

With the release of vSphere 7, VMware natively supports NVMe over Fibre Channel (NVMe/FC). This storage networking protocol is a key enabler for enterprises undergoing digital transformation that need higher storage performance for their mission-critical workloads.

Native NVMe/FC Support Provides a Performance Growth Path for Virtual Infrastructure

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Questions posed by: Broadcom and VMware

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Q. What is NVMe over Fibre Channel (NVMe/FC), what are its primary business benefits, and what type of customers use it?

A. Nonvolatile memory express (NVMe) is a new storage protocol that transcends the capabilities of the legacy SCSI protocol. Relative to SCSI, NVMe supports at least an order of magnitude lower latencies, much higher throughput and bandwidth, and three to four orders of magnitude higher parallelism (a critical concern with the preponderance of multicore processors in today's servers). It was developed specifically for solid state media and is a much more efficient protocol for storage than SCSI. As enterprises deploy more applications that are real time in nature and work with large data sets (e.g., artificial intelligence, machine learning, and big data analytics workloads), NVMe brings needed performance, scalability, and efficiency capabilities to storage.

The NVMe protocol has been used in direct-attached storage for a long time and is rapidly replacing SCSI in external storage. Although it started out being used primarily for performance-sensitive, mission-critical workloads, it is quickly becoming the mainstream storage protocol for general-purpose mixed enterprise workloads. NVMe storage prices have been dropping, and because the cost has become sufficiently low, we have already seen several systems targeted for secondary storage workloads based on NVMe. With many servers, storage devices, and storage systems already supporting NVMe, there is a need for a network storage platform that also supports it.

The NVMe over Fabrics (NVMe-oF) standard is that platform. It provides all of NVMe's performance and efficiency benefits across switched networks, allowing end-to-end NVMe-based all-flash arrays (NAFAs) connected to servers across NVMe-oF the ability to consistently deliver low latency at scale (from the application's point of view). (As a comparison point, an NVMe-based NAFA is 100 times faster than traditional hard disk drive [HDD]-based systems.) Many of the next-generation application workloads that are being deployed by enterprises as part of digital transformation are demanding this kind of performance. Those workloads include big data analytics (e.g., Splunk, Spark, Apache, Cassandra, MongoDB), ecommerce (e.g., Booking.com, Travelocity), and latency-sensitive transactional applications (e.g., Oracle, SQL Server).

NVMe is rapidly displacing SCSI-based arrays in the primary storage market. Although the first NAFAs started shipping only in late 2017, over 50% of primary external storage revenue will be generated by NAFAs by 2021. Almost all of the major external storage vendors offer NAFAs as well as NVMe-oF host connection options. Many of VMware's enterprise customers are running their virtual infrastructure on external storage arrays that are connected over FC, and their workloads will benefit most from the additional performance of NVMe/FC. Even if customers do not absolutely require the performance benefits of NVMe technology now, it is highly likely that they will within the lifetime of arrays they are buying today. Enterprise VMware customers looking for lower latencies and improved infrastructure efficiencies are very interested in end-to-end NVMe solutions.

Q. What proof points exist that validate the business benefits of NVMe/FC?

A. Published industry benchmarks already support the performance benefit claims of NVMe/FC. NVMe solid state drives (SSDs) enable higher transactions, faster throughput, and lower latency than SCSI SSDs, and NVMe/FC allows that performance to be delivered back to applications running on NVMe-oF attached servers. Traditional storage systems based on HDDs and connected over SCSI-based hosts typically deliver latencies from 5 milliseconds to 20 milliseconds. NAFAs connected to servers over NVMe-oF networks consistently deliver sub-100 microsecond latencies. Lower latencies not only drive higher bandwidth and throughput but also allow higher CPU utilization in servers so that a CPU can get more done in the same amount of time (it spends less time waiting for the storage to respond).

In April 2020, Tolly Enterprises LLC (an independent third-party testing organization) ran a direct comparison between SCSI and NVMe/FC performance in VMware environments. Microsoft SQL Server 2017 and Oracle 19c were tested in ESXi 7.0 environments, and the NVMe/FC configurations delivered a 2.4 times higher transaction rate on SQL and a 2.1 times higher transaction rate on Oracle (with the same hardware configurations). The complete report is available at <https://docs.broadcom.com/doc/12398264>.

Q. How easy is it to move to NVMe/FC?

A. For customers already running Gen 6 FC hardware, the software upgrade is nondisruptive. Customers can use vSphere Storage vMotion to live-migrate workloads already running on SCSI over FC individually without having to shut down the applications. All the familiar storage and FC management semantics that customers are currently using with their individual arrays apply to NVMe/FC — everything just runs faster and more efficiently. Because NVMe/FC uses the same storage tools, does not require new user guides, and is plug and play, it is very easy for a VMware administrator to manage.

FC-attached enterprise storage is widely deployed among VMware's enterprise vSphere customers today. Broadcom has been shipping Gen 6 FC hardware and end-to-end solutions from Brocade and Emulex since 2016, so

For most of VMware's enterprise customers, the prospect of more than doubling database performance (as an example) with just a nondisruptive software upgrade is compellingly attractive.

the vast majority of VMware deployments using FC already have the hardware they need. NVMe over FC-enabled solutions first started shipping over two years ago, so much of the installed base of FC networking will already be NVMe/FC ready. Different enterprise array vendors started shipping their NVMe/FC support at different times, but most of the established players have been NVMe/FC ready (from a hardware point of view) for several years. And now NVMe/FC is available for VMware, which will allow all VMs running on ESXi to take advantage of NVMe/FC. Given these statistics, most of VMware's enterprise FC customers will not need to make any hardware changes to move to NVMe/FC.

Q. What does NVMe/FC mean for workloads in VMware environments?

A. Customers using SAN (or NAFA) are potentially leaving a lot of performance on the table if they are not planning to transition their vSphere environments from SCSI-based storage networking to NVMe/FC. NVMe/FC unlocks the ability to get the performance and efficiency of NVMe all the way to the applications.

This improved application performance has several implications for VMware customers. First, it enables support for much more performance-sensitive applications, providing the flexibility to support a broader set of workloads. Second, it supports higher workload density on vSphere nodes, improving the efficiency of VMware configurations to lower costs. Third, it preserves all the benefits of SAN environments — more efficient sharing of storage along with high performance and availability and enterprise-class stability — and allows them to be harnessed for new workloads that might not have been feasible in VMware environments before. NVMe/FC further extends the capabilities of VMware to consolidate legacy workloads as well as accommodate the next-generation applications that enterprises are deploying as part of their digital transformations.

About the Analyst



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Eric Burgener is a Research Vice President within IDC's Infrastructure Systems, Platforms, and Technologies Group. Mr. Burgener's core research coverage includes Storage Systems, Software and Solutions, quarterly trackers, and end-user research as well as advisory services and consulting programs. Mr. Burgener's research includes a particular emphasis on emerging infrastructure technologies, including all-flash arrays (AFAs), persistent and storage-class memory, and software-defined storage. He is an active participant in the IT Buyer's Research Program at IDC and blogs throughout the year on the topic of Infrastructure and Data Management.

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With vSphere7, VMware customers can utilize their existing Broadcom Fibre Channel infrastructure to implement NVMe over Fabrics performance with a software upgrade.

Fibre Channel-attached enterprise storage is widely deployed with VMware's vSphere customers. Now with a software upgrade to enable NVMe over Fibre Channel, customers can reap all the same benefits of SAN environments – more efficient sharing of storage along with high performance, availability and enterprise-class stability, while more than doubling database performance with their current infrastructure.

The common misconception about NVMe over Fabrics is that it is a technology that requires greenfield experimentation. Enterprises may not realize that they already own all the elements to deploy an NVMe over Fibre Channel fabric to potentially gain more than twice the performance at scale in their existing VMware Fibre Channel environment.

Fibre Channel was engineered for storage and Broadcom switches, and HBAs are purpose-built to deliver the performance advantages of NVMe. This is how NVMe over Fibre Channel became the NVMe over Fabrics solution that is ready for deployment and production today.

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