



TECHNOLOGY BRIEF

SAS 1-0-1

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WHAT IS SAS?

SAS stands for Serial-Attached SCSI. It is a connector and interface-type that has been used with disk drives for a number of years, and was first introduced to tape drives with the fourth generation of LTO tape drives, LTO-4, in 2007.

From a tape drive and tape automation perspective, SAS tape drives are intended as the replacement for SCSI tape drives for drives that are attached directly to a media server. This is opposed to native Fibre Channel tape drives, which are intended primarily for connection into a Fibre Channel storage area network (SAN).

SAS HISTORY AND ROADMAP

As shown in Table 1 below, prior to LTO-4, the LTO tape drive vendors (Quantum, HP, and IBM) produced drives with two types of interfaces: native Fibre Channel and SCSI.

LTO-3		LTO-4		LTO-5	
Interface Types	Max Interface Speed (MB/sec)	Interface Types	Max Interface Speed (MB/sec)	Interface Types	Max Interface Speed (MB/sec)
4Gb Fibre Channel	400	4Gb Fibre Channel	400	8Gb Fibre Channel	800
U160 SCSI	130	U320 SCSI	260		
		3Gb SAS	300	6Gb SAS	600

Table 1. Tape Drive Interface Types by LTO Generation

With LTO-4, SAS was also introduced because the speed of the tape drives was catching up with the maximum speed that the SCSI interface could support. Remember that a tape drive speed is different than the interface speed. As an example, LTO-4 Fibre Channel drives have a maximum speed (or “throughput”) of 240MB/sec, but the 4Gb Fibre Channel interface can support speeds of up to 4Gb/sec, or about 400MB/sec.)

So that LTO tape drives could continue to increase their speed over time with future generations of LTO, a faster interface type was needed. SAS was already prevalent in disk drives, HBAs and even servers with integrated SAS ports were already available, so SAS was chosen.

Note that with LTO-4 interface speeds, SAS and SCSI are similar, but the SAS interface is a bit faster due to some overhead in the SCSI interface that does not exist with SAS. With LTO-4, both types of tape drives were produced to give the market some time to transition from legacy SCSI to SAS, which is the future. Also notice that with LTO-5 drives, the SAS interface speed has doubled to 6Gb, which gives the SAS drives plenty of headroom for the drive throughput to improve. Finally, with LTO-5 drives, none of the tape drive vendors is producing a SCSI drive—this will further drive SAS adoption in the market.

HOW DOES SAS COMPARE TO SCSI?

Figure 1 on page 4 shows a typical SAS set up where the customer has two SAS drives in a library connected to a dual-port SAS HBA.

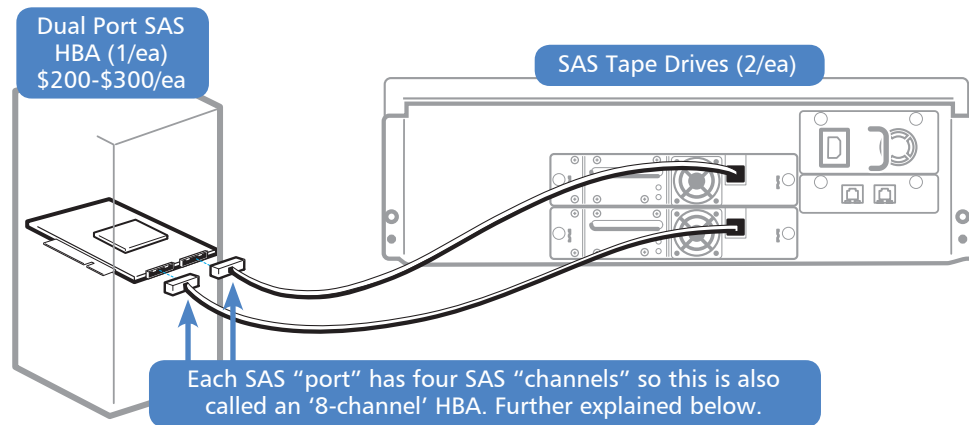


Figure 1. Typical Two-Drive SAS Setup

This is by far the most common SAS setup, with either one or two SAS drives directly connected to the host. Note that SAS drives are not 'daisy-chained' like SCSI drives, rather, each SAS port on a SAS HBA is directly connected to a SAS drive and there is no need to use terminators as with SCSI drives.

In this setup, a dual-port SAS HBA is used. Each SAS 'port' has four SAS 'channels' so this HBA is also called an '8-channel' HBA. Each SAS channel can communicate with a single tape drive, so in this particular setup, only two of the eight SAS channels are actually being used. In order to use all eight channels, a SAS 'fan-out' cable would be required. The 'fan-out' cable would connect to one SAS port and then split into four cables, one for each channel. Then, each channel could be connected to an individual SAS drive. Quantum does not support fan-out cables today and they are not widely used in the market, but we are evaluating the demand for this as the SAS market adopts. There are a few more details on this topic in the last section of this tech brief.

Let's build on this setup to show an example setup with four SAS drives as shown in Figure 2 below.

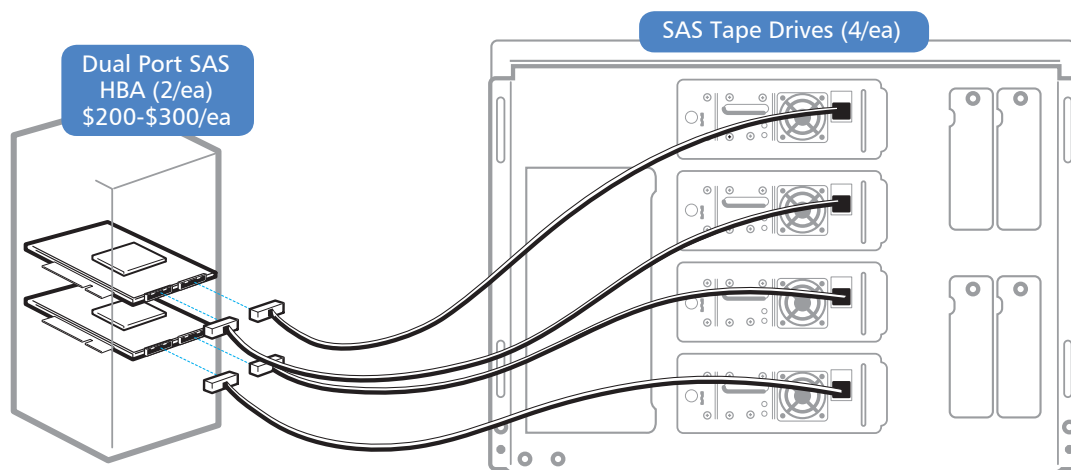


Figure 2. Typical Four-Drive SAS Setup

This setup shows a tape library with four SAS tape drives. This setup is just like the two-drive setup, except two dual-port HBAs are used instead of just one. Again, each SAS drive is directly connected to a port on the SAS HBA.

Now let's compare this setup to a similar setup using SCSI as shown in Figure 3 below.

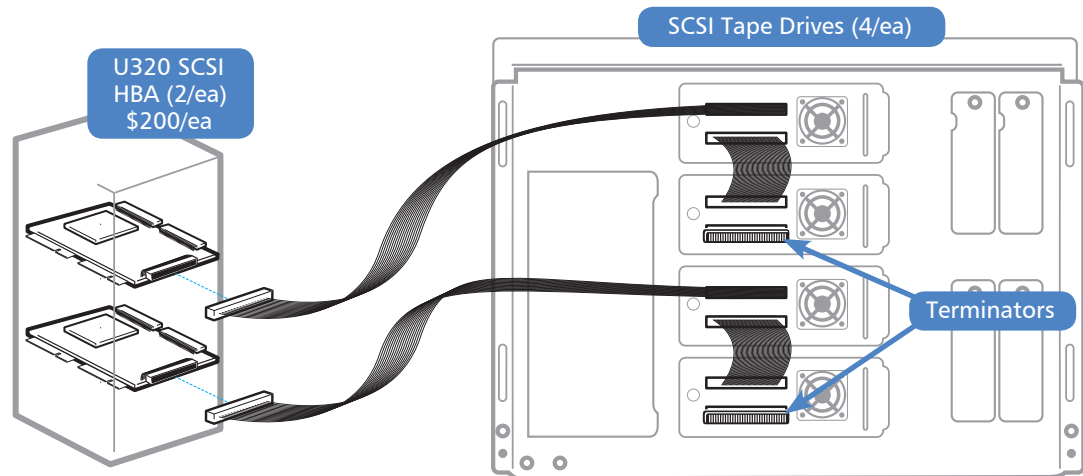


Figure 3. Typical Four-Drive SCSI Setup

This figure shows four SCSI drives in a library connected to a host. Just like with SAS, the SCSI drives are directly connected to the host, but in this case the four SCSI drives are on two separate SCSI buses. There are two SCSI drives connected together on each bus, this is commonly called "daisy-chaining." With SCSI, one end of the chain is connected to a SCSI HBA on the host, and both ends of the bus need to be terminated with a SCSI terminator.

This points out an important advantage of SAS—with daisy-chained SCSI drives, an issue with one device can cause issues with other devices. SAS provides improved reliability over SCSI because it has a 'point-to-point' architecture versus the 'daisy-chain' style architecture of SCSI; an issue with one SAS device doesn't affect other SAS devices because they are connected in a point to point manner.

From a customer benefit perspective, SAS provides a simple alternative to SCSI, with equivalent or better performance, equivalent or lower acquisition costs, improved reliability, full support by all of the common backup applications, and a future roadmap.

SAS CONNECTOR AND CABLE OPTIONS

There are many types of SAS connectors in the market, but in terms of the LTO-4 and LTO-5 SAS tape drives used in automation, the external connectors are SFF8088-style connectors.



Figure 4. SAS Connector Types

Although all tape drives use the SFF8088 connector type, there are HBAs available with either connector type. To allow connection to either type of HBA, Quantum offers two types of SAS cables in lengths from one meter to four meters. These are shown in Table 2 and Table 3 below:

Model Number	Description	MSRP ¹
1-00827-01	Quantum SAS Interface Cable, SFF8088-to-SFF8088, 3.3 ft (1 m)	\$125
1-00827-02	Quantum SAS Interface Cable, SFF8088-to-SFF8088, 6.5 ft (2 m)	\$150
1-00827-03	Quantum SAS Interface Cable, SFF8088-to-SFF8088, 9.8 ft (3 m)	\$175
1-00827-04	Quantum SAS Interface Cable, SFF8088-to-SFF8088, 13.1 ft (4 m)	\$200

Table 2. SFF8088-to-SFF8088 Interface Cables

Model Number	Description	MSRP ¹
1-00828-01	Quantum SAS Interface Cable, SFF8088-to-SFF8470, 3.3 ft (1 m)	\$125
1-00828-02	Quantum SAS Interface Cable, SFF8088-to-SFF8470, 6.5 ft (2 m)	\$150
1-00828-03	Quantum SAS Interface Cable, SFF8088-to-SFF8470, 9.8 ft (3 m)	\$175
1-00828-04	Quantum SAS Interface Cable, SFF8088-to-SFF8470, 13.1 ft (4 m)	\$200

Table 3. SFF8088-to-SFF8470 Interface Cables

SUPPORTED SAS HBAS AND OTHER INTEROPERABILITY CONSIDERATIONS

Quantum supports the following SAS HBAs for use with LTO-4 SAS drives in the Scalar 50, Scalar i40, Scalar i80 and Scalar i500:

- LSI LSI3801X 3G SAS (recommended)
- LSI LSI3801E 3G SAS (recommended)
- Dell 5E 3G SAS
- HP SC44Ge 3G SAS
- SUN SG-XPCIE8SAS-E-Z 3G SAS
- ATTO H380 3G SAS

¹ Prices subject to change without notice.

Aside from HBA compatibility, two other common questions that are asked regarding SAS compatibility pertain to SAS switches, also known as 'SAS expanders' and SAS 'fan-out' cables.

A SAS switch or expander is very similar to a Fibre Channel switch. It is a device with multiple SAS ports that can communicate to multiple hosts and multiple targets like tape drives or disk drives over SAS. Quantum has not certified any SAS expanders for use with our products, but as the SAS market evolves we continue to evaluate the need for this and the appropriate vendors.

A SAS 'fan-out' cable is a cable that allows a customer to connect more than one SAS tape drive to a single SAS port on an HBA. This type of configuration is shown in Figure 5 below. Quantum has not certified any SAS 'fan-out' cables for use with our products, but we continue to evaluate the need for this based on market demand.

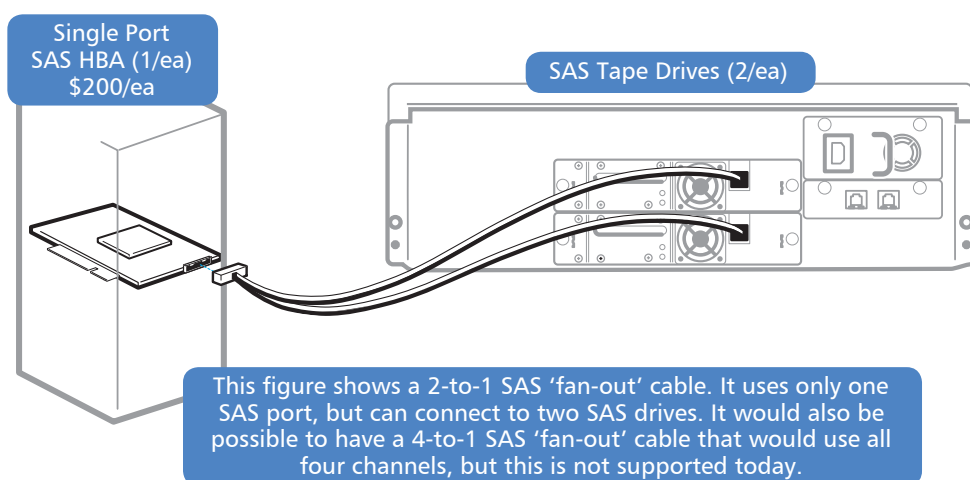


Figure 5. SAS 'Fan-Out' Cable Setup (not supported today)

CONCLUSION

As the successor to the popular SCSI interface, SAS provides higher performance, better reliability, simplified cabling and reduced costs for direct host-to-drive connections.

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