) basis. Still, a Jetstress test completed by Principal Technologies showed that only three SSDs outperformed twenty-four HDDS by almost 200% for delivering sustained IOPS, verifying that the dollar per IOP profile for SSDs is far more favorable.

Not long ago, concerns about SSD reliability and endurance prevented mainstream storage vendors from adopting Flash for mainstream system, but newer management technogies now offer enterprise-class endurance with improved error checking. Most storage

vendors today tend to prefer SSDs for caching schemes to improve IOPS performance. Data is written first to the cache, and this is where the storage system will first look for data on a read. Using SSDs as a cache can provide a strong boost to IOPS performance, yet it's important to note that this is typically burst IOPS and not sustained IOPS. When it comes to a virtualized environment, the difference is critical. Remember, virtualization results in an order of magnitude more random I/O, which requires sustained IOPS. Simply adding a solution that provides an occasional IOP boost will be like asking a race car driver to constantly pull in for a pit stop.

Another factor to consider is cost. Even when limited to cache applications, adding SSDs to a SAN can increase system costs substantially. In response, system architects try to minimize the SSD cache used. To get a cache hit rate of at least 50% implies that a cache should comprise 10% or more of total storage. If a 100TB storage system has less than 10TB of cache, the hit rate falls off exponentially. Moreover, managing a cache can be complex and time-intensive, further raising costs.

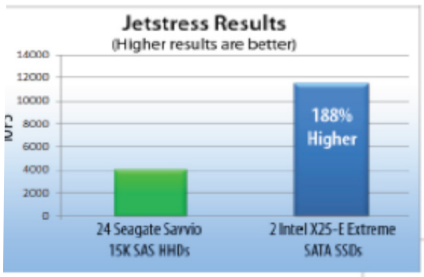
## TIER-ZERO

An alternative approach is to use SSDs for the primary storage tier, or tier-zero. This tier contains the most recently stored and accessed data, and data used by applications requiring high random access performance. Over time, if not needed, the data is moved to lower storage tiers using less costly, slower drives. The storage vendor is able to reduce the number of high performance high-cost hard drives, instead using a smaller number of high capacity lower performing hard drives together with fast SSDs to provide the performance needed. Power, cooling, and space requirements are all reduced for further savings.

The key to making this scheme work is the data migration process, which must either be done manually or through storage tiering software. Automated storage tiering can be expensive, is usually unable to handle dynamic workloads, and lacks granularity. Additionally, this process tends to migrate data from faster tiers to slower tiers, and cannot be counted on for the precision and accuracy required to ensure that data in the primary storage tier is available when needed. In reality, IT professionals will often take the costly step of overprovisioning each tier to get the performance they need.

There are other issues with automated tiering. Because data is frequently moving from one tier to another, data requests can be stalled while waiting for the move to complete. Many storage managers like to have better control over what data is stored on various tiers. Automated storage tiering also tends to increase power usage substantially, as disks spend more time spinning.

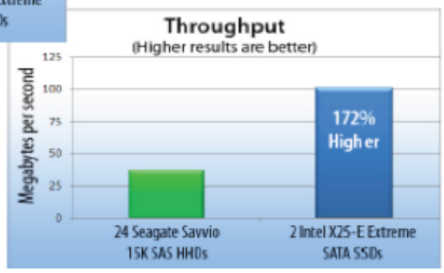
Nonetheless, automated storage tiering paired with SSDs can provide a real I/O benefit for non-virtualized data centers, and can work well in virtualized environments given the right architecture and implementation.




3 Solid State Drives (SSDs) = 188% more IOPS & 172% More MB/s

vs

24 Hard Disk Drives (HDDs)



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IT Delivered

## JOHN ASKS FUSIONSTORM TO HELP

Though John knew there were risks, he also knew that FusionStorm had helped thousands of other customer over the years solve large problems. He also knew they had a great reputation for having one of the best teams of virtualization experts in the industry. Certainly their lineup of vendors was impressive, and he felt confident they would recommend the best solutions.

John invited FusionStorm's team back to complete the assessment. What they found was revealing, but not surprising. Steve's initial calculations were not far off. The good news was they had isolated the culprits. The bad news was they still needed to solve the massive IOPS problem. Steve recommended a few approaches. They increased memory in some of the servers, tuned some databases and optimized performance, but that was just the start.

Dwayne created a Total Cost of Ownership analysis that outlined how John could replace several servers that were approaching end-of-life with newer HP ProLiant DL980 G7 servers. Dwayne explained that the DL980 used a newer HP PREMA Architecture with Smart CPU caching and a resilient system to reduce bottlenecks, improve throughput and performance, and deliver enhanced reliability in an x86 environment. The server series used a 10-core Intel® Xeon® Processor and could pack up to 4 terabytes of expandable memory. Steve jumped in and showed John how a single DL980 could handle up to 197 virtual machines without sacrificing performance. John's current servers started wheezing at about 20 VMs.

Steve demonstrated how the DL980 could boost system availability by as much as 200% with the PREMA architecture, support John's IOP hungry applications with up to 16 I/O slots and cut his datacenter power and energy costs in half. Dwayne went through the TCO analysis line by line and showed John how he could replace dozens of servers with just a few DL980s. With the reduced cost of management, power, cooling and other efficiencies, the payback would come in less than 90 days. What's more, John could lease a new DL980 for under $1,000 a month. At that price, even Gage would have to smile.

Dwayne and Steve then recommended an HP P4900 add-on to John's HP P4000 SAN. Using high performance solid state drives, the P4900 could overcome the performance bottlenecks they were seeing during storms and tsunamis. The upgrade proved to be quite affordable, given the benefits, and John felt confident that armed with FusionStorm's crisp TCO analysis, he could get Gage to approve the funds.

John was right. Once Gage reviewed the cost savings, performance boost and reduced management requirements, he marched down the hall and pushed for approval from the CFO. John and FusionStorm spent the next few weeks installing everything. Then they started the test period. With his job at stake, John remained on pins and needles for the next several days. At night, Sherry tried to console him, but there was little she could do. A week went by without a single storm or tsunami, but they still needed to provide Gage with a full set of test reports before he'd be convinced they'd solved the problem. The fateful Monday arrived, and John drove into work.

Dwayne and Steve arrived at 10am. They peered over John's shoulders as the three reviewed the logs and analyzed the test results. First Steve smiled. Then Dwayne. Finally, John let his shoulders relax. He smiled and then grinned.

Moving the ERP and business intelligence system over to solid state drives had improved latency from ten milliseconds a transaction at 10,000 I/O operations per second to one millisecond. Further boosted by faster, more efficient servers, the overall performance improvement exceeded 80%. Virtualized desktops were no longer experiencing data storms, let alone tsunamis. Angry employees no longer lined up outside John's door or lit up his phone line. John was pleased with the results, but now he had to hope that Gage didn't have a different opinion.

Two days went by. John did not hear a word from his boss. He didn't know if that was a good sign or a bad one. At 11am on the third day, one week before Christmas, Gage entered John's office. Two people entered as well, and stood near the door. A man and a woman. The CEO and CFO of the company. Gage's face seemed hard, but then again, it always did. Gage approached John's desk. John stood up. If this was bad news, he preferred to take it standing.

"Mr. Bettoni," Gage said.

John tried to answer, but a lump in his throat held his tongue.

The corners of Gage's mouth turned up ever so slightly. "Congratulations." Gage brought forth a plaque. "This is an award from the company for your recent outstanding performance."

John's jaw dropped as Gage handed him the plaque.

"And this," Gage said, handing John an envelope, "is a bonus check for helping save the company money."

John finally let himself smile. The CEO and CFO stepped forward and shook his hand. Gage patted John on the shoulder and invited him to join the rest of the company in the cafeteria for a Christmas celebration.

That evening, after dinner, John sat near the fireplace and watched the Christmas tree lights sparkle. Little Julie sat in his lap, with Angela and Sherry nearby.

Angela said, "Daddy, do you still like the globe ornament we got you?"

"Absolutely," John said. "I keep it on my desk where I can see it every day."

"That's good," Angela said. "We wanted you to have the world."

John's heart filled with joy. He smiled and said, "I already do."

## JOHN TRIES TO SOLVE THE PROBLEM ON HIS OWN…

John wanted to trust the guys from FusionStorm, but the fear of making a mistake kept him from moving forward with them. Instead, he decided to handle the problem on his own with the help of this team. They increased server memory, added disk drives to the SAN and tweaked network performance. They tuned databases, optimized applications and implemented a dozen other tactics. They even tried to coerce users into better balancing their application usage times. Nothing worked. The storms kept coming. Soon the tsunami waves washed over the entire Pittsburgh datacenter and flooded John with a sea of worry.

A few days later, Gage entered John's office. Two large suited men stood on either side of the door. Gage did not act mad when he fired John. In fact, he appeared to be almost sympathetic. Still, though John knew it was coming, the finality of the act hit him hard. It was all he could do to remain placid and professional. As the two big guys escorted John out of the building, he felt like a wounded duck on a pond: trying to stay calm on the surface while below the water, his legs struggled to keep him afloat.

The drive home was the longest John could remember. Sherry and the girls met him at the door, full of excitement. He returned their smiles, hoping they would not see the slight quiver of his lip. Inside the house, the Christmas tree sparkled, the fire crackled and the smells of the season filled the air.

Julie grinned and pointed at her toothless gums. "Do you think Santa will bring us everything we want for Christmas, Daddy?"

"I hope so, Julie," John said, wiping a tear from his eye. "I really hope so."

FIND OUT WHAT HAPPENS WHEN JOHN MAKES A DIFFERENT CHOICE...

## SOLUTIONS DISCUSSED IN THIS ARTICLE…

### HP ProLiant DL980 G7 Server

Blending business-critical and industry-standard design principles, the HP ProLiant DL980 G7 Server with HP PREMA Architecture is an eight-socket, x86 server, designed with balanced scalability, self-healing resiliency, and breakthrough efficiencies for the largest and most demanding x86 enterprise-class workloads. The benefits of consolidating by replacing dozens of legacy servers with a few DL980 servers, especially in virtualized environments, include:

- ✓ Up to 80% more input/output capacity than the competition, balanced with up to 8 processors and 2 TB of memory (RAM).

Benefits:

- ✓ Reduces performance bottlenecks, especially in virtualized environments
- ✓ Can pay for itself in as little as two months when you compare it to a scale-out solution (especially when you factor in software licensing and support)
- ✓ Can actually cost less than keeping current older technology servers
- ✓ Mission-critical technology to increase system availability by 200%. Benefits:
- ✓ Reduces downtime, increases performance, allows virtualization of DBs & performance-intensive applications
- ✓ Allows for Desktop Virtualized Infrastructure (VDI) implementation (may need Violin Memory)
- ✓ Consolidate up to 197 physical servers into one DL980 (more Virtual Machines per server). Benefits:
- ✓ Breaks typical barrier of only 5 to 20 VMs per physical server
- ✓ Supports Windows, Linux & Solaris (easy porting from older servers using HP-developed scripts)

### HP P4900 G2 SSD Storage System

High performance workloads and virtualized environments that need the power of solid state rely on the HP P4900 G2 6.4TB SSD Storage System. The P4900 is a 2-node cluster that can be used standalone, or as a performance tier-0 in a P4000 environment. HP P4000 G2 Storage Area Network is a well-balanced and affordable approach that offers a virtualized pool of storage resources to deliver enterprise SAN functionality. The P4000 enhances virtual environments, simplifies management, and reduces costs. Easy to deploy, grow and maintain, P4000 SANs ensure that critical business data remains available. The innovative approach to storage provides a unique data protection level across the entire SAN, reducing vulnerability without driving up costs the way traditional SANs can.

Planning for everything from data growth to disaster recovery to centralized backup to future proofing your infrastructure—these are all daunting tasks for any company no matter the size. When it comes to the storage part of the design, P4000 LeftHand SAN Solutions are a perfect fit for environments with a variety of virtual servers, client virtualization, database, email, and business applications.

P4000 SANs scale capacity and performance linearly to seamlessly grow with your business. The P4000 portfolio has affordable enterprise functionality with a comprehensive feature set and simplified central management for all locations. Superior application availability and disaster recovery features are integrated into the P4000 SANs for automated failover/failback in any situation. P4000 SANs are optimized for virtualized environments with VMware ESX/ESXi & Microsoft Hyper-V integration and offer continuous data availability to users and applications that meets demand on-the-fly.

- ✓ Simplified backup and easy recovery
- ✓ Integrated snapshots for ESX/ESXi and Hyper-V
- ✓ Simplified recovery and snapshot searching
- ✓ Linearly scales IOPS as you grow
- ✓ Faster replication speeds and shorter RPOs

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# FUSIONSTORM COMPANY OVERVIEW

## Leader in Information Technology Delivery

- ✓ Best-of-breed vendors & solutions
- ✓ Full suite of professional & managed services
- ✓ State-of-the-art managed services facilities
- ✓ 600+ technical certifications
- ✓ 175+ technical/engineering experts
- ✓ 2,200+ customers in 14 U.S. cities

Our strategic partners

## Award Winning Track Record

- ✓ Founded in 1995
- ✓ EMC Partner Executive of the Year
- ✓ Cisco Partner of the Year (Breakaway & Collab.)
- ✓ Top Five Fast Growth Company (5 years)
- ✓ Emerson Partner of the Year Award

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