The SCSI bus stops here

Flag down some sound advice on the venerable Small Computer System Interface — SCSI, or *scuzzy*, as it's more popularly known. Roger Gann presents a run-through of its development.

SCSI types compared

Mode	Bus Width	Synchronous Speed (Mb/s)
SCSI 1	8-bit	5
Fast SCSI	8-bit	10
Fast/Wide SCSI	16-bit	20
Ultra SCSI	8-bit	20
Wide Ultra SCSI	16-bit	40
Ultra2 SCSI	8-bit	40
Wide Ultra2 SCSI	16-bit	80

It's been quite a while since I last broached the subject of SCSI and there have been some significant developments in that time, principally the launch of the Ultra2 standard. But first, some brief background. The Small Computer System Interface — SCSI, prounced *scuzzy* — is a general-purpose parallel bus system that originated from Al Shugart's 1979 SASI (Shugart Associates System Interface). It became an official ANSI in 1986. SCSI in all its flavours is now an acknowledged and very well standardised multi-purpose interface, supporting a wide variety of devices such as hard disks, removable disks, magneto-optical devices, tape drives, printers, WORMs, CD-ROMs, scanners, medium-changers (jukeboxes) and communication devices.

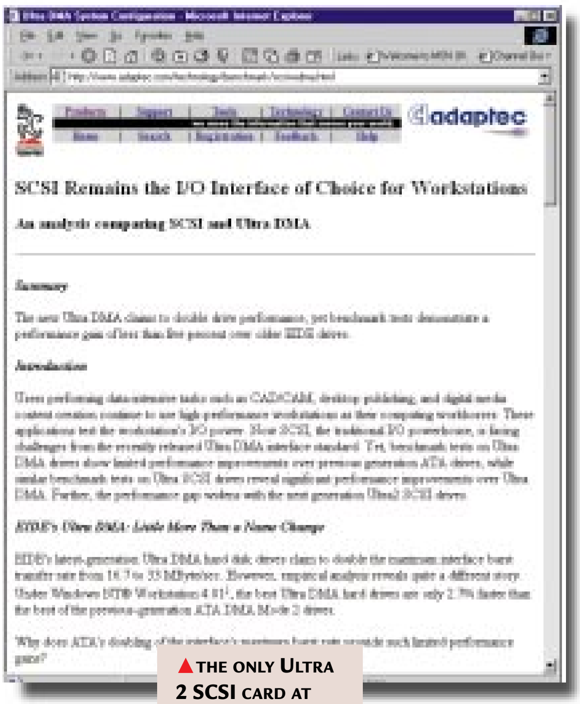
SCSI was originally an 8-bit I/O-bus that allowed connection of up to eight devices, including the host adapter card. SCSI-1, as it became informally known, was a high-speed bus system compared with the peripheral devices around at that time. SCSI-2 followed in 1994. It was not a major leap forward, but it tightened up the standard and added the ability to double and even quadruple data transfer speed on the SCSI bus.

Faster, Wider, Ultra!

The SCSI-2 specification introduced us to Fast SCSI. Or, rather, faster SCSI, because it was a rather broad term referring to devices with data transfer rates up to 10Mbps — twice that of plain vanilla SCSI. It also introduced us to Wide SCSI, which was wide in the sense that it offered a 16-bit data path compared to SCSI's normal eight-bit path and it, too, doubled the data transfer rate to 10Mbps. Add Fast to Wide and you got a data transfer rate of 20Mbps. But Wide SCSI-2 never really made it, as SCSI-2 devices would need two cables to transfer 16 signal bits.

The most recent SCSI-3 specification extends the original SCSI interface to support Ultra SCSI, which permits the SCSI bus to operate at double the transfer rate. Some of the goals for SCSI-3 include "scatter write" and "gather read" capability, 16 devices per bus, longer cable length, auto-configuration of device addresses, operations on other physical layers such as fibre optics, and 16-bit transfer using a single cable. Just to confuse matters even more, the three SCSI standards — 1, 2 and 3 — were recently re-christened by the SCSI Trade Association. Under a new naming convention they're now referred to as SCSI-1, Fast SCSI and Ultra SCSI respectively.

ULTRA2 IS the latest SCSI technology, offering higher performance and improved flexibility in peripheral configuration. It's no longer based on the single-ended physical interface that previously limited SCSI signalling distance and hence cable length. Previously, as the data transfer rate increased, so the maximum cable length decreased. Ultra2 is also not based on the original high-voltage differential (HVD) interface. Instead, it uses a low-voltage differential (LVD) interface which offers several advantages, in particular extended cable lengths — as long as 25m in certain cases. Under Ultra2 SCSI, transfer rates on an eight-bit bus will increase to 40Mbps. With 16-bit Wide Ultra2 SCSI devices, transfer rates soar to 80Mbps. The Ultra2 SCSI bus supports seven Ultra2 SCSI devices, while the Wide variant supports up to 15 devices. Both bus types support only LVD transceivers.



▲THE ONLY ULTRA 2 SCSI CARD AT PRESENT IS THE WIDE ADAPTEC AHA-2940U2W. A NARROW VERSION IS IN THE PIPELINE

The first Ultra2 Wide SCSI card to hit these shores was the snappily named

Adaptec AHA-2940U2W. Despite the similar model number, this card is, in fact, completely different to its predecessor, the AHA-2940UW. The new PCI host adapter positively bristles with SCSI interfaces and has no less than three internal SCSI ports, for Ultra2 Wide (68-pin), Ultra Wide (68-pin) and "ordinary" 50-pin Ultra/Fast SCSI header. It also has an Ultra2 Wide external connector, plus a spare Ultra Wide socket on a blanking plate, so pretty much every SCSI angle is covered. It comes complete with four cables: a SCSI-2 Wide 68-pin three-connector ribbon cable, a SCSI-2 50-pin three-connector narrow cable, a five-connector Ultra2 Wide terminated cable, and an internal-to-external 50-pin Ultra cable with two additional internal connectors.

Ultra2 SCSI won't offer any perceptible performance gains over Ultra DMA

ONE ADVANTAGE OF SCSI is that it guarantees backwards compatibility with older devices. As a result, devices equipped with any SCSI interface can be mixed and co-exist on a common SCSI bus. However, the performance of the SCSI bus is limited to the features the host adapter and the devices have in common — that is, the lowest common denominator. Which means that if a SCSI-1 device was on the bus, everything else on that bus would run at 5Mbps. Adaptec's SpeedFlex technology, employed on the AHA-2940U2W, allows you to mix Ultra and Ultra2 SCSI devices on the same SCSI bus and run each at their maximum speed, rather than defaulting to the slower rate.

The SCSI forecast

The SCSI Trade Association forecasts that a SCSI transfer rate of 640Mbps is within reach, and that a rate of 160Mbps will be available within 12 months. More than 32 SCSI devices may be present on these advanced buses. Beyond Ultra2 SCSI, the SCSI Trade Association is talking about Ultra3 and Ultra4 SCSI. Fibre Channel may be offering these kinds of throughputs now, but there's plenty of life left in the old SCSI dog! But why go for Ultra2 SCSI anyway? Doesn't Ultra DMA deliver fast data throughputs, too? It's true that Ultra DMA and its maximum data transfer rate of 33Mbps narrows the gap between EIDE and SCSI, but raw speed is only one element in the equation. EIDE offers only limited expansion potential. Although some EIDE controllers can support more than two drives, and you can now install two EIDE controllers in a system, EIDE still isn't as flexible as SCSI, which lets you chain up to 15 devices. Another restriction is cable length: an EIDE cable can't exceed half a metre in length, regardless of how many devices you connect. This can be a royal pain with tower cases, because it's often quite a stretch from the motherboard to the drive. By contrast, SCSI cables can total three metres in length. A more serious restriction is that EIDE controllers and drives can process only one I/O command at a time, while SCSI can handle multiple requests simultaneously. This alone will keep EIDE devices out of high-end NT desktop systems. Unlike Windows 95, NT can take advantage of SCSI's ability to simultaneously process I/O commands from multiple applications and get the most out of multiple SCSI-device chains.

SO, SHOULD YOU INVEST in Ultra2 SCSI hardware? Let's look at prices: an Adaptec AHA-2940U2W host adapter will set you back around £235 (ex VAT), while an Ultra2 SCSI drive, such as the 9Gb Seagate Barracuda, will cost £525 (ex VAT). Comparable Ultra Wide SCSI solutions would cost £175 and £500, so the premium you pay for double the bandwidth is modest. However, most modern motherboards incorporate Ultra DMA so the cost of this technology is zero, while a comparable 9Gb Seagate UDMA drive costs £200 (ex VAT). This makes the cost of upgrading to SCSI large enough to warrant economic justification.

OK, what about the performance gain: doesn't that justify forking out the extra for Ultra2 SCSI? Well, if you're running a network file server, or a graphics workstation where you routinely handle multi-megabyte image files, or you are into real-time video editing, then undoubtedly you'll appreciate the very real benefits of Ultra2 SCSI.

BUT IS ULTRA2 SCSI WORTH IT for the average Joe/Josephine? I'd have to say, probably not. While the performance is very impressive, in everyday use Ultra2 SCSI won't offer any perceptible performance gains over Ultra DMA. Don't forget that the data transfer rates quoted are the maximum or peak transfer rates, and sustained throughputs are typically half this. It is true that Ultra2 SCSI is more resilient to demanding tasks and can cope better than EIDE when stressed, but on a standalone PC it is unlikely to encounter situations that put it under much strain. You'd go down the Ultra2 SCSI route for other reasons — flexibility, and the ability to use very long connecting cables.

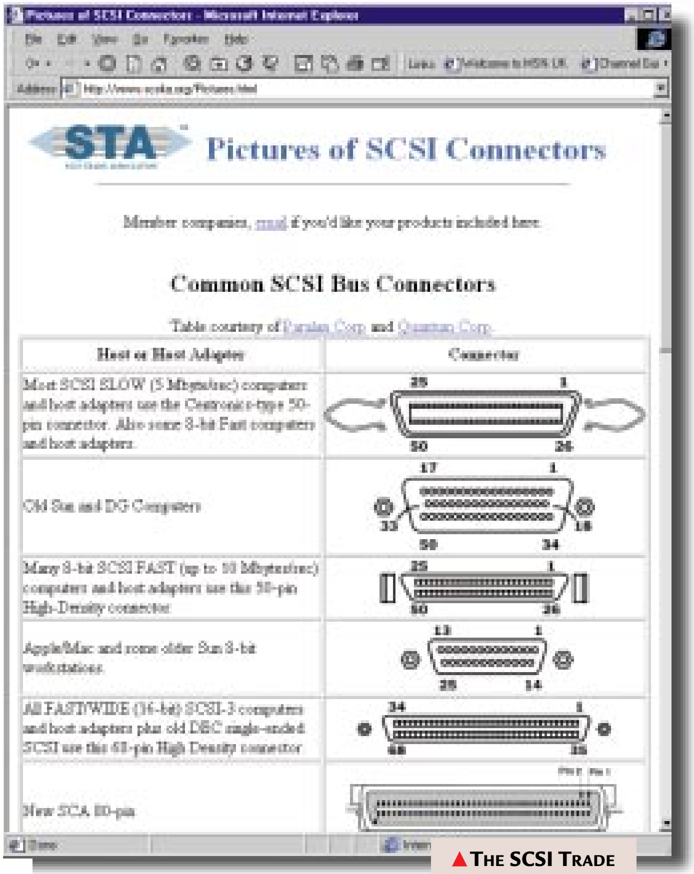
▲ ADAPTEC'S WEB SITE DETAILS JUST HOW LITTLE ULTRA DMA DELIVERS IN REAL PERFORMANCE GAINS

One of the big bug-bears about installing SCSI devices is that while the host adapter may be plug-and-play, the devices that you attach to it are not self-configuring and have to be manually adjusted in order to get them to work. Two things have to be set: first of all the SCSI ID. All SCSI devices have to be assigned a unique ID number, between either zero and seven, or zero and 15. Generally speaking, the host adapter itself takes the highest ID and the other devices have the pick of the remaining numbers. If you want a bootable hard disk, you should assign SCSI ID 0 or 1 to it. And what if you want to change the SCSI IDs later on? No problem with the external devices, you just click on a button or flick some DIP switches. But internal devices? This entails the complete removal of the unit simply to gain access to a set of miniature jumpers.

Roughly coinciding with the launch of Windows 95 and the upsurge of interest in all things plug-and-play, something called SCAM surfaced. SCAM stood for SCSI Configured Auto-Magically (no, really). SCAM is a protocol for automatic SCSI ID assignment: the SCAM master (typically the host adapter) scans the bus for attached SCSI devices. For compatibility, it also needs to find and identify legacy — that is, standard — manually assigned SCSI devices. Thus the SCAM master gets a map of the attached devices and assigns a valid "soft" ID to each SCAM-compliant SCSI device. After this process, the SCAM master keeps this device table in a non-volatile memory to provide, if possible, an identical ID set up for further boot processes. So, in theory, SCAM extended some of the functionality of plug-and-play across the SCSI bus.

Well, that was the theory. It promised to make the installation of all SCSI devices a whole lot easier, the only thing left to worry about being termination. In practice, the promises made by SCAM have still to be delivered.

WHILE MOST MODERN SCSI hard disks support SCAM, the feature isn't enabled by default, so you have to explicitly enable this plug-and-play feature, which is a little odd. The same is true of SCSI host adapters: on the Adaptec AHA-2940U2W card, SCAM is an option but by default is disabled. The original release didn't even have this feature. The story gets worse for other peripherals. Most external SCSI peripherals – scanners and re-writable drives, for example – don't feature SCAM at all. Which all seems to be a very great pity, having seen what plug-and-play has done to simplify configuration for other peripherals.



▲ **The SCSI Trade Association's web site at www.scsita.org is awash with nuggets of useful SCSI info**

Perhaps I shouldn't be too depressed by the damp squid of SCAM; after all, it was only a partial solution and other things need to be set, too. As well as setting the SCSI ID on a device you also have to work out whether to terminate it or not. Just as you have to terminate Thin Ethernet network cabling, so you have to terminate your SCSI chain to prevent ghost signals from bouncing back from each end.

In theory, SCAM promised to make the installation of all SCSI devices a whole lot easier... the promises have still to be delivered

SETTING TERMINATION is a pain because every time you add a new SCSI device to the chain, you have to double-check to make sure that only the devices at the ends of the chain are terminated. If you get it wrong, devices become invisible to the host adapter. And the way you actually turn termination off or on differs from device to device. So it would be nice if SCAM could sort out termination automatically as well, but it doesn't. Actually, in a weird and rather clumsy way, termination is taken care of automatically by Ultra2 SCSI because instead of the devices themselves being terminated, it's the SCSI cable that does the business.

The rather unusual-looking "mares nest" LVD SCSI cable features a 40 x 60mm printed circuit that takes care of termination issues on the Ultra2 bus. However, the other SCSI buses on the card still need conventional termination.

More on matters SCSI in next month's column.

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