



Technical FAQ

SAS Storage Cabling and Infrastructure FAQ

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Abstract

This technical FAQ covers frequently asked questions and basic concepts related to SAS storage, shelves, cabling, and other related infrastructure. It is a collection of information for use as a reference when planning and implementing SAS based storage solutions.

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1 General

1.1 SAS Basics

What is SAS?

Answer: Serial Attached SCSI (SAS) is a point-to-point protocol used to move data to and from disk or other data devices such as tape.

What is a SAS expander?

Answer: An expander is a switch used to route requests and data to and from the end points. It manages connections between the end points and provides a mechanism for environmental monitoring of the shelves. SAS expanders are found in modules within NetApp shelves.

How is SAS different from FC-AL?

Answer: SAS differs from Fibre Channel Arbitrated Loop (FC-AL) in several ways. FC-AL utilizes a logical loop topology while SAS utilizes a point-to-point topology. NetApp's implementation of SAS utilizes four data paths between end points compared to a single loop data path with FC-AL.

Table 1) SAS FC-AL Comparison

SAS and FC Protocol Comparison	
FC-AL	SAS
4Gb/sec per loop (DS14mk4 ESH4)	12Gb/sec aggregate with 4x-wide ports (IOM3) 24Gb/sec aggregate with 4x-wide ports (IOM6)
Drives are not isolated from each other	Drives are isolated from each other
Discovery/management and I/O can conflict	SAS protocol discovery/management and workload I/O can coexist
Limited addressability	Addressability is limited only by performance considerations

Figure 1) Example FC-AL Topology

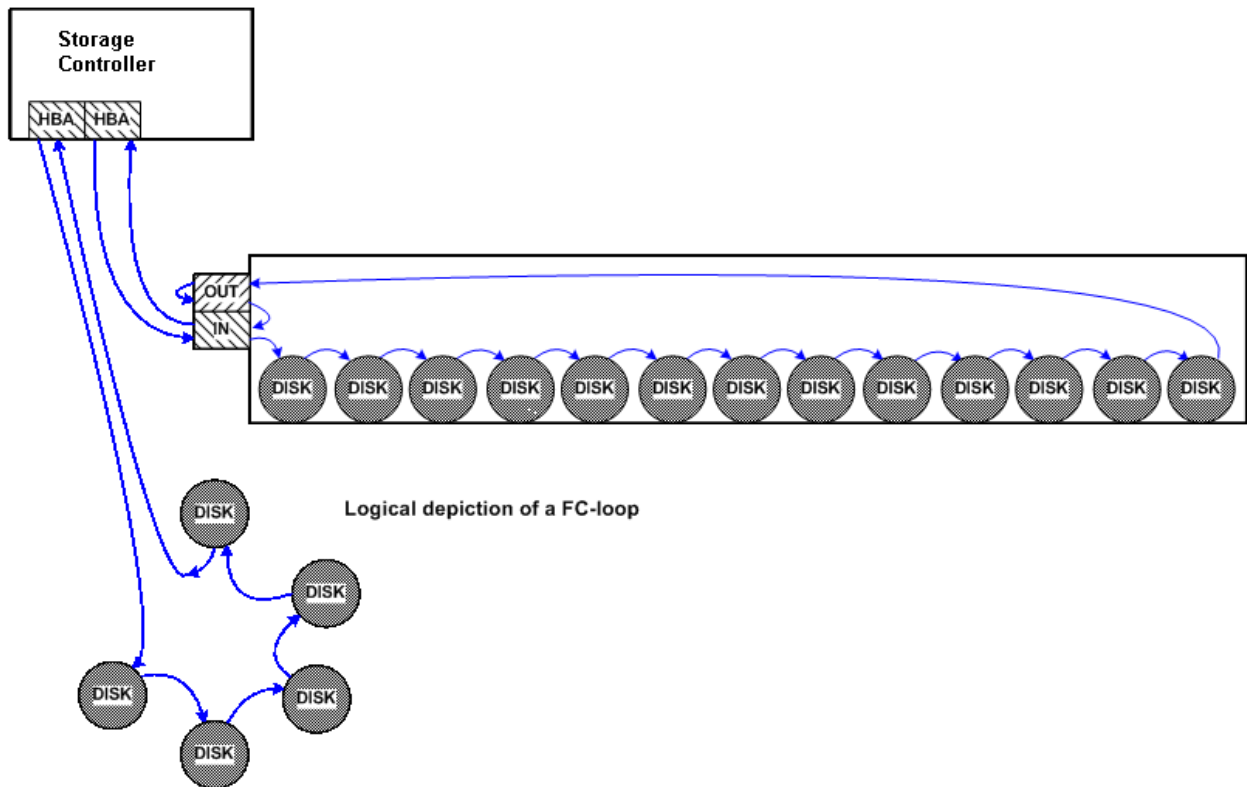
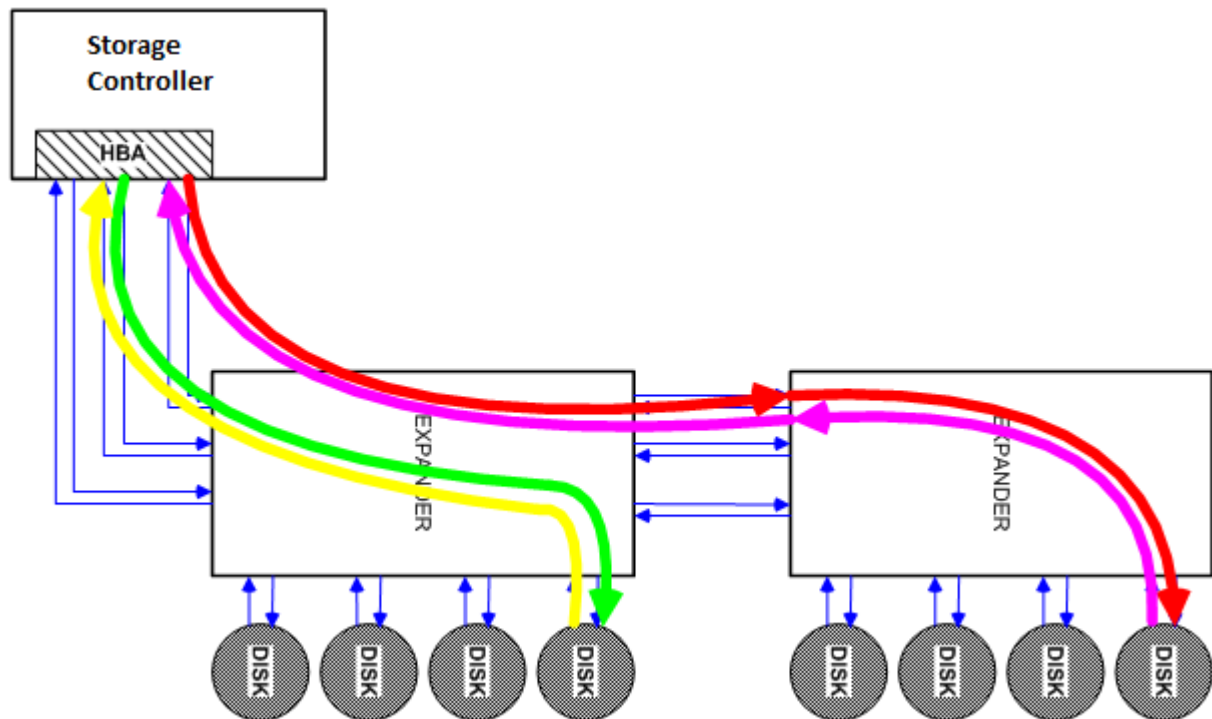


Figure 2) Example SAS Topology



Are there commands used to manage and troubleshoot SAS?

Answer: The “sasadmin” command set can be used from the CLI for a wide variety of SAS administration and troubleshooting operations. More information on the command set can be found in the Data ONTAP command reference here:

<http://support.netapp.com/documentation/productlibrary/index.html?productID=30092>

2 Cabling

2.1 MPHA

How is a standard HA pair cabled?

Answer: HA pairs of NetApp storage controllers are cabled in an MPHA configuration. Each storage controller is cabled to stacks of shelves by two connections to redundant expanders. Additional information regarding proper HA configuration for your version of ONTAP can be found in the HA Configuration Guide:

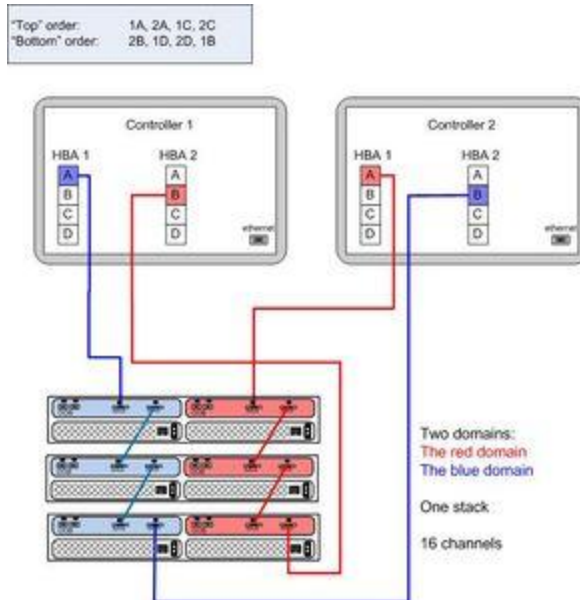
<http://support.netapp.com/documentation/productlibrary/index.html?productID=30092>

and

Universal SAS and ACP Cabling Guide

https://library.netapp.com/ecm/ecm_get_file/ECMM1280392

Figure 3) Example of MPHA SAS Cabling



What copper cable lengths are supported?

Answer: Passive copper SAS cables are supported in lengths of 0.5m, 1m, 2m, and 5m. Active copper cables of 10m and 20m in length are qualified with DS4243 and DS2246 shelves with certain restrictions:

- Data ONTAP version 7.3.5.1P1, 8.0.1P5, 8.0.2, and 8.1 or later
- Not supported with FAS2040 onboard ports or X2062 miniSAS HBA with FAS2050

2.2 Optical SAS

What is Optical SAS?

Answer: Optical SAS is used to connect SAS shelves. Connections are made using active optical cables with existing QSFP connectors on supported SAS HBA's. Optical SAS cables are available in both multimode and single mode fiber types, and are compatible with existing optical patch panel infrastructure.

Data ONTAP version 8.1.3 and 8.2.1 or later required. NOT Supported with Data ONTAP 8.1

What types of Optical SAS cables are supported?

Answer: Optical SAS Cables are available in four varieties:

- Active Optical Cable (AOC)
 - 1m, 2m, 3m, 5m, 15m, 30m, and 50m lengths
 - Cable assemblies with attached QSFP connector
- Multimode Direct Cable Connect
 - For non-standard lengths or connectivity up to 150m
 - QSFP with MPO connector provided, OM4 cable with MPO connectors will need to be procured from vendor
- Multimode Optical Patch Panel Connect
 - Utilizes existing optical patch panels for distances up to 150m with OM4 cable and 100m with OM3
 - Cables available in 5m and 30m lengths
 - Available with LC, SC, or MT-RJ connectors
 - Utilizes QSFP with MPO connector
 - Requires eight patch panel ports per connection
- Single mode Optical Patch Panel Connect
 - Utilizes existing Single mode optical patch panels for distances up to 500m
 - Cables available in 5m and 30m lengths
 - Available with LC, SC, or MT-RJ connectors
 - Attached QSFP connector for HBA connectivity
 - Requires eight patch panel ports per connection

When should optical SAS cables be used?

Answer: Optical SAS cables were designed to provide greater flexibility in configurations of storage controllers and associated disk shelves. These cables should be used when placing shelves greater than 10m from the storage controller. Optical SAS cables can also be used in place of FibreBridge 6500N devices in Stretch MetroCluster configurations.

Are there any additional limitations to optical SAS cables?

Answer:

- Connection to storage controller HBA may be of any cable type, however inter-shelf SAS cables must be of the same type
- If optical SAS cables are used for inter-shelf cables, optical SAS cables must also be used to connect to storage controller
- Only one pair of patch panels can be used between connections
- Only 6Gb/sec configurations are currently supported, no IOM3 support
- No support for DS4486 in MetroCluster configuration
- Limitation of 96 SSD spindles per stack
- FAS22xx NOT supported

Can optical SAS cables be used to replace FibreBridges in MetroCluster configurations?

Answer: Yes. In stretch MetroCluster configurations optical SAS cables can be used in place of FibreBridge 6500N devices.

Figure 4) Example Multimode Stretch MetroCluster

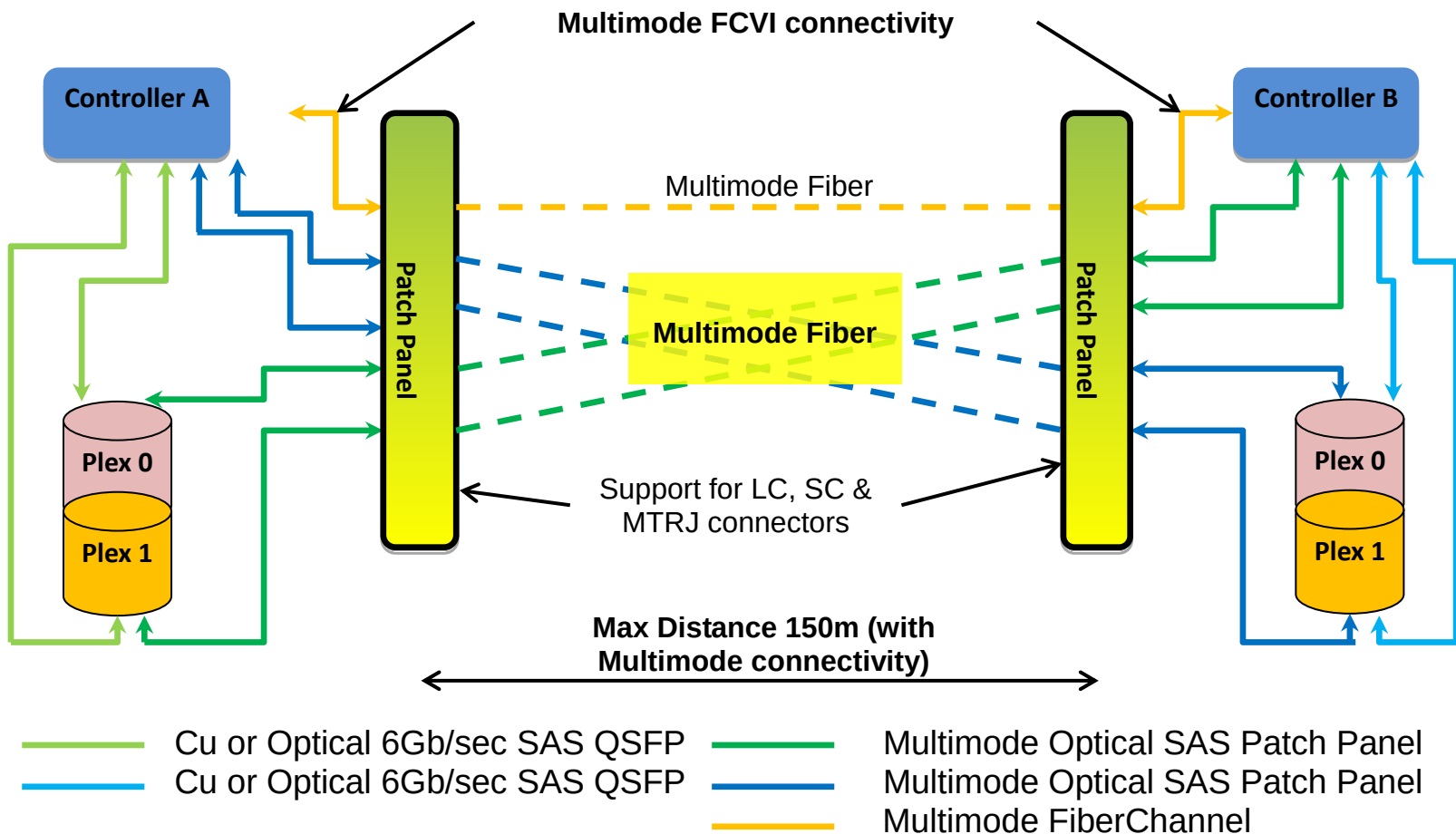
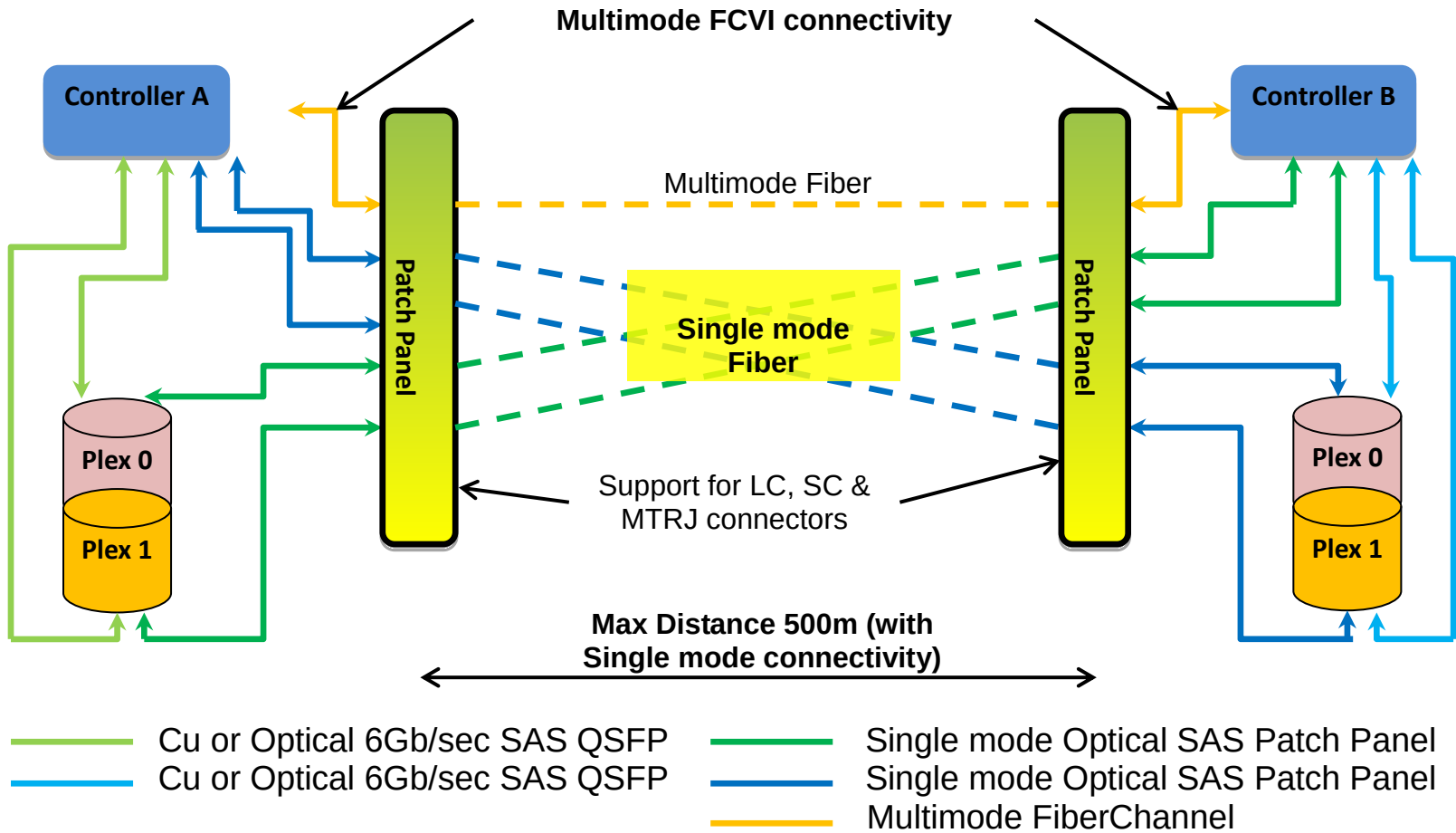


Figure 5) Example Single mode Stretch MetroCluster



2.3 ACP

What is ACP?

Answer: The Alternate Control Path (ACP) provides a non-disruptive, out of band, recovery mechanism for shelf modules and expanders. ACP allows for automatic non-disruptive reset and recovery of expanders. ACP uses standard CAT6 Ethernet network cabling with RJ45 connectors.

How do I cable ACP?

Answer: ACP is cabled out of band from SAS storage. ACP uses dedicated network ports on the storage controller to connect to shelf expanders. Expanders are daisy chained together, with the last expander connecting to the partner controller. Additional information for cabling ACP can be found in the Universal SAS and ACP Cabling Guide:

https://library.netapp.com/ecm/ecm_get_file/ECMM1280392

What length cables are supported with ACP?

Answer: ACP must be cabled using CAT6 Ethernet cable with RJ45 connectors. Due to limitations of these cables, the maximum length of a cable segment is 100m. Be aware that ACP will not be supported for distances over 100m.

References

The following references were used in this FAQ:

- HA Configuration Guide
<http://support.netapp.com/documentation/productlibrary/index.html?productID=30092>
- Universal SAS and ACP Cabling guide
https://library.netapp.com/ecm/ecm_get_file/ECMM1280392

Refer to the [Interoperability Matrix Tool \(IMT\)](#) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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