NetApp Multi-Protocol Storage Evaluation

Evaluation report prepared under contract with NetApp, Inc.

Introduction

One of the advantages of the NetApp Unified Storage solutions is that these end-to-end solutions support a full range of Ethernet and Fibre Channel storage protocols including NFS, CIFS, iSCSI, Fibre Channel and FCoE across the entire FAS and V-Series product family from entry to high-end systems, with the same core software and management software. The Ethernet protocols, NFS, CIFS, iSCSI and FCoE are supported on a single connection at 10Gb speeds and Fibre Channel is supported at 8Gb speed on a separate connection. In addition, because of the advanced features of Data Center Bridging (DCB) for Ethernet, NetApp supports the ability to allocate bandwidth to different traffic types within the Ethernet environment, separating the FCoE traffic from the NFS, CIFS and iSCSI traffic.

NetApp has supported all of these protocols concurrently over a shared network port from the same storage solution for several years, introducing general availability of FCoE support in 2009. NetApp was the first storage vendor to support FCoE and multiple protocols on a shared port.

NetApp commissioned Demartek to evaluate its FAS3240, one of the members of its full line of unified storage solutions, for its ability to handle a full load of mixed traffic types simultaneously.

Evaluation Summary

The NetApp FAS3240 storage system was able to handle multiple file and block protocols simultaneously including NFS, iSCSI, FC and FCoE, and supported the bandwidth allocation capabilities of DCB known as Enhanced Transmission Selection (ETS). It also provides traditional Fibre Channel data access on separate Fibre Channel connections within the same storage controller.

We were able to provide enough of a workload to fill one 10GbE connection with a mixture of NFS, iSCSI and FCoE traffic while at the same time providing a full line rate 8Gb Fibre Channel protocol workload. In addition, we were able to adjust the bandwidth priority of the DCB Ethernet traffic by setting the FCoE bandwidth priority in the DCB Ethernet switch.

The NetApp storage systems support managing the bandwidth utilization of the 10Gb traffic using the ETS functions of enhanced Ethernet. As datacenter managers and administrators consider placing Fibre Channel traffic onto the converged network, they can be assured of achieving a minimum bandwidth for the Fibre Channel traffic so the performance of storage applications is maintained, while providing bandwidth for other types of traffic.

Based on the results of these tests, we can say that NetApp FAS storage systems are ideally suited for multi-protocol file and block storage applications.

Unified Storage

CIOs are facing a number of challenges in scaling up current storage technologies and protocols to the meet new demands. In addition, CIOs must be ready to take advantage of emerging new technologies such as FCoE, SSDs and others, knowing when and where to deploy them for the best long-term gain.

Modern datacenters currently deploy multiple network interfaces running at different speeds and carrying different protocols and types of traffic over these networks. The two most common networking technologies deployed in commercial datacenters today are Ethernet and Fibre Channel. These two separate networks exist today because they each meet needs that the other does not. Each of these networks requires their own adapters, switches and cables.

As computing requirements continue to increase, especially with the popularity of server virtualization, Big Data and multi-core processors, the existing Ethernet and Fibre Channel networks must add connections and ports to keep pace. With the added concern of electric power consumption and the large numbers of cables required for each network in the datacenter, challenges arise with current technologies to meet these demands.

As new racks in existing datacenters are deployed, or as new datacenters are built, one way to handle the increased requirements is to use one network that provides the best of Ethernet and Fibre Channel, supporting all the protocols over a single cable, single host adapter technology and single network switch technology. This simplifies the infrastructure by reducing the number of host adapters, cables and equipment required, while continuing to support today's protocols and applications.

Ethernet has been used for many years to carry various types of storage traffic, including NFS, CIFS and iSCSI traffic. In the recent past, FCoE has been added to this list of protocols that can be carried by Ethernet. As datacenters explore the advantages of adopting a unified approach to storage networking, questions may arise about how the bandwidth can be allocated.

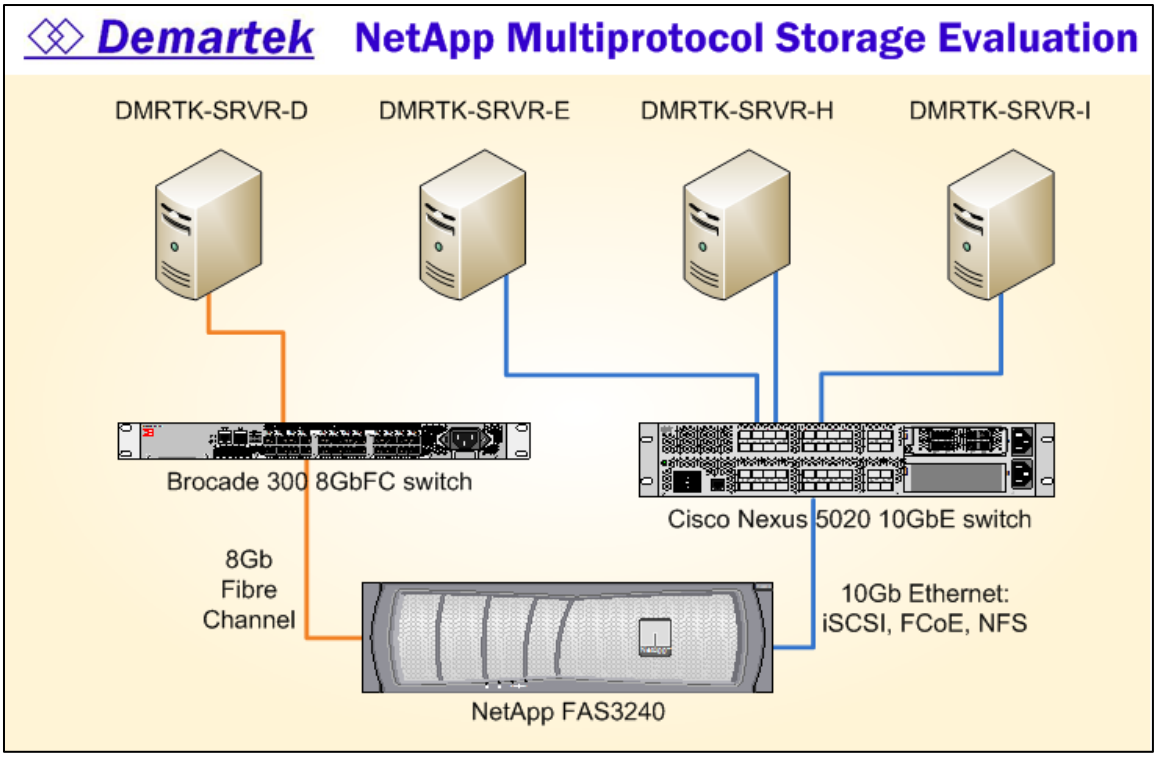
The good news is that with the advanced features of Data Center Bridging (DCB), this traffic can be managed so that one type of traffic does not overwhelm other traffic running on the same connection. For example, for datacenters that are currently using 4Gb Fibre Channel, NFS and iSCSI on separate connections, it is possible to run all of these protocols on the same 10GbE connection by using FCoE to handle the Fibre Channel traffic and upgrade the 1Gb NFS and iSCSI traffic to 10GbE. DCB provides a mechanism to guarantee FCoE no less than a specified throughput, such as 40% of the 10Gb pipe, while guaranteeing no less than 60% for other protocols. This imposes predictable and efficient resource sharing during times of high utilization. In this particular case, if the non-FCoE traffic does not consume its full bandwidth, DCB allows the FCoE traffic to consume more than the specified 40% of the bandwidth.

Testing Overview

In these tests, we placed workloads from different servers onto the same NetApp FAS3240 storage system. In order to achieve line rate on the connections, we configure the server workloads to access only the cache of the FAS3240 so that the test results would not be dependent on the number of disks deployed.

The workloads consisted of Windows servers running SQLIO for the iSCSI, FC and FCoE workloads, and a Linux server running VDbench for the NFS workload. All of these servers were connected to the FAS3240 via the appropriate networking switches as shown in the diagram below, using the following protocols.

- 8Gb Fibre Channel (FC)
- 10Gb iSCSI
- 10Gb FCoE
- 10Gb NFS



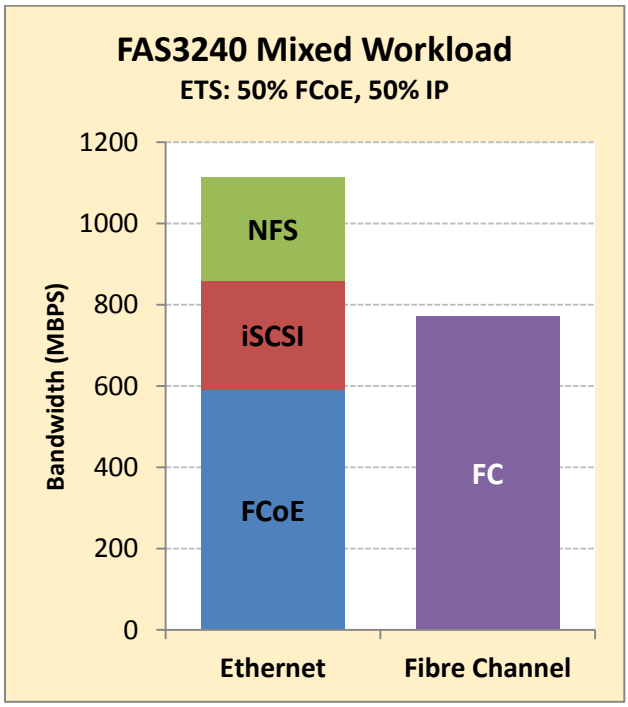
Performance Test Results Commentary

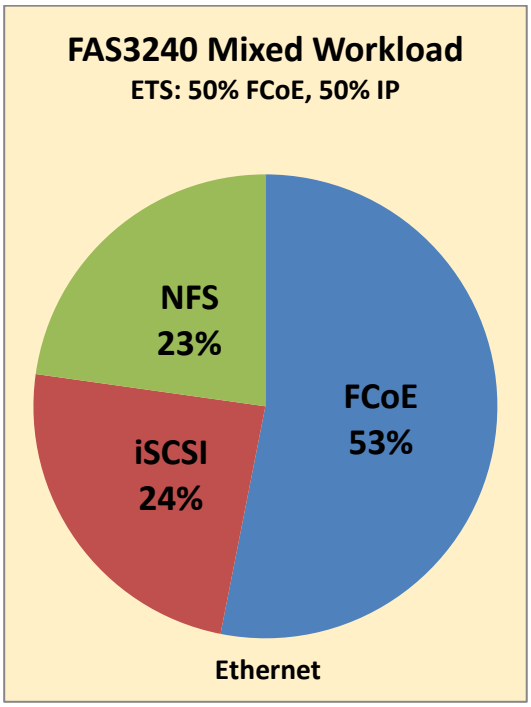
In our testing, we were able to achieve near line rate with the 10GbE protocols and the 8Gb Fibre Channel protocol. For 10GbE, a total bandwidth of approximately 1150 MB/sec is available, and for 8Gb Fibre Channel, approximately 800 MB/sec of bandwidth is available.

For the first set of tests, we used a default bandwidth setting in the DCB/FCoE switch of 50% for FCoE and 50% for other Ethernet. We used a combined set of workloads from each of the servers to generate a steady load for NFS, iSCSI and FCoE workloads over a single 10Gb connection to the FAS3240. While these were running, a separate server connected via the Fibre Channel environment was also connected to the FAS3240.

The average bandwidth consumed during this 15-minute test period for each protocol is shown below. The 8Gb Fibre Channel workload was on its own connection to the FAS3240. The 10GbE workloads were configured to share the same connection to the FAS3240.

- 8Gb FC: 771.9 MB/sec
- 10GbE FCoE: 590.8 MB/sec
- 10GbE iSCSI: 268.4 MB/sec
- 10GbE NFS: 253.4 MB/sec





These results are reported from the server viewpoint.

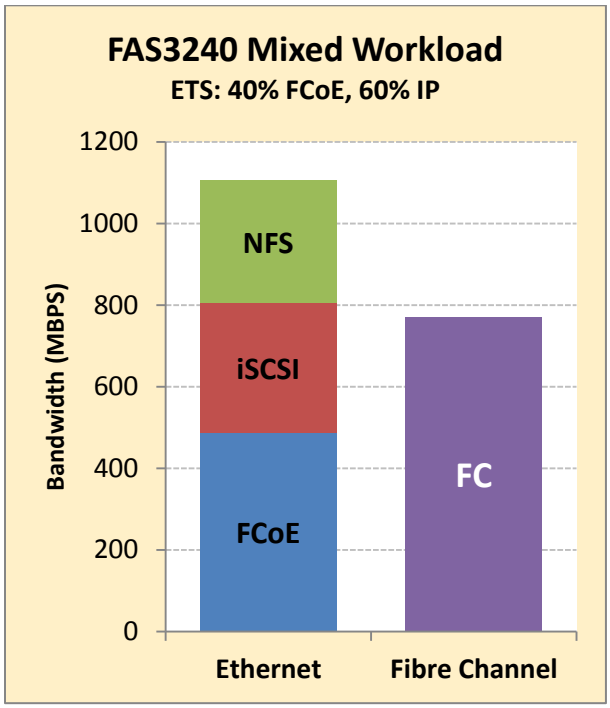
Bandwidth Allocation

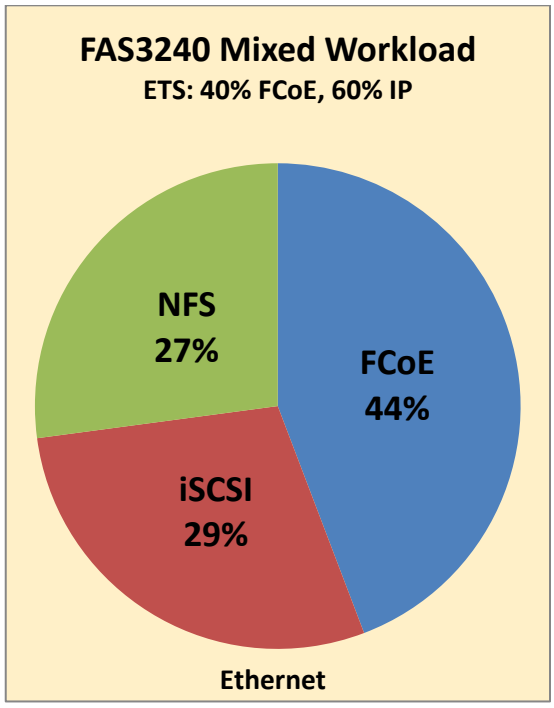
To show the bandwidth allocation policies available in the DCB/FCoE switch, we set the bandwidth allocation to 40% for FCoE and 60% for other Ethernet traffic and repeated the test workloads, keeping the server and storage configurations the same.

Here we see that the Ethernet results reflecting the bandwidth allocation policies set in the switch. The native Fibre Channel results are not affected by this change.

The average bandwidth consumed during this 15-minute test period for each protocol is shown below. As with the previous test, the 8Gb Fibre Channel workload was on its own connection to the FAS3240. The 10GbE workloads were configured to share the same connection to the FAS3240, with a 40%/60% allocation.

- 8Gb FC: 771.5 MB/sec
- 10GbE FCoE: 488.5 MB/sec
- 10GbE iSCSI: 316.9MB/sec
- 10GbE NFS: 299.6 MB/sec





In this case, the FCoE workload was reduced to approximately 40% of the available bandwidth and the iSCSI and NFS workloads consumed approximately 60% of the available bandwidth. These results are reported from the server viewpoint. The native Fibre Channel connection is unaffected by the 10GbE DCB ETS settings.

Appendix – Evaluation Environment

These tests were conducted in the Demartek lab in Arvada, Colorado using Demartek server, storage and networking infrastructure.

Server Specifications

DMRTK-SRVR-D

- Dual Intel Xeon E5345, 2.33 GHz, 8 cores, 8 logical processors
- 48GB RAM
- Windows Server 2008 R2
- Emulex LPe12002 FC HBA
- FC workload with SQLIO

DMRTK-SRVR-E

- Dual Intel Xeon E5345, 2.33 GHz, 8 cores, 8 logical processors
- 48GB RAM
- Windows Server 2008 R2
- Emulex OC11102-F CAN
- FCoE workload with SQLIO

DMRTK-SRVR-H

- Dual Intel Xeon E5540, 2.53 GHz, 8 cores, 16 logical processors
- 48GB RAM
- Windows Server 2008 R2
- Emulex OC11102-N NIC
- iSCSI workload with SQLIO

DMRTK-SRVR-I

- Dual Intel Xeon E5320, 1.86 GHz, 8 cores, 8 logical processors
- 16GB RAM
- Red Hat Enterprise Linux 6
- Emulex OC11102-N NIC
- NFS workload with VDbench

Switch Specifications

10GbE Switch: Cisco Nexus 5020 10GbE/FCoE, 40-ports

8Gb FC Switch: Brocade 300, 24-ports

Storage Specifications

NetApp FAS3240, Data ONTAP 8.0.1, with two disk shelves (24x 2.5-inch disk drives each shelf)