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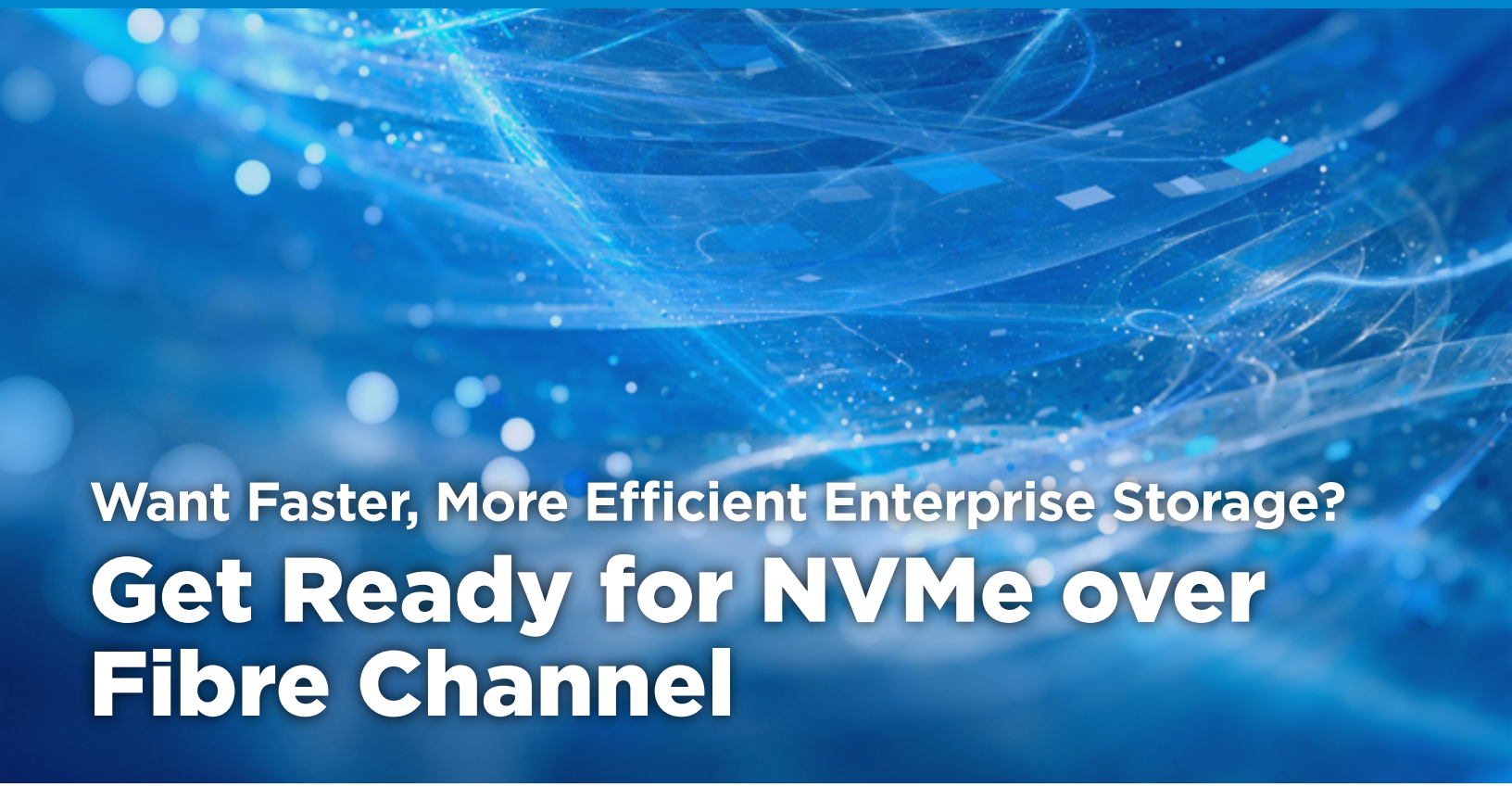

Want Faster, More Efficient Enterprise Storage?

Get Ready for NVMe over Fibre Channel

Today's performance-intensive enterprise workloads demand greater IOPS and lower latency than legacy storage infrastructure can handle. A new breed of NVMe-based all-flash arrays running on Fibre Channel fabric is changing the rules of the game.

No one has to belabor the point that data volumes are exploding and that enterprise workloads demand greater performance, availability and responsiveness than ever. The often discussed trend toward digital transformation is rooted in the assumption that critical applications will fail to deliver their intended economic and operational value unless infrastructure—particularly storage—is modernized and optimized for fast performance, low latency and improved economic metrics. This, along with the density per rack unit of flash storage, has helped drive the shift to all-flash arrays (AFAs).

Fortunately, NVMe-based flash storage has burst onto the scene to turbo-charge enterprise workloads compared to legacy storage arrays based on spinning hard disks and even most flash drives being deployed today. Market researchers are projecting total global NVMe revenues will approach a massive $65 billion by 2022,[1] aided by the introduction of NVMe-over Fabrics (NVMe-oF), a fabric-agnostic approach that traffics data over the high-speed PCIe bus for all popular fabrics, including Fibre Channel, Ethernet and InfiniBand.

1 Spring 2018 NVMe Market Sizing Webinar, G2M Research, May 2018.

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In fact, NVMe is poised for a rapid uptake in market adoption: In less than two years, current and planned adoption of NVMe storage surged from 34% to 43% among enterprise storage buyers, according to TechTarget's Storage Market Landscape for the first half of 2018.[2]

But to take full advantage of NVMe-based all-flash arrays (AFAs), organizations are looking for ways to combine NVMe storage with high-speed Fibre Channel fabric to support performance-intensive, mission–critical enterprise workloads. Legacy storage solutions—even those utilizing earlier versions of flash storage—often suffered performance bottlenecks due to limitations in existing storage networks.

However, new NVMe-based AFAs running over enterprise-class Fibre Channel fabric (FC-NVMe), have obliterated those performance roadblocks that threatened to limit the economic value of enterprise workloads. And, a new generation of FC-NVMe solutions from a partnership of long-time industry leaders and technology innovators is about to change everything for IT infrastructure decision-makers. In fact, that partnership between NetApp and Broadcom is resulting in solutions that are quickly becoming the storage infrastructure of choice for all-flash arrays, as evidenced by recent market data pointing to NetApp's No. 1 position in the AFA market.

Why NVMe over Fibre Channel makes a difference for enterprise workloads

High performance has always been a prerequisite for enterprise storage; no one wants to wait while storage systems search for files in an enterprise database, or even be shut out of systems during off-hours while production systems are being backed up or archived.

But performance requirements in today's enterprise storage environments are being redefined due to a variety of factors, including massive data growth, the stunning shift toward unstructured data such as voice, video and social media, the need for real-time access to data to make critical business decisions and, of course, the unprecedented demands of modern enterprise workloads, such as analytics/big data, hyperscale virtualization, internet of things (IoT) applications, artificial intelligence/machine learning and automated cybersecurity monitoring and management.

Then, add to those the growing size, complexity and performance demands of mission-critical enterprise applications such as Oracle, SAP HANA, Microsoft SQL Server and NoSQL databases such as MongoDB.

The result: We have left behind the era of spinning hard disks, replaced with solid-state drives in various configurations. Increasingly, however, AFAs are dominating the enterprise storage landscape, particularly as we continue to migrate to an era of flash storage over all manners of fabric—Fibre Channel, Ethernet and InfiniBand.

What is it about NVMe that is fast making it the technology of choice in data centers, server-side storage and other configurations, including hyper-converged infrastructure (HCI)? "I think NVMe will make a huge difference, especially in

2 Storage Market Landscape, 1st Half 2018, TechTarget, July 2018.

the HCI space, because the storage performance in that segment is really lacking," said a storage administrator for a global financial services firm. "It's really going to help with the latency issues, and maybe when we have NVMe more broadly deployed, we will see database workloads that would actually be able to perform at a higher level."

An IT administrator in another financial services firm agreed, noting the smooth upgrade path from their existing infrastructure design: "Our chosen SAN fabrics are NVMe-ready, so it's just a matter of either enabling code or upgrading some of the hardware components to make connect them to the host.... The new products that we are buying have NVMe at the back end, so that means that once you have the need for it, you can run NVMe end-to-end on those products. That's a good direction, a really important step." This popular viewpoint highlights one of the simplest and most risk-adverse storage upgrade paths in decades.

And, as enterprises evaluate how best to utilize NVMe for the biggest benefit to their enterprise workloads, they are increasingly opting for FC-NVMe because it offers the highest performance, investment protection for existing SAN infrastructure, a purpose-built-for-storage design and high reliability and security for mission-critical data.

According to data based on interviews with storage buyers, Fibre Channel overwhelmingly is—and will continue to be—the fabric of choice for NVMe implementations, far outdistancing InfiniBand and Ethernet.[3]

The trend is clear and powerful. "...FC-NVMe represents a critical next step in defining the future of the data center," according to a recent report on SearchStorage.com. "No one wants to rip and replace infrastructure. Knowing this, (the Fibre Channel Industry Association) designed FC-NVMe to fit into existing SAN fabric infrastructure—no new hardware or infrastructure investment required. This is incredibly beneficial to current FC-based SAN environments, which are likely already NVMe-ready."

The NetApp/Broadcom partnership: Technology synergy, enterprise storage leadership

Creating this new generation of storage infrastructure solutions typically requires the collective skills, experiences and knowledge of OEM partners with a breadth of knowledge on everything from flash storage engineering and microcode to switches and fabrics. Two market leaders—NetApp and Broadcom—have brought a new line of FC-NVMe solutions to market that not only meet the current needs of enterprise storage customers, but are designed to scale and adapt over time as customer environments evolve.

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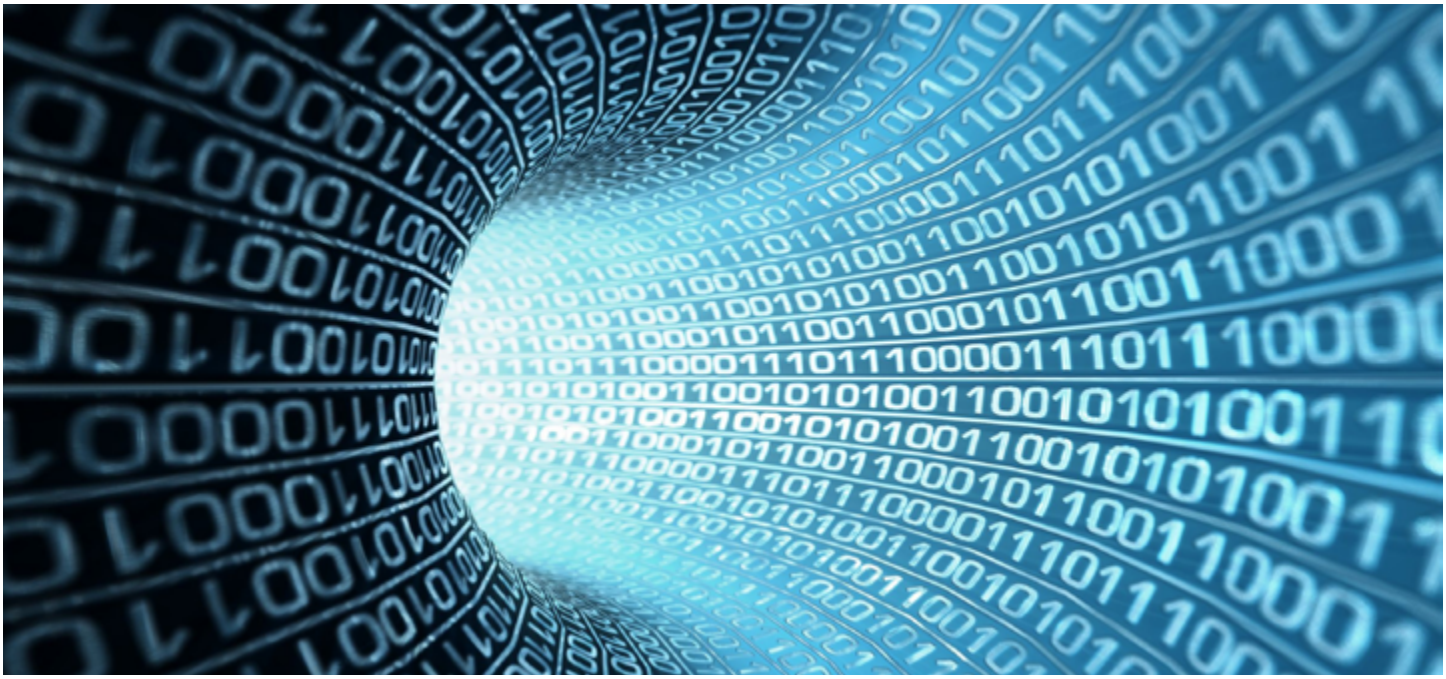
3 TechTarget, Ibid.



NetApp has chosen Fibre Channel as its first NVMe fabric implementation in ONTAP due to a variety of factors, including:

- A majority of existing high-performance, latency-sensitive block workloads are currently running on FCP.
- Most performance-focused workloads already use Fibre Channel Gen 5 and Gen 6 platforms in their fabrics.
- FCP and NVMe/FC can use the same physical components to transport FCP and FC-NVMe concurrently.
- Most NetApp customers already own all the hardware they need to enable NVMe-FC with a simple software upgrade to ONTAP 9.4.
- As applications and drivers are able to take advantage of the parallel queueing mechanisms available in the NVMe standard customers will be able to implement them in a software only update that does not touch the hardware infrastructure.

In a joint effort with NetApp and Broadcom's Brocade and Emulex divisions, the result has been an increase in IOPS by more than 50%, as well as a reduction in latency by as much as 34% compared to SCSI-based FCP.[4] This research, conducted by third-party testing organization Demartek, points out that NetApp ONTAP 9.4 is the first generally available enterprise storage offering enabling FC-NVMe. Key findings from the research include assertions that FC-NVMe:

- Accelerates existing workloads, such as Oracle, SAP, Microsoft SQL Server and others.
- Is easy to adopt and deploy, typically through a software upgrade.
- Provides financial investment protection because the NetApp/Broadcom solutions run on existing hardware infrastructure.
- Enables new SAN workloads, such as analytics, IoT and artificial intelligence/ machine learning.

4 "Performance benefits of NVMe over Fibre Channel: A new, parallel, efficient protocol," Demartek, May 2018.

Additionally, results from testing conducted by NetApp and Broadcom highlight the impressive financial benefits of this new line of AFAs, including 93% return on investment, a short 6-month payback period and a $2.2 million cost reduction over a 3-year period compared to legacy SAN systems.[5]

These and other benefits make the NetApp AFA solutions ideally positioned for current and future workloads that demand higher and higher performance, whether deployed in the data center or any distributed computing environment. The NetApp FC-NVMe-based solution is rooted in a data fabric that seamlessly connects a customer's increasingly complex and distributed computing infrastructure spanning on-premises, off-premises and cloud-based architectures.

This NetApp data fabric includes such features as automated policy-based tiering of cold data to a public cloud; pay-as-you-go backup and disaster recovery in a public cloud; automated data sync, and support for cloud-based predictive analytics.

Therefore, it should probably come as no surprise that NetApp has made a full transformation from its initial roots in network-attached storage to a leading enterprise storage solutions provider. In fact, recent data from IDC indicates that NetApp became the No. 1 AFA vendor in the second quarter of 2018.[6]

The fact that NetApp continues to grow faster than the overall rate of the AFA market is an indicator that enterprise storage customers are "voting with their wallets" in selecting NetApp AFA solutions—something that bodes well for NetApp as it rolls out its new FC-NVMe solution.

A question that gets asked is how will companies financially gain from this? Imagine a scenario where a financial institution needs to do analysis on a large numeric array. For instance, you might have an application that can decompose the array into smaller segments and then stream it through parallel NVMe queues to perhaps an NVIDIA chip with tens of GPUs on it and then aggregate the return; imagine how drastically you could shorten the analytics cycle. Now consider that same type of mechanism being used by a pharmaceutical company modeling a new medication or speeding up threat analysis for security. The first movers in this technology will reap time-to-market and responsiveness gains that could bring them very real revenue returns.

...enterprise storage increasingly is centering around NVMe solutions optimized for the high-performance Fibre Channel fabric, due to Fibre Channel's acknowledged performance advantages and its widespread presence in many enterprise data centers.

5 NetApp and Broadcom Modern SAN Cloud-Connected Flash Solution, NetApp Inc., June 2018.

6 NetApp Attains #1 Spot for All-Flash Arrays and Fastest Growing Top 5 AFA Vendor, NetApp Blog, September 2018.

Conclusion

The insatiable demand for high performance—measured in both high IOPS and low latency—has transformed enterprise storage to a flash-centric architecture. In particular, the exciting advances offered by NVMe-based flash solutions gives infrastructure managers and storage administrators the solutions they need for performance-intensive workloads such as analytics, IoT, enterprise databases, hyperscale virtualization and more.

In point of fact, enterprise storage increasingly is centering around NVMe solutions optimized for the high-performance Fibre Channel fabric, due to Fibre Channel's acknowledged performance advantages and its widespread presence in many enterprise data centers.

The combination of NetApp and Broadcom offers enterprise IT decision-makers and storage administrators the ability to "have it all"—high throughput, low latency, best-in-class technology leadership and a clear roadmap to the future for NVMe-based solutions. That partnership is a major factor in NetApp's ascendency to the top position in all-flash arrays, according to widely respected third-party research.

NetApp's long-established market leadership, augmented by its strategic relationship with Broadcom, is resulting in a new standard not only for enterprise AFAs, but specifically for Fibre Channel environments where optimized performance, low latency and high reliability are must-haves.

For more information about the benefits of NVMe over Fibre Channel and the NetApp/Broadcom partnership, please visit:

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