DIFFERENCE BETWEEN SAS, NEAR LINE (NL) SAS, AND SATA

When you buy a server or storage array these days, you often have the choice between three different kinds of hard drives: **Serial Attached SCSI (SAS)**, **Near Line SAS (NL-SAS)** and **Serial ATA (SATA)**. Yes, there are other kinds of drives, such as Fibre Channel, but I'm focusing this article on the SAS/SATA question.

Further, even though **solid-state disks (SSD)** can have a **SAS** or **SATA** interface, I'm not focused here on **SSDs**. I'm focusing solely on the devices that spin really, really fast and on which most of the world's data resides.

So, what is the real difference between **SAS**, **NL-SAS** and **SATA** disks? Well, to be cryptic, there are a lot of differences, but I think you'll find some surprising similarities, too. With that, let's dig in!

SAS

SAS disks have replaced older **SCSI** disks to become the standard in enterprise-grade storage. Of the three kinds of disks, they are the most reliable, maintain their performance under more difficult conditions, and perform much better than either **NL-SAS** or **SATA** disks.

In reliability, **SAS** disks are an order of magnitude safer than either NL-SAS or SATA disks. This metric is measured in **bit error rate (BER)**, or how often bit errors may occur on the media. With SAS disks, the BER is generally 1 in 10^16 bits. Read differently, that means you may see one bit error out of every **10,000,000,000,000,000 (10 quadrillion)** bits.

By comparison, **SATA** disks have a BER of 1 in **10^15 (1,000,000,000,000,000 or 1 quadrillion)**. Although this does make it seem that SATA disks are pretty reliable, when it comes to absolute data protection, that factor of 10 can be a big deal.
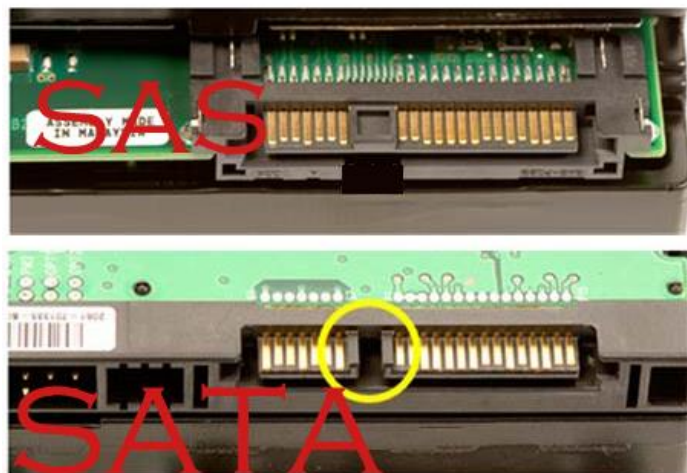
SAS disks are also built to more exacting standards than other types of disks. SAS disks have a mean time between failure of 1.6 million hours compared to 1.2 million hours for **SATA**. Now, these are also big numbers – 1.2 million hours is about 136 years and 1.6 million hours is about 182 years. However, bear in mind that this is a mean. There will be outliers and that's where SAS's increased reliability makes it much more palatable.

SAS disks/controller pairs also have a multitude of additional commands that control the disks and that make SAS a more efficient choice than SATA. I'm not going to go into great detail about these commands, but will do so in a future article.

NL-SAS

NL-SAS is a relative newcomer to the storage game, but if you understand SATA and SAS, you already know everything you need to know about **NL-SAS**. You see, NL-SAS is basically a merging of a SATA disk with a SAS connector.

From Wikipedia: "**NL-SAS** drives are enterprise **SATA** drives with a SAS interface, head, media, and rotational speed of traditional **enterprise-class SATA** drives with the fully capable SAS interface typical for classic **SAS** drives."

There are two items of import in that sentence: "**enterprise SATA drives**" and "**fully capable SAS interface**". In short, an NL-SAS disk is a bunch of spinning SATA platters with the native command set of SAS. While these disks will never perform as well as SAS thanks to their lower rotational rate, they do provide all of the enterprise features that come with SAS, including enterprise command queuing, concurrent data channels, and multiple host support.

Enterprise/tagged command queuing. Simultaneously coordinates multiple sets of storage instructions by reordering them at the storage controller level so that they're delivered to the disk in an efficient way. Concurrent data channels. SAS includes multiple full-duplex data channels, which provides for faster throughout of data.

Multiple host support. A single SAS disk can be controlled by multiple hosts without need of an expander. However, on the reliability spectrum, don't be fooled by the acronym "**SAS**" appearing in the product name. **NL-SAS** disks have the same reliability metrics as SATA disks – BER of 1 in 10^15 and MTBF of 1.2 million hours.

So, if you're thinking of buying **NL-SAS** disks because **SAS** disks have better reliability than SATA disks, rethink. If reliability is job #1, then **NL-SAS** is not your answer.

On the performance scale, **NL-SAS** won't be much better than **SATA**, either. Given their SATA underpinning,**NL-SAS** disks rotate at speeds of **7200 RPM**… the same as most **SATA** disks, although there are some SATA drives that operate at 10K RPM.

It seems like there's not much benefit to the **NL-SAS** story. However, bear in mind that this is a **SATA** disk with a **SAS** interface and, with that interface comes a number of benefits, some of which I briefly mentioned earlier. These features allow manufacturers to significantly simplify their products.

Compared to **SATA**, **NL-SAS** drives have additional benefits such as the ability to connect a device to multiple computers, slightly faster interface, up to 30%, compared to **SATA**, no **STP (Serial ATA Tunneling Protocol)**overhead. **Reliability ratings** fall in the same range as **SATA** drives so although they have many characteristics of SAS drives, they are not SAS drives.

In short, **near line SAS** drives are basically big, cheap and slow **SAS** drives targeted towards near line/occasional use storage solutions. They can be cost effective solutions for storage space targeted towards **NAS (Networked Attached Storage)** servers and other non-mission critical, occasionally accessed data storage needs.

SATA

Lowest on the spectrum is the **SATA** disk. Although it doesn't perform as well as SAS and doesn't have some of the enterprise benefits of **NL-SAS**, **SATA** disks remain a vital component in any organization's storage system, particularly for common low-tier, mass storage needs.

When you're buying **SATA** storage, your primary metric is more than likely to be cost per TB and that's as it should be. **SAS** disks are designed for **performance**, which is why they're available in **10K and 15K RPM speeds** and provide significant **IOPS** per physical disk. **SATA** drives spin at **5400-7800 RPM** with data transfer rates up to 3/GS (gigabits per second) with some newer drives have up to **6/GS transfer rates**. SATA drives are the most common drive in the market today, and offer the largest drive capacities available. **SATA** drives today range up to two **(2) Terabyte** capacities and continues to grow.

With **SAS**, although space is important, the cost per IOPS is generally just as, if not more, important. This is why many organizations are willing to buy speedier **SAS** disks even though it means buying many more disks (than **SATA** or **NL-SAS**) to hit capacity needs.

SUMMARY

At a high level, **SAS** and **SATA** are two sides of the storage coin and serve different needs — **SAS** for_performance_ and **SATA** for _capacity_. Straddling the two is **NL-SAS,** which brings some **SAS** capability to SATA disks, but doesn't bring the additional reliability found with **SAS**. **NL-SAS** helps manufacturers streamline production, and can help end users from a controller perspective, but they are not a replacement for **SAS**.