

## Transporting Fiber Channel Protocols over 10GBE Switches with FCOE

### Introduction

Storage deployments at 10GE require the capability to carry Fiber Channel, iSCSI and NAS protocols. Technical committees in both the ANSI T11 and the IEEE have been actively working on standards to make FCOE standards possible over 10GE.

The evolution of FC networks over 10Gigabit Ethernet (10GE) networks requires a combination of products, which together form the FCoE (Fiber Channel over Ethernet) architecture:

1. Converged Network Adapters (CNAs) for hosts.
2. Fibre Channel over Ethernet (FCoE) capable switches – i.e., low-latency 10GE switches that serve to connect these adapters to Ethernet networks and transport FC traffic.
3. FCoE gateways – i.e., switches with mixed Ethernet and FC ports to connect to legacy FC-enabled storage devices.

In this document we propose terminology to clarify the roles these product components will play in a converged FCoE network.

### Converged Network Adapters

The main reason for developing or requiring FCoE is to provide Data Center operators with a single transport layer, Ethernet, while preserving the FC protocol for transport of high end storage traffic. This is only applicable in high end storage applications.

Full convergence begins inside the host with the creation of a Converged Network Adapter (CNA). FCoE maps the FC commands and data directly into Ethernet frames. That means FC is carried alongside IP data traffic on a common Ethernet port. The FC-0 (physical layer) and FC-1 (encoding/decoding) layers are replaced with the standard Ethernet physical layers (PHYs) and media access controller (MAC) layers combined with the FC mapping function. The higher layers of the FC stack, FC2 (Framing), FC3 (Services) and FC4 (Protocol Map) remain unchanged.

CNAs may replace or augment FC Host Bus Adapters (HBAs) in both servers and storage end-points in data centers over time for customers to realize the power and cabling cost savings.

These adapters in turn connect to FCoE capable switches. Arista has partnered with a number of companies that provide CNAs – for a complete list, please refer to the [host adapter solutions section](#) on the Arista website.

### Characteristics of an FCoE capable Switch

The main requirement of an FCoE capable switch is to be able to transport FC traffic in a lossless manner. To deliver that requirement the FCoE switch may implement several protocols, some of which are still in development in the IEEE 802.1 Data Center Bridging Task Group (DCB).

IEEE 802.1Qau – deals with congestion notification to ensure adequate buffering is available upstream to the flow

IEEE 802.1Qaz – creates traffic classes to separate traffic with different Quality of Service needs

IEEE 802.1Qbb – flow control mechanism created using priority values in the VLAN tag

In addition, the following capabilities of an Ethernet switch help it carry FCoE frames in a lossless fashion:

- 10Gigabit interfaces, which provide 10 times the bandwidth of 1Gigabit interfaces, and can carry 2/4/8G FC in a lossless fashion

- Deep port buffers which insure FCoE frames are not lost in transit from source to destination, even in severe fan-in situations

Arista's 7000 family of Ethernet switches have the following characteristics today that enable them to serve effectively as an FCoE capable switch:

- Arista's 7100 switches support non-blocking 10GE on each and every port
- Arista's 7048 switch supports non-blocking 1GE on each and every port, four 10 GE uplinks, and offers unprecedented buffering capability on every port in combination with a purpose built architecture for congestion management.
- Arista 7148SX offers 48 10GE ports in a space-saving 1U form factor
- Arista's highly-resilient EOS software, featuring self-healing and live-patching capabilities

### Characteristics of an FCoE forwarder (FCF)

This product is distinct from the FCoE switch described in the previous section.

The function of the FCF is to implement both Ethernet and FC ports to allow for the connection of an FCoE network to a legacy FC-only SAN. The FCF has to encapsulate and de-encapsulate FC frames to and from an FCoE network.

In addition, an FCF may implement FC2-4 functionality of the FC stack.

Many Fibre Channel switch vendors are developing FCF capable products. These FCFs will be deployed at the aggregation layer of the FCoE network not at the access layer.

### Moving Fibre Channel Networks towards 10GEthernet

Some Fibre Channel HBAs are being converged onto 10GE Ethernet NICs through FCoE mapping functionality on the NICs resulting in the development of Converged Network adapters. These adapters will become mainstream in server and storage offerings over the next few years.

These adapters in turn will connect to FCoE capable 10GE Ethernet switches (such as Arista's 7100 family of switches) that will be carrying data and storage traffic.

Ethernet switches will be inter-connected to Fibre Channel Forwarders, gateway switches that provide access to FC islands that have FC HBAs. All Fibre Channel mapping services will be embedded in these forwarders thereby keeping the Ethernet network from having to implement FC-specific service functionality.

In a completely converged network all interfaces will be CNAs and all the switches will be high-bandwidth low latency FCoE capable Ethernet switches. Fibre Channel functionality will exist as FCoE mappings on the CNAs.

## Arista and FCoE

Today's data centers are architected with FC traffic carried over FC HBAs and data traffic from servers carried over ethernet NICs. The introduction of CNAs as commercially viable products by several vendors this year will lead to the networks converging within the servers and having a single 10 GE interface to the FCoE switch. These switches may connect to FCFs that would be deployed to interconnect the FCoE network to an existing FC network as shown in the diagram below.

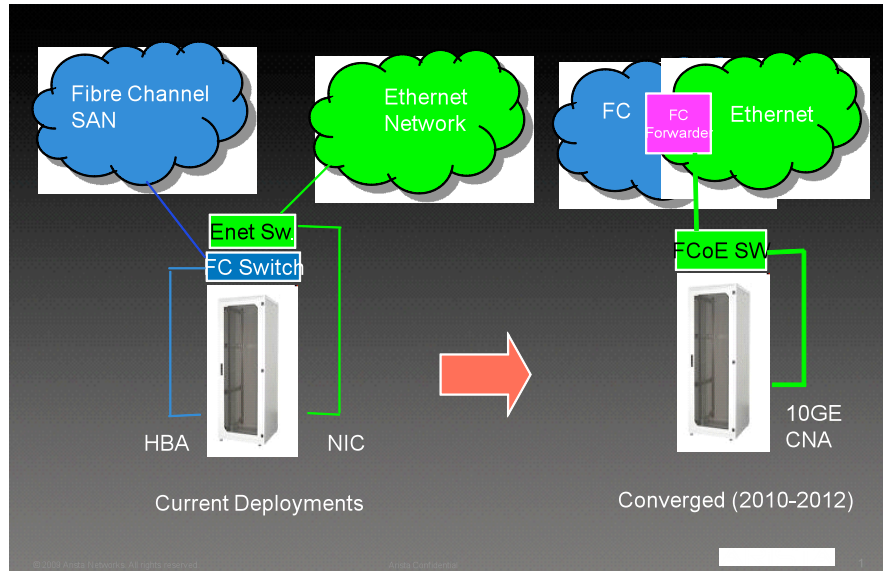


Figure 1: Moving Fibre Channel transport to Ethernet

Over time, as more storage and servers are deployed with CNAs the FC may shrink resulting in tremendous operational savings for enterprises. The resulting Ethernet network delivering both data and storage traffic based on the specifications of IEEE 802.1Q standards is depicted in the diagram below.

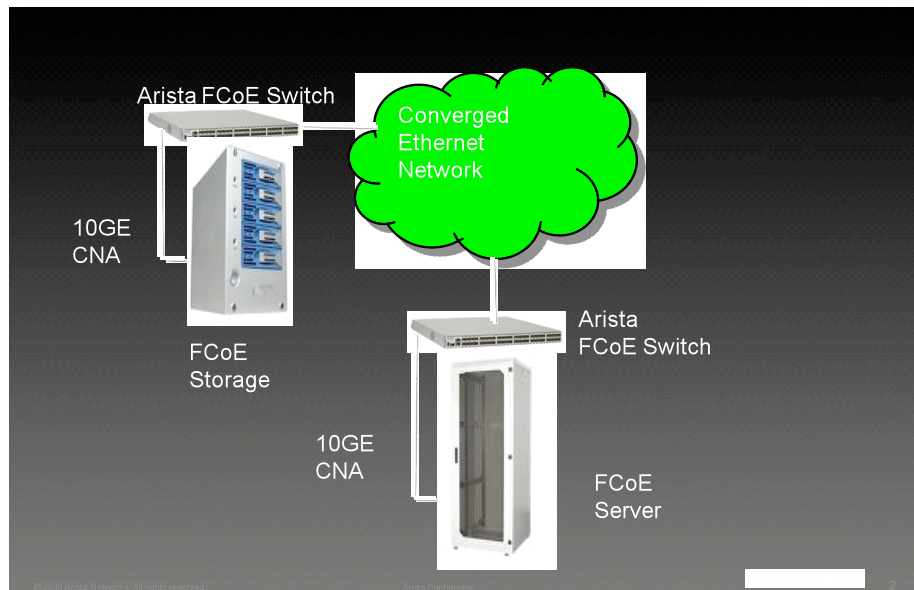


Figure 2: Ethernet Storage and Data Network

## Summary

Storage protocols running over 10GE is gaining momentum. Today majority of the deployments are iSCSI and NAS based. In the future, FCoE capable switches and FCFs along with converged adapters may drive new data centers towards greater efficiency in terms of network I/O power and cooling. This evolution will be over a three to five year timeframe. As standards and interoperability mature, CNAs will begin to be adopted across servers and storage systems. In the 2010 through 2020 decades we expect to see high end SANS such as Fibre Channel and Ethernet networks integrate into a single, seamless 10GE driven Ethernet network in the data center. Arista's lossless, low-latency, and fully non-blocking FCoE capable switches will be a key component of such FCoE networks.

Information in this document is provided in connection with Arista Networks products. For more information, visit us at <http://www.aristanetworks.com>, or contact us at [sales@aristanetworks.com](mailto:sales@aristanetworks.com)