

Highly Scalable, Enterprise Class

NVMe over Fibre Channel

Benefits

Faster networking- bandwidth of 32Gb & 128Gb Fibre Channel versus 25Gb/100Gb Ethernet	✓
Low latency- Gen 6 FC is half the latency of Gen 5 FC	✓
Scalability- beyond the rack	✓
Reliable- Lossless, credit-based network by design	✓
Ease of deployment- leverages current Fibre Channel infrastructure - no forklift network upgrades!	✓
Secure- air gap network for storage security	✓

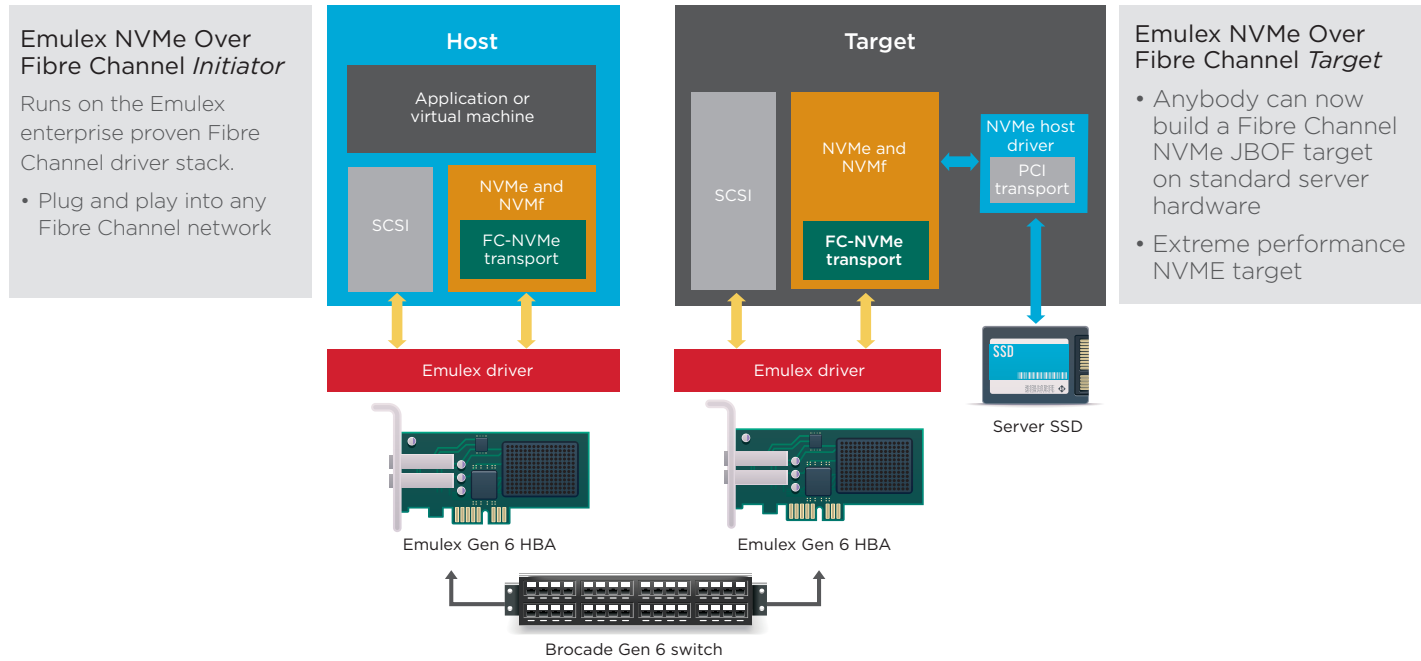
NVMe over Fibre Channel cuts latency by 55%

Introduction

Modern datacenters require storage systems that support high bandwidth, high IOPS and low latency. The first two requirements are addressed by flash, the later is addressed by Non-Volatile Memory express® (NVMe). Reducing latency is the new storage battle front.

As datacenter architects plan their all-flash strategies, they are considering deploying flash and planning for fast non-volatile memory. In parallel, new software stacks and networking technologies from NVM Express including NVMe over PCIe (NVMe) and NVMe over Fabrics (NVMeF) which provides native support for NVMe over Fibre Channel are emerging.

Fibre Channel leads as the enterprise-class, low latency network for storage, and today Broadcom is sampling Emulex® Host Bus Adapters (HBAs) with NVMe over Fibre Channel to support faster flash and next generation non-volatile memory.



Emulex HBAs with NVMe over Fibre Channel

NVMe over Fibre Channel leverages standard Fibre Channel deployments and runs a new protocol, NVMe over Fibre Channel (NVMe over FC), over the fabric with the result of cutting latency in half. Broadcom is sampling open source NVMe over Fibre Channel Initiator code and NVMe over Fibre Channel Target code for Emulex HBAs so that customers can deploy NVMe Just a Bunch of Flash (JBOfs) today, as well as providing a platform for developing next generation storage solutions.

Investment Protection with Concurrent NVMe and SCSI Support

The key factor that makes enterprise customers choose Fibre Channel over other protocols is that it is a superior network for storage within busy data centers. Datacenter architects can run NVMe traffic in parallel with their SCSI traffic over their current Fibre Channel infrastructure, providing investment protection. Fibre Channel is already future proofed so there is no need for network upgrades or reconfiguration - "It Just Works."

Emulex NVMe over Fabrics is based on standards

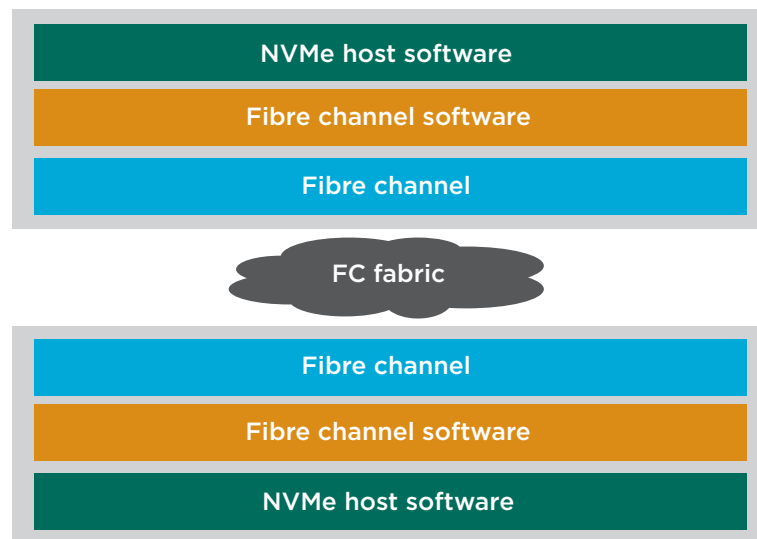
The NVM Express group released Version 1.0 of the NVMe over Fabrics standard on June 6th, 2016. NVMe over Fibre Channel is natively defined in V1.0.

The InterNational Committee for Information Technology Standards (INCITS) T11 has authored the FC-NVMe standard that natively integrates Fibre Channel fabric services into the NVM over Fibre Channel solution.

Open Source Software Solutions

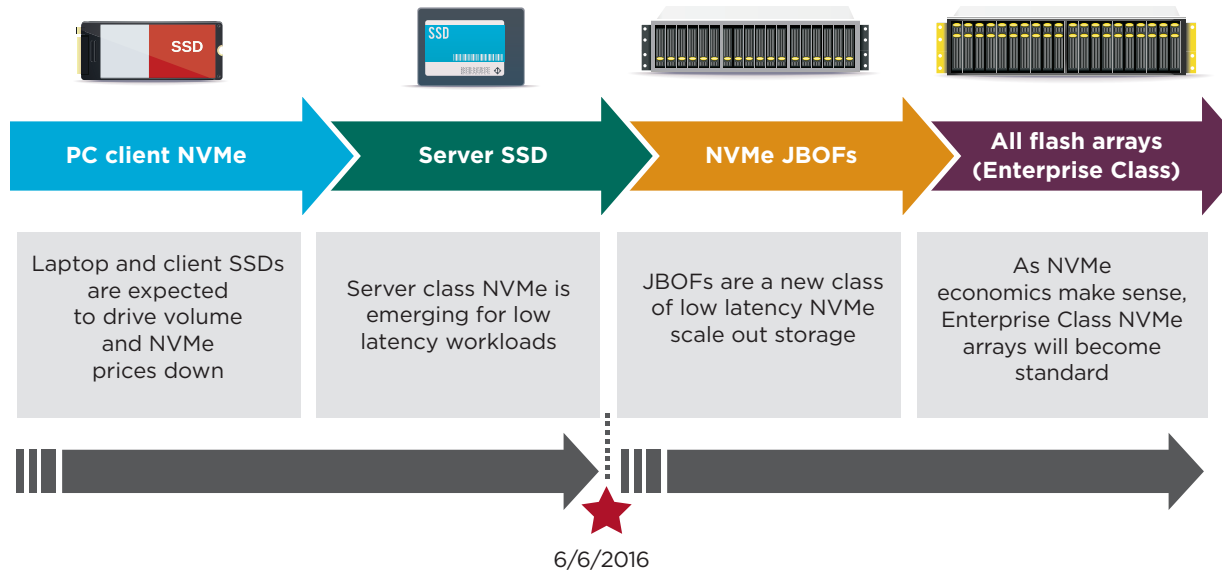
Broadcom's Emulex Connectivity Division, working with the NVMe Express Linux working group, have released the NVMe over Fibre Channel software and driver stack to the open source community. This accelerates adoption for NVMe over Fibre Channel in the Linux community and provides an open baseline for VMware and Microsoft solutions for NVMe over Fibre Channel.

Fibre Channel Transport Protocol Layer



Source: NVM over Fabrics Standard

This diagram illustrates the layering of the Fibre Channel transport within the host and NVM subsystem.



NVMe and NVMf Evolution

NVMf is the next phase for NVMe storage. NVMe is migrating from consumer devices that are driving volume, and lowering costs, to server SSDs that deliver lower Total Cost of Ownership (TCO) and higher application performance. With the release of the NVMf standard, NVMf Linux software stack, and the Emulex HBA NVMe over Fibre Channel solution, datacenter architects can start planning now for their NVMe infrastructure. For workloads and cloud applications that don't require full featured enterprise-class all-flash arrays and only require raw speed, NVMe JBOFs can be deployed. Applications

that require enterprise storage features such as data movement, replication, de-dupe, compression, thin provisioning, etc., can deploy Emulex Fibre Channel HBAs that support today's requirements as well as future NVMe deployments.

Broadcom - The Leader in NVMe Solutions

Broadcom has been the primary NVMe choice for OEM customers due to its vast portfolio of NVMe and NVMf solutions and expertise. Broadcom provides NVMe chips on NVMe drives, Tri-Mode NVMe/SAS/SATA controllers, NVMe storage adapters, NVMe server JBOF management, new NVMe over Fibre Channel solutions as well as NVMe over remote direct memory access (RDMA).

Next Steps for Datacenter Architects

While storage technology is quickly evolving, drive latencies are reduced and performance has increased, Fibre Channel is ready today to support next generation NVMf arrays by providing high performance, low latency networks that "Just Work". You can plan your migration to all-flash arrays with the confidence that once you decide to deploy NVMf arrays, the Fibre Channel network is ready to support new low-latency and high performance workloads.