Despite threats from USB and Firewire, IEEE 488 ain't down yet

DAN STRASSBERG, SENIOR TECHNICAL EDITOR

USB costs less. Firewire can be 50 times as fast and will get faster. But IEEE 488 still has a lot going for it. Not the least of the reasons for the bus's survival are the thousands of instruments that manufacturers can't redesign overnight.

Like the "unsinkable" Molly Brown, who refused to go down with the Titanic, the venerable IEEE 488 general-purpose instrumentation bus will survive to fight another day. The Universal Serial Bus (USB) offers lower cost. IEEE 1394 (Firewire), also a serial bus, promises both low cost and amazing speed. Ethernet has branched out from the office and is finding a growing niche in data acquisition and in instruments that large-company product-development teams use. Still, despite the intruders on its turf, IEEE 488 will not, in the words of poet Dylan Thomas, "go gentle into that good night."

At press time, the results of an IEEE ballot on a proposal to sanction a faster version of 488 were still unavailable (**Reference 1**). The new bus would allow transfers at 8 Mbytes/sec versus the current version's 1 Mbyte/sec. Several companies (most notably Hewlett-Packard) had expressed serious doubts about the wisdom of tampering with the more-than-20-year-old standard, which is well-understood, broadly supported, and widely used.

Although failure to upgrade the bus speed has negative implications, familiarity, confidence, and broad support augur continued life for IEEE 488. In addition, getting the advertised performance from the buses that can potentially replace 488 is not necessarily a trivial exercise. For example, despite a burst-transfer speed about 50 times that of IEEE 488,

USB AND FIREWIRE IN T&M: THE OPENING SALVOS

Instrumentation and data-acquisition manufacturers are rolling out their initial Universal Serial Bus (USB) offerings (see **sidebar** "For more information…"). However, if you exclude the tools that several listed vendors offer for developing other Firewire products, only two Firewire test-and-measurement (T&M) units had been announced by press time. One of the products, a National Instruments Firewire-to-IEEE 488 converter, is so new that this article couldn't cover it, but you can read about it in this issue's Leading Edge (pg 11).

Hewlett-Packard was the first to announce a Firewire T&M product—the E8491A, a C-size slot-zero controller for the industry-standard VXI modular-instrumentation system. The product costs $2490, including a PCI-bus Firewire adapter for the host PC and a Firewire cable. Firewire is well-

Continued on next page

This VXI slot-zero controller, the HP E8491A, is the first to use Firewire to link PCs to VXI cages. The speed is greater and the cost is lower than that of competing technologies.

Firewire can be substantially slower in responding to instruments' service requests. Although ignoring such application nuances doesn't generally prove fatal, normally conservative test-system developers will insist on fully understanding the buses and the supporting software before applying them.

Then there is the economics of test and measurement (T&M). The T&M industry manufactures thousands of highly specialized products, few of which achieve annual volumes that exceed 10,000 units. These sales volumes are minuscule when compared with those of such products as PC peripherals. Yet, the development costs can be similar. For T&M manufacturers to recover those costs, a product must remain in production for years. Therefore, you can expect T&M companies to continue for many years to supply instruments that incorporate IEEE 488 ports.

Sealed PCs

Meanwhile, in their PC'9X specifications (**Reference 2**), Microsoft (www.microsoft.com) and Intel (www.intel.com) are pushing hard for "sealed" PCs. For the next few years, USB ports will coexist with legacy ports and buses in most new PCs. But after that, legacy ports will give way to increased numbers of USB ports on the back panels of the most popular PC models. Gone will be the RS-232C serial ports, the extended parallel ports (EPPs), the somewhat better defined enhanced-capabilities ports (ECPs), and the ISA-bus slots that accept peripheral cards. For the time being, desktop-PC main boards will continue to include PCI-bus slots, but, in about a year, a significant number of PCs should also include Firewire ports.

On the basis of cost alone, the case for the new serial buses is compelling. The silicon for the PC end of USB is free; it's part of PC chip sets. In about a year, at least some chip sets should also include a large portion of the Firewire interface. However, high-density digital-IC processes may impose speed limitations that relegate Firewire's physical-layer interface to a separate chip. Even so, industry observers expect Firewire interfaces to fall within the price range of most PCs. (At press time, Intel announced that, to hold down product cost, its 440BX chip set would eliminate planned 1394 support. Nevertheless, Firewire supporters remain

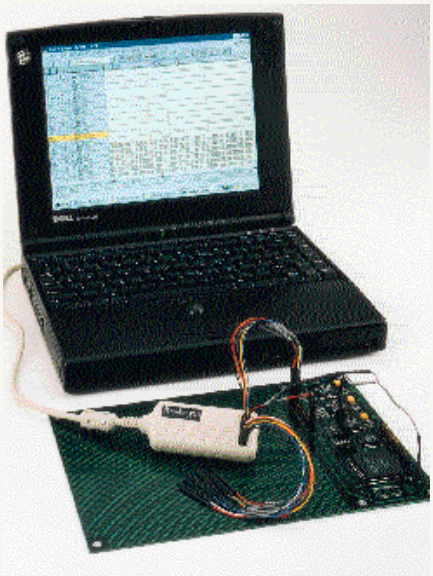
THE OPENING SALVOS

Continued from previous page

suited to connecting VXI cages to host PCs. The 400-Mbps transfer rate is a good match for VXI's 40-Mbyte/sec bus speed. Moreover, the E8491A's cost is 55% of that of the best performing competing approach, which HP says isn't quite as fast.

Two companies offer USB products that qualify as benchtop instruments—minus the display, which the host PC provides. Boulder Creek's $2495, 33230.5-in. Pod-A-Lyzer 8040 logic analyzer can communicate with the host via USB or RS-232C. The RS-232C port makes the unit compatible with the company's earlier Pod-A-Lyzer 8020. The new unit samples as many as 32 channels at 200 MHz in timing-analysis mode (50 channels at 100 MHz in state mode) and provides memory of 128 kbits/channel. According to Boulder Creek, USB transfers data to the host fast enough to enable screen updates that users perceive as instantaneous.

National Instruments offers a family of products that it calls USB instruments. The family includes a $995 5½-digit multimeter and a $1595, two-channel digital oscilloscope. With a bandwidth of 15 MHz and a real-time sampling rate of 20M samples/sec, the scope has neither the bandwidth nor the real-time sampling rate of some benchtop units that cost even less. Nevertheless, the scope stores 663,000-sample records, and, using random-interleaved sampling, it effectively captures repetitive waveforms at 1G samples/sec. Both specs are impressive for products in its price range.



The tiny unit resting on the board under test is a 200-MHz, 32-channel logic analyzer, Boulder Creek's Pod-A-Lyzer 8040. It talks to the PC via USB.

USB data-acquisition products

Five companies offer USB-based data-acquisi-

National Instruments offers several USB T&M products. The three units in the foreground are USB instruments. The three units in the back row are USB-based data-acquisition products. In the center is a USB-to-IEEE 488 converter.

hopeful that 1394-compliant chip sets will appear during 1999.)

Still, the replacement of the legacy ports and buses is a mixed blessing. Though almost certainly a favorable development in the long run, the absence of these ports will pose dilemmas for most PC buyers—at least initially. Test-system developers will be among those most seriously affected because of their heavy use of the legacy ports. Although many T&M devices plug into RS-232C and parallel ports, the greatest impact will probably come from the lack of ISA slots in desktop PCs. IEEE 488 interfaces are readily available for the PCI bus and for laptop-PC slots that accept credit-card-sized PC Cards, but most 488 interfaces still plug into the ISA bus.

Because of the ongoing need, industrial-PC suppliers will continue to offer systems that include the legacy buses. Passive-backplane industrial PCs, which don't use conventional main boards, will have the least difficulty supporting legacy buses. Such PCs are already a major force in the industrial-PC market. Still, over time, PCs that directly support the legacy buses will become increasingly scarce and costly.

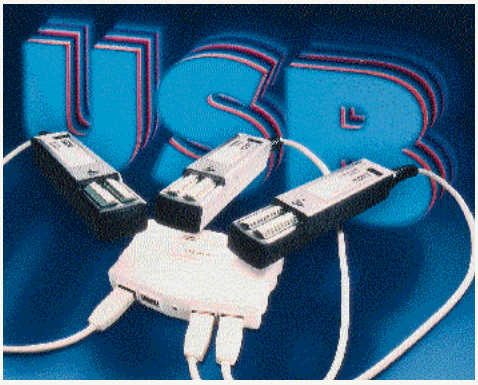
Bridge products

In anticipation of this development, "bridge" products are already emerging (see **sidebar** "USB and Firewire in T&M: the opening salvos"). These units plug into USB and Firewire ports and allow the connection of legacy devices, including instruments with IEEE 488 interfaces. The suppliers of bridge products expect to provide software that enables transparent communication between the host PC and the legacy devices. Nevertheless, response speed can sometimes be a problem, even when the PC interface uses the fast Firewire bus and the instruments use the relatively slow IEEE 488.

More bewildering than the change in ports is the software-support situation for USB devices—even for devices that fall into the most popular classes. Examples are pointing devices, video monitors, and audio-output devices. Microsoft and USB suppliers have defined the capabilities that drivers for such devices must provide (see **sidebar** "VxD gives way to WDM").

Legacy serial ports

Using serial ports to interface instruments to computers predates modern



When it added USB to the long list of buses that its SmartLinks support, Keithley became the first company to offer a USB data-acquisition product.

IOtech originally intended its Personal Daq units for laboratory data acquisition. The advent of DIN-rail-mountable smart USB hubs encouraged the company to introduce DIN-rail-mountable Personal Daq products.

tion products. The first company to do so was Keithley Instruments, which added USB to the long list of communication standards that its 6.731.331.1-in. SmartLink modules support. Most SmartLink modules are designed to work with a specific type of transducer or sensor. Prices begin at less than $65/channel.

IOtech was the second company to offer USB data-acquisition modules. Its Personal Daq units start at $695. That price buys a unit with a 22-bit ADC, five differential or 10 single-ended analog inputs, eight channels of digital I/O, and two frequency/pulse counters.

When they were shown the original products, everyone from trade-press editors to IOtech salespeople exclaimed, "You've *got* to offer these products for DIN-rail mounting.!" They forgot one thing: The target market for DIN-rail-mounted data-acquisition units is *remote* data acquisition, and without some help, USB's 30m length limit doesn't suit that application. The DIN-rail-mounted-component industry has come to the rescue, though. DIN-rail-mountable intelligent USB hosts that interface to a variety of fieldbuses are starting to appear. Such units are ideal for connecting DIN-rail-mounted Personal DAQ units to distant PCs.

At least three companies offer bridge products. Of those companies, National Instruments offers a $495 USB-to-IEEE 488 converter.

TEST-AND-MEASUREMENT BUSES

PCs by decades. Serial ports have been around for more than 40 years. The RS-232C standard is not that old, but it can trace its lineage back to the heyday of minicomputers in the 1960s. Scores of companies make hundreds of T&M and data-acquisition products that support RS-232C and its newer, more tightly defined, and better engineered siblings, such as RS-422 and RS-485.

These serial-communication specifications offer important advantages if you can put up with their limitations. One of the biggest advantages is the ability to send data over long distances—thousands of feet, if the data-transfer rate is slow enough. Although a few systems support RS-232C at 230.4 kbps, RS-232C rarely runs faster than 115.2 kbps, which is usually equivalent to 11.5 kbytes/sec. (Because of the start and stop bits that accompany each asynchronously transmitted byte, you divide bits per second by 10, not eight, to get bytes/sec.) At 115.2 kbps, you should expect reliable communication at distances of no more than a few feet.

Legacy parallel ports

Using PCs' parallel ports as T&M and data-acquisition interfaces allows higher speed communication than does using legacy serial ports. On the parallel ports of today's PCs, a transfer rate of 2 Mbytes/sec is theoretically possible but usually not achievable; 800-kbyte/sec rates are often achievable.

@a glance

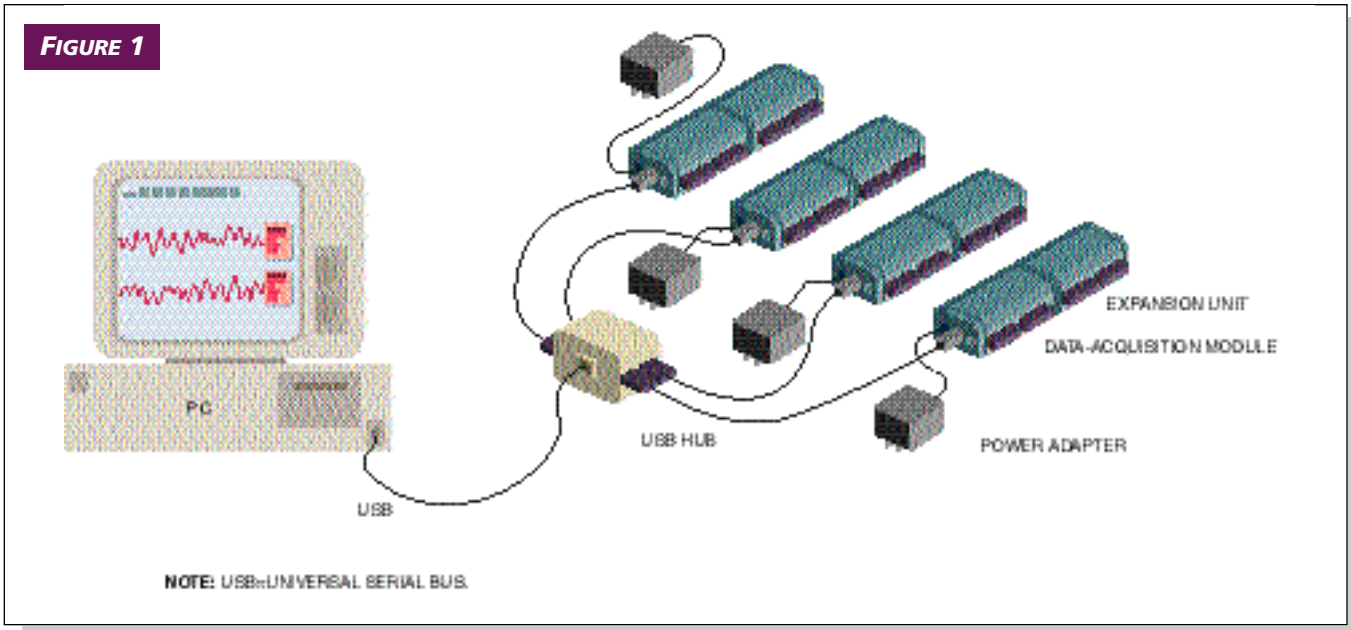
- USB and Firewire show great promise for instruments, but IEEE 488 won't go down without a fight.
- In using "bridge" products that connect IEEE 488 instruments to USB or Firewire ports, watch out for application "gotchas."
- USB and Firewire provide rapid data transfers, but IEEE 488 can respond faster to service requests.
- USB and Firewire can lose data when they force data transfers to

Companies such as IOtech and Signalogic have developed thriving businesses by exploiting the capabilities of PC parallel ports for connecting data-acquisition units. Some of these units acquire data as fast as 1M samples/sec (2 Mbytes/sec). Although this speed exceeds the port speed, the units match the port capabilities by acquiring data in bursts and storing it in internal memories until the bus can accept it. Some parallel-port-connected data-acquisition units even include DSPs that perform complex signal processing on the acquired data before transferring it to the PC.

Nevertheless, companies that make parallel-port data-acquisition units are among the first to admit that they find the legacy ports less than ideal. Some of the problems stem from the original port design, which was meant for one-way data transfer—from the computer to a printer. Originally, the ports could accept only limited information from a peripheral device (busy and offline indications, for example). In data acquisition, far more information travels in the other direction—from the peripheral to the PC.

Belated attempts at standardization resulted from the PC industry's realization that customers were using parallel ports in many ways that the designers of the original port never envisioned. From the standardization efforts came the EPP, ECP, and IEEE 1284 parallel-port specifications. Considering how widespread support is for the general-purpose parallel ports, it is wrong to call the standards efforts unsuccessful. Still, companies that make parallel-port-connected devices look forward to seeing USB replace EPP and ECP. For one thing, these companies think that users will find USB easier to apply—and not mere-

FIGURE 1



USB's topology is not a daisy chain but a star or tree (courtesy IOtech Inc).

ly because of USB's plug-and-play capabilities.

Many parallel-port-connected devices and the software that accompanies them expect one device to have exclusive use of the port. Because most PCs have only one EPP or ECP, devices must often share ports. Problems with port sharing often cause frustrated users to seek technical support. The parallel-port-peripheral companies expect widespread adoption of USB to significantly decrease the number of technical-support calls.

USB and Firewire

Despite major differences in speed and architecture, Firewire and USB share several major attributes. The most obvious are that both buses are serial and feature plug-and-play operation. In contrast, IEEE 488 is an 8-bit, 24-wire parallel bus that can link 15 devices. Like the original parallel printer port, IEEE 488 is decades older than the notion of plug-and-play operation.

Both USB and Firewire can send dc power down the cable; IEEE 488 cannot. Although using the bus cable to deliver power reduces the attached devices' need for ac-line-operated power supplies, many devices require more power than the bus can deliver. And even when the bus supplies enough power for one device, adding devices can cause overloads.

Both USB and Firewire transmit data in packets and incur some overhead as a result. Both buses also give devices the option of using an isochronous mode, which guarantees the device a time slot for data transfer in every frame. In USB, the frame duration is 1 msec; Firewire frames are 125 msec long.

Isochronous modes

Firewire is a very fast bus, currently capable of transfers at 400 Mbps, which

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For information on products such as those discussed in this article, circle the appropriate numbers on the Information Retrieval Service card or use *EDN*'s Express Request service. When you contact any of the following manufacturers directly, please let them know you read about their products in *EDN*.

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fax 1-512-320-8940
www.1394ta.org
Circle No. 316

3A International Inc
(Firewire development and debugging tools)
Tempe, AZ
1-602-437-1751
fax 1-602-437-1774
Circle No. 317

Allison Technology Corp
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fax 1-713-777-4746
www.atcweb.com
Circle No. 318

B&B Electronics Manufacturing Co
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fax 1-815-434-7094
www.bb-elec.com
Circle No. 319

Boulder Creek Engineering
(USB-interfaced logic analyzer)
Santa Cruz, CA
1-408-460-3710
fax 1-408-460-3715
www.pod.com
Circle No. 320

Capital Equipment Corp
(IEEE 488 controllers, data-acquisition software)
Billerica, MA
1-800-234-4232,
1-978-663-2002
fax 1-978-662-2626
www.cec488.com
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Chase Scientific Co
(parallel-port data acquisition)
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fax 1-408-479-8572
www.chase2000.com
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Computer Access Technology Corp (CATC)
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fax 1-408-727-6622
www.catc.com
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ComputerBoards Inc
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fax 1-508-946-9500
www.computerboards.com
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CyberResearch Inc
(parallel-port data acquisition)
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fax 1-203-483-9024
www.cyberresearch.com
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Dataq Instruments Inc
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fax 1-330-666-5434
www.dataq.com
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DKD Instruments
(parallel-port spectrum analyzers) Nipomo, CA
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fax 1-805-929-5983
www.dkdinst.com
Circle No. 327

Hewlett-Packard Co
(VXI slot-0 controller with Firewire interface, IEEE 488 controllers, LAN-connected DSOs)
Palo Alto, CA
1-800-452-4844
www.hp/com/go/tmdir
Circle No. 328

Industrial Computer Source
(parallel-port data acquisition, IEEE 488 controllers)
San Diego, CA
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1-619-677-0877
fax 1-619-677-0895
www.indcompsrc.com
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Tucson, AZ
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is equivalent to 50 Mbytes/sec. Moreover, a road map exists for increasing the speed, in steps, by a factor of eight, to 3.2 Gbps. However, for T&M use, the bus's isochronous mode is not ideal because it doesn't guarantee lossless data transmission. The mode was designed for transferring video data streams, in which brief losses of information are not fatal. USB's isochronous mode can also lose data; like its Firewire counterpart, it lacks facilities for error correction.

USB is much slower than Firewire. USB offers 1.5- and 12-Mbps (187.5-kbyte/sec and 1.5-Mbyte/sec) speeds. No device may monopolize the bus; individual devices can use it a maximum of 50% of the time. Thus, a single device can transfer data at a theoretical maximum rate of 0.75 Mbytes/sec. In practice, the maximum rate is somewhat slower—not more than 0.6 Mbytes/sec, which is lower than IEEE 488's 1-Mbyte/sec maximum. Nevertheless, most IEEE 488 instruments don't use the bus's full speed. Therefore, proponents of USB for T&M think USB is fast enough to supplant IEEE 488 in more than 80% of instruments.

Like IEEE 488, Firewire uses a peer-to-peer protocol; USB does not. In USB, the host initiates all data transfers—even interrupt-driven ones. Because the host is in complete control, devices must wait until the host polls them to announce that interrupts have occurred. The USB structure is not a daisy chain but a star or tree that uses different host and target connectors (**Figure 1**).

The points at which the bus splits into branches are called "hubs." A hub can be a single-function device, or it can be a device such as a video monitor that also functions as a hub. In theory, each USB tree can connect 127 nodes, although such large networks will be

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(continued from pg 72)

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(USB and parallel-port data acquisition, IEEE 488 controllers)
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fax 1-440-439-4093
www.iotech.com
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Keithley Instruments Inc
(USB, Ethernet, and parallel-port data acquisition; IEEE 488 controllers)
Cleveland, OH
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1-440-248-0400
fax 1-440-248-6168
www.keithley.com
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Lawson Labs Inc
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fax 1-610-725-9344
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(parallel-port data acquisition (oscilloscope/spectrum-analyzer/logic-analyzer modules)
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fax 1-973-808-8786
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Pressure Systems Inc
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(parallel-port data acquisition)
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(parallel-port data acquisition)
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www.strawberrytree.com
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(USB development and debugging tools)
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www.usbnews.com

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VxD GIVES WAY TO WDM

Microsoft and Universal Serial Bus (USB) suppliers have defined the capabilities that software drivers for the most popular classes of USB devices must provide. Unfortunately, most test-and-measurement (T&M) and data-acquisition products don't naturally fit these classes, although manufacturers may find ways to make some instruments behave as if they do fit.

One of the complications is that PCs with USB ports appeared before Windows 98, with its built-in USB support. Although Windows 95 OEM Service Release (OSR) 2.1 also supports USB, OSR 2.1 is available only preinstalled on new PCs. Users of older Windows 95 versions cannot obtain OSR 2.1 as an upgrade. Moreover, for most devices, USB device-driver support is different under Windows 95 and 98.

Under versions of Windows 95 earlier than OSR 2.1, device drivers conform to the Virtual Device Driver (VxD) model. Whereas Windows 95 OSR 2.1 and Windows 98 can also use VxDs, their preferred driver model is the 32-bit Windows Driver Model (WDM). WDM drivers are the only type of device drivers that work under Windows NT 5.0. Informed observers currently expect Microsoft to release that OS by mid-1999.

Confusion compounded

To compound the confusion, for many USB devices, the interface between WDM drivers and the OS is different under Windows 95 OSR 2.1 and Windows 98. For Windows 98 and NT 5.0, manufacturers often need not supply drivers for devices that conform to the popular predefined classes. In many cases, drivers that Microsoft supplies with the OS or as upgrades that users can download from the company's Web site provide the necessary support.

Devices that can use these built-in drivers offer major advantages to both manufacturers and purchasers. Purchasers need not install separate drivers to achieve true plug-and-play operation, and manufacturers need not invest in developing custom drivers. When you turn on the system power or connect a USB device to a running system, the device identifies itself to the system software. You almost always need application software, but if you have it, the device just runs. (For the moment, try to ignore Microsoft CEO Bill Gates' mishap during a press preview of Windows 98. Connecting a "true plug-and-play" document scanner to a USB port crashed the demo system.)

To work under Windows 95 OSR 2.1, USB devices normally require different drivers from those they require under Windows 98. The device manufacturer must supply these drivers, and manufacturers usually don't. They expect most of their customers to use Windows 98 or NT 5.0—not Windows 95. (The current version of NT, V4.0, lacks USB support.) By and large, even T&M companies that supply custom USB drivers don't offer drivers that work under Windows 95.

Dodging a bullet

As it turns out, the USB-device manufacturers' position involves some risk, but the vendors seem to have dodged a bullet. Shortly before press time, it appeared that the courts would not accede to a request to delay the Windows 98 introduction. The US Department of Justice and a group of states' attorneys general contemplated seeking such action to deter Microsoft from engaging in conduct that they deem anticompetitive. Although Justice and the attorneys general are suing Microsoft over a number of the company's practices, the suits did not appear to jeopardize the Windows 98 introduction.

A delay in the Windows 98 introduction would force the USB vendors to do some serious scrambling. Without a user-installable, USB-compliant Windows 95 upgrade, most of the companies would be stuck with inventories that they could not sell until the Windows 98 release.

uncommon. When one PC must host large numbers of USB devices, the more usual approach will be to add USB ports to the PC.

The manufacturer of an instrument that contains a PC main board cannot achieve USB connectivity by installing a USB adapter in a PCI slot or by using a USB-compliant main board. To make such an instrument USB-compliant requires a USB target adapter. Currently, however, all PCI-to-USB adapters are host adapters; USB's architects didn't envision PCs as targets. (You can, however, interpose a device between a pair of USB hosts to force one of the "hosts" to behave as a target.)

Because Firewire uses a peer-to-peer protocol, plugging an interface board into a main-board PCI slot enables a PC to act as a Firewire node. Although the PC is usually the bus's "root node," that is, the source of the Firewire bus, the PC can also act as a "child node." Therefore, manufacturers of PC-based instruments can already obtain the hardware they need to connect their instruments to the Firewire bus without forcing the instruments to act as bus controllers. When PC main boards include Firewire interfaces, PC-based instruments can incorporate the child-node capability at no cost beyond that of the main board.

Serial-bus cabling advantages

Serial buses, such as USB and Firewire, offer cabling advantages over parallel buses, such as IEEE 488. Because they include fewer conductors than cables for parallel buses, serial-bus cables are thinner and more flexible. A standard Firewire cable is less than 1/4 in. in diameter; a USB cable is less than 1/6 in. in diameter. The connectors are also smaller than parallel buses' multipin connectors.

As for cable lengths, IEEE 488 allows a maximum cable length of 20m (much more if you use repeaters), whereas if you include all branches, USB's maximum accumulated length is 30m. (The maximum length of a single branch is 5m.) Because of Firewire's high speed, the bus's maximum length is more difficult to explain. A commonly cited number is 72m. Actually, the limitation is 16 hops of no more than 4.5m each.

Each hop connects two devices, but each physical device can contain four logical nodes. Thicker, less flexible cables containing heavier wire allow increased bus length.

The cost of USB's serial cables is inherently low and helps to give the bus a cost advantage over IEEE 488 and Firewire. Each Firewire cable includes two shielded, twisted pairs (one for signals; one for the clock) and two straight conductors (one each for power and ground). When you include the cost of connectors, the cost of these elegant and amazingly flexible cables is comparable with that of IEEE 488 cables.

Driver complexities

Compared with IEEE 488, USB and Firewire generally simplify life for application developers and users who do little or no real programming. The secret behind the new buses' ease of use is driver software whose internal complexity can be significant. Users and application developers rarely have to deal with this complexity, although programmers who develop drivers are less fortunate. In contrast, IEEE 488 device drivers are quite straightforward. Sending commands usually involves sending strings of ASCII characters. The application developer does most of the work; there are no complex drivers to obscure how the application is supposed to operate.

USB and Firewire use a layered communication model. For example, the application issues a command to a device driver, which issues a command to a lower driver, which issues a command to yet another driver. The last driver sends a frame of data (usually a command) to the device. This layered approach insulates the application developer from the true workings of the system and makes the developer's job appear simpler. Unfortunately, the approach also introduces software delays that can make seemingly trivial transactions take unexpectedly long times.

This situation is particularly true with service requests (also called SRQs or interrupts) that devices on the bus generate. Compared with IEEE 488 devices, even Firewire devices can wait a long time for the system to respond to their SRQs. And the situation is worse with USB, which makes the devices wait for the host to poll them.

In contrast, the designers of IEEE 488 focused on fast response to SRQs. When a device pulls down the wire-ORed SRQ line, the bus controller is immediately aware of the request. Normally, the control software quickly jumps to a routine that polls the devices to determine which one initiated the request. The programmer establishes the polling sequence to minimize the latency of high-priority requests.

Proponents of standardization believe that worthwhile savings will result from having drivers that work for all instruments of a particular class.

To standardize or not

For the new buses to succeed, many observers feel that the T&M industry must address several software-related issues. The complex nature of driver software for serial-bus-connected devices suggests the need for some sort of instrument-driver standard. The discussion of whether the industry needs such a standard is giving some people in T&M a sense of déjà vu. Only a few years ago, the VXI Plug&Play Systems Alliance (www.vxipnp.org) set forth standards of this type for the modular instruments that plug into the VXI bus.

The idea is similar to that of defining classes of popular USB peripherals for office and consumer applications. The much smaller size of the T&M market doesn't necessarily diminish the need for standards. Proponents of standardization believe that worthwhile savings will result from having drivers that work for all instruments of a particular class. For example, a driver for Firewire-connected digital oscilloscopes should work for all such instruments, regardless of manufacturer or features.

Indeed, you can think of such standardization as carrying forward the concepts of IEEE 488.2 and SCPI (Standard Commands for Programmable Instruments). IEEE 488.2 and SCPI are the software companions of IEEE 488.1, which is mainly a hardware standard and is the current version of IEEE 488.

Better uses for their time

So far, USB T&M manufacturers show no enthusiasm for a software standard. The consensus among these companies is that such standardization is neither necessary nor appropriate for devices that focus on moderate performance, ease of use, and low cost. The companies point out that not all instruments that support IEEE 488.1 support IEEE 488.2, and fewer still support SCPI. The companies believe that the time and effort they might devote to standards efforts could produce greater profits if directed elsewhere.

Five companies that manufacture or expect to manufacture Firewire-connected T&M and data-acquisition products have begun work on a standard, however. The companies are conducting the work as the Instrumentation and Industrial Control Working Group of the 1394 Trade Association. Working-group members come from 3A International, Hewlett-Packard, Keithley Instruments, National Instruments, and Yokogawa Corp of America (www.yca.com).

The T&M industry has already begun to embrace USB and Firewire. As you would expect, USB is the early favorite in cost-sensitive applications. There is evidence that Firewire will become the preferred bus for midrange and higher priced instruments. In the world of T&M, Firewire lags behind USB in deployment by a year to 18 months, however. Therefore, Firewire for T&M is still very much in the early-adoption stage. Hence, the evidence of Firewire's predicted popularity mostly takes the form of industry-group activities and expressions of corporate interest. With a few exceptions, T&M products that embody the technology are at least a few months away. EDN

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