TASKING

Embedded web for 8- and 16-bit MPUs

Published: Components in Electronics

Date: April 1999

By Clarke Esler, TASKING Inc,
and Christopher S. Sontag, emWare

We are beginning to see the Internet and associated technologies manage our work and home environments through the use of intelligent embedded devices. Companies that have provided RTOS and proprietary solutions for networking are rushing to add internet technologies and embedded web servers to their product lines to provide a more open and economical means of the networking devices. Although great strides have been made in reducing the size and cost of such web servers, they are still too large and too costly for most applications. The plain fact is that companies are using web technologies for devices in standard waus when they ought to be using standard web technologies for devices in new ways.

The Internet has traditionally been a 'fat server/thin client', technology. This is fine for storing and accessing large amounts of data over the Internet, but it does not scale well for contolling embedded devices. Applying that paradigm to the networking of embedded devices is like using a jumbo jet to transport children to school. To achieve the pervasive availability of networked embedded device practices have to be turned upside down. To truly make the networking of embedded devices practical, the same solution has to scale from the most complex medical equipment down to something as somple as a door lock. This is achieved by distributing the components of the web server closer to the device or further away from the device, depending on architectural requirements.

It does not make sense to have a TCP/IP web server in every device to make them manageable from the Internet. With small devices, it is necessary to reduce the web server to its essential components, requiring just a few bytes of memory at the device.In larger devices,where more memory is available,the server should still be kept as small as possible,allowing more room for the device's application software. Furthermore, not having a TCP/IP stack at every device makes it possible to use lighterweight protocols to communicate to the device.

As one of the most widely used interfaces in the market today, the web browser is the natural place to look for controlof embedded devices, regardless of connectivity – whether direct or over the Internet. When interfacing with embedded devices, getting the information to and from the device quickly and easily is essential so reducing the amount of information sent to and from the device makes the web a more efficient communications medium. And, since the most timeconsuming information to be moved is graphics,putting the graphical interface objects and the browser where there is more horsepower to process them greatly accelerates communication with the device. Communication with devices over the Internet does not require each to be connected directly to the Internet. Many companies have taken the approach that devices must have a full-blown TCP/IP web server, but that is another area where the paradigm needs to be altered. The new comms paradigm for embedded

networks has to be flexible, allowing the user to get close to the device using large networks like the Internet, and then extending the device locally using lighter networks, such as Powerline, RS485, RS232, CAN or 12C. Such flexibility lets developers design systems that are cost-effective and that more closely meet their needs. For example, with emWare's device web server, which consumes only 1 Kbyte of memory and is specifically designed for microcotroller-based embedded devices, designers can create embedded devices that can be connected to the Internet and controlled remotely using a standard web browser.

Until recently, adding Internet networking capabilities to most devices has been difficult. Many devices that could use 8-and 16-bit architectures to communicate over the Internet are now forced to use a 32-bit environment, because they need the processing power and memory required to manage their TCP/IP-based embedded web servers. To enable widespread networking of embedded devices over the Internet, 8- and 16-bit microcontrollers must be empowered to communicate and be managed via the net. Thanks to the increased versatility of such microcontrollers as Philips 80C51 and XA, and Infineon C500 and C166 that flexibility enables manufacturers to create solutions for their customers inexpensively. Companies are now able to connect large-scale networks to embedded devices using 8- and 16-bit microcontrollers. For instance, emWare has been working to provide developers and manufacturers with a cost-effective and flexible means to easily implement Internet capabilities in their 8-and16-bit microcontroller based devices.

A good example of how to apply web technology to embedded systems is a vendig machine. A local group of EMIT-enabled machines can be inexpensively networked with simple serial or wireless technology. Three main components – emMicro, emGateway, and the web browser – provide a complete and flexible device-to-user solution. emMicro is an extremely thin (1kbyte) web server that requires minimal resources at the device. emGateway complements emMicro by serving as a fat-client/host, and provides the additional services for multiple device management and Internet communication with a standard web browser. The web browser uses emObjects to display and interact with the device in an intuitive, straightforward manner. If the device has adequate resources, emMicro and emGateway can be combined and embedded, allowing direct Internet acces.

Other situations will require that emGateway be combined with a web browser (on a laptop, for example) to directly connect to the device. With a web browser and emGateway combined, the vending machines can be accessed directly through a serial or dial-up connection. If emGateway is embedded in a master vending machine , any authorised user at any location can access the devices over the Internet with a standard web browser. If there are many groups of local vending machines in one area, emGateway services can be provided by a local ISP (Internet Service Provider). emGateway can then dial-up or direct-connect to the local group networks. A user with a standard web browser can transparently connect to any one of the local groups via emGateway on the ISP.

emWare's EMIT software uses standard Internet technologies to manage embedded devices using 8- and 16-bit mcus over the Internet without the costs associated with large web server software. It reduces the web server to its essential components, moves the graphical interface objects off the device, offers flexible communicationand delivers the tools necessary for manufacturers to implement user-to-device Internet connectivity at a very low cost.

Development tools

These developments present a new challenge to embedded systems developments, who need to look at product designs requiring Internet connectivity and based on 8- or 16-bit devices. Fortunately, providers of development tools have risen to this challenge. TASKING Inc, for example, has added emWare's EMIT to its development solution packages,and will be distributing EMIT development solutions for 8051, C166, XA and other CPUs.

