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SILICON UPDATE

Tom Cantrell

Embedded I-Way Explosion

Get your modem running, head out on the I-way…. If you're looking for adventure, then you might want to consider making your next product web-ready. According to Tom, this year's Embedded Internet Workshop made it clear that big things are coming soon.

If you think the concept of an Internet appliance is a pipedream, you may be the one smoking something. Judging by the developments at the second annual Embedded Internet Workshop (EIW), getting gadgets on the web is easier and cheaper than many people may realize.

My own view is that just about anything with moving electrons is a candidate for webification, including traditional appliances. The only issue is the cost of getting online. The less it costs, the more gadgets we'll see headed in that direction. If it can be done, it will be done.

During the keynote by Intel VP Tom Franz (bottom line: Intel is going to be as much about communication as computing), an interesting discussion arose surrounding the concept of a web-enabled microwave oven. Conventional thinking recognizes that a WebOven would give the manufacturer a way to download bug fixes and run diagnostics. That's well and good, but frankly the idea doesn't sound all that compelling.

But, imagine you toddle over to the supermarket and pick up (unless you decide to order it over the web) a Gourmet-Dinner-In-A-Box containing meat, potato, veggie, and so on. Each item goes into an individual compartment of your spanking new superscalar WebOven, which can cook up to four dishes simultaneously with independent timing and power settings.

Need to read a complicated four-chapter label and punch in directions for each course? Nah, just run the box past the WebOven's barcode reader and hit the Cook button. The WebOven knows what it's trying to cook and what its own capabilities are (i.e., the individual cooking modules may be specialized in terms of wattage, carousel, sensing capabilities, etc.). All it needs are the proper directions.

Those directions are stored locally in the oven using flash memory. Whenever an unrecognized dinner is encountered, the WebOven automatically calls the food manufacturer to download the update. Better yet, anyone who feels like splurging can just click over to WolfgangPuck.com or JuliaChild.com and have a celebrity server be their individual chef for the evening.

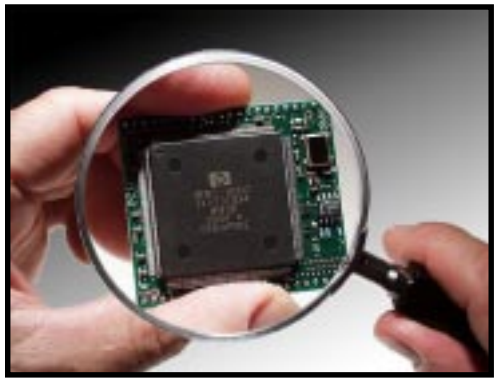

Photo 1—*BFOOT is the latest embedded web server from HP and part of their vision of connecting the factory floor with the enterprise.*

• Username/password multilevel authentication
• Query software version
• Query factory configuration
• Query and set user configuration
• Query and set security configuration
• Query and set network configuration
• Query and set current date and time
• Query 1451.2 configuration
• Query 1451.2 TEDS by block and field
• Write 1451.2 TEDS into STIM
• Validate 1451.2 TEDS lengths and checksums
• Read and write 1451.2 functional address
• Read and write calibrated transducer values
• Read uncalibrated transducer values
• Reboot node
• Wink status LED
• Serve trend chart applet
• Serve custom web page

Table 1—*Hitting an associated URL accesses BFOOTs built-in functions.*

PIVOTAL PRICE POINT

How far web enabling goes is a simple matter of how much it costs. Until now, the entry-level solution would be a bare-bones 32-bit setup (i.e., embedded PC or RISC) running DOS, CE, or an RTOS with TCP/IP stack. You would be hard pressed to get under triple digits in volume.

But now we're starting to see a bunch of under (in some cases way under) $100 solutions. At the high end of the low-end products we find highly integrated variants of the 32-bit + RTOS approach. A good example is HP's second-generation network-capable application processor shown in Photo 1 and known as BFOOT. It incorporates a custom SOC with a 68k CPU and 10BaseT Ethernet connection with Wind River's VxWorks RTOS and protocol stack making up the basic firmware. Pricing for the module and firmware is $95 in high volume.

Communication between BFOOT and the client (web browser) is via HTTP in the form of function-specific URLs like those in Table 1. That's a natural fit with popular software packages that increasingly support web-based data import/export. For example, a cell in a spreadsheet can be mapped to a URL that queries a sensor attached to BFOOT.

Speaking of sensors, BFOOT includes an IEEE 1451.2 sensor interface. The standard defines a clocked-serial port physical layer and includes an electronic datasheet, correction engine, and units conversion (see *Circuit Cellar* 103, "Car 1451, Where Are You?"). There's also a standard asynchronous serial interface (i.e., UART) and a half-dozen I/O lines with programmable counter/timer modes (e.g., PWM, pulse-train, event recorder) that rely on the local oscillator to achieve 25-ns resolution.

One concern of using Ethernet for real-time apps is the jitter that can be introduced at various stages of network access and protocol processing. HP has come up with a time-synchronization scheme that allows multiple nodes to track within 200 ns, largely independent of network traffic characteristics and local applications processing.

This approach relies on one node to play the role of a master clock server that sends several short packets every few seconds. Reminiscent of a phase-lock loop, the other nodes gradually lock to the master, getting from 100- to 1-ms synchronization within 2 s and achieving total lock within about 30 s. The overall accuracy, drift, and stability are similar to the master clock's. This arrangement implies that all node clocks are traceable to UTC (coordinated universal time) if the master clock is traceable to UTC.

Meanwhile, if you're looking for an econo-Ethernet solution, check out the PicoWeb server shown in Photo 2 from Lightner Engineering. It doesn't have all the bells and whistles of the HP unit (e.g., time sync, full-blown RTOS, etc.), but the price, as low as $79, is definitely right. Check out the EIW presentation by designer Bruce Lightner at www.circuitcellar.com for more interesting background and detail on PicoWeb.

READY FOR IREADY?

Those of you who subscribe to the print version of *Circuit Cellar* have already seen my 'Net-In-A-Chip' article (*Circuit Cellar* 111) describing the Seiko 7600A built around design know-how from iReady (see Figure 1).

The good news about the iReady technology is that it handles the meat-and-potato 'Net protocols (TCP/IP, PPP, UDP) in hardware at low cost and power. The bad news is that iReady is a design house, not a chip company, which limits access to their technology to those accounts with big enough volumes and deep enough pockets to roll an ASIC or custom chip.

But now Seiko has stepped into the breech, offering the 7600A as a standard off-the-shelf solution suitable for all manner of less-conventional, smaller-volume apps. I hope Seiko is staffing the order lines because this puppy is going to be hot. At under $10 in volume, have at it!

HERE COME THE MICROS

Exciting news comes in the emergence of web-enabling solutions based on 8-bit MCUs. Although not an expert in networking protocols and such, I've always suspected that a sharp under-the-hood programmer should be able to get something working without needing a 32-bit CPU and megs of memory.

When I first saw the design in Photo 3 by self-professed Canadian-farm-boy-turned-engineer Myron Loewen, my intuition was confirmed. By short-circuiting much of the protocol stack complexity and focusing on the basics, he was able to get a PIC to pass the turn-on-an-LED-via-the-web test. It was great to hear him explain the inner workings of his design at the EIW (his presentation is also available at

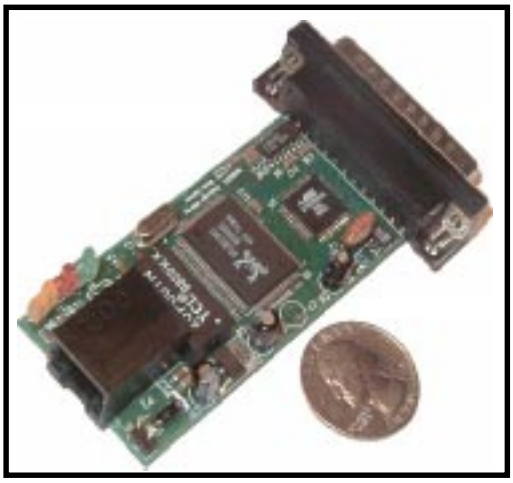

Photo 2—*The low-cost PicoWeb server from Lightner Engineering recognizes the proliferation of Ethernet as the serial port of tomorrow.*

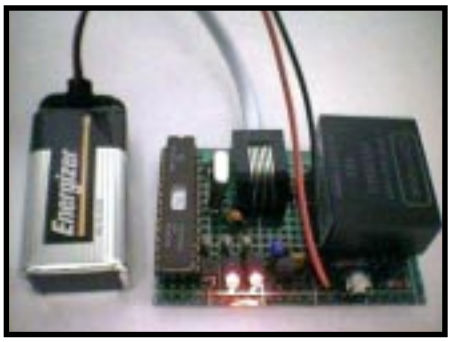

Photo3—*Signaling the start of a trend, the PIC-based design by Myron Loewen proves it doesn't take much silicon to get on the web.*

www.circuitcellar.com).

Microchip was also impressed with Myron's work, so impressed that they incorporated the idea into their latest design contest (PIC2000).

You can't keep a good idea down, so watch for an accelerating pace of 8-bit solutions that will no doubt refine and extend the capabilities quickly. Upstart Scenix, known for putting a lot of MIPs in their little SX chips, is firing back with their own mini-stack software and, the recently rejuvenated Zilog has announced plans to enter the fray as well. Stay tuned….

WEB WAKEUP CALL

So, if you think the Web is just for high-ticket items and couldn't possibly be relevant to your lowly embedded app, better think again. As the price plummets from $100 to $10, the number of existing applications that upgrade with web features will explode. More importantly, entire new classes of products will be born, introducing us to gizmos and gadgets we can't even imagine yet.

Bernard Cole, longtime editor for *EE Times*, gave some opening remarks at the Workshop. As a Silicon Valley veteran, he related that the feeling he's getting about the embedded Internet is the same feeling he got when the microprocessor was introduced.

I feel the same way. I can't predict who, what, when, where, or even why, but this is going to be big.

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SOURCES

BFOOT Ethernet web server
Hewlett-Packard Inc.
(800) 235-0312
(408) 654-8675
Fax: (408) 654-8575
www.hpie.com

SX protocol stack
Scenix Semiconductor, Inc.
(408) 327-8888
Fax: (408) 327-8880
www.scenix.com

PicoWeb Ethernet web server
Lightner Engineering
www.picoweb.net

7600A iChip
Seiko Instruments, Inc.
(408) 433-3208
Fax: (408) 433-3214
www.seiko-usa-ecd.com

iReady Corp.
(408) 330-9450
Fax: (408) 330-9451
www.ireadyco.com

eZ80 protocol stack
Zilog, Inc.
(408) 370-8000
Fax: (408) 370-8056
www.zilog.com

PIC 2000 Contest
Microchip, Inc.
(888) 628-6247
(480) 786-7200
Fax: (480) 899-9210
www.microchip.com