To Build or Buy:

Weighing the Options of Adding Network Connectivity

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Introduction

The demand for device connectivity continues to grow at a tremendous rate. Companies are seeing that new levels of efficiency and cost-savings can be realized through the ability to remotely control, monitor, and collect data from Internet-enabled equipment. However, most of the business devices currently installed lack network ports and require dedicated serial connections for management.

Device servers can enable these devices to become fully-functioning parts of the network so that they can be remotely managed and controlled over the network or Internet. The question companies are facing is how exactly to go about incorporating these servers into their business infrastructure. OEM's looking to add network connectivity to their products need to evaluate two basic options -- is it better to use internal engineering resources to build a solution or go outside to buy the technology needed?

There is a widely held belief that adding secure network connectivity to a serial device is a straightforward process. But when an engineer delves further into the project, he sees the complexity of developing a network interface and the many decisions that need to be made in the process. OEMs must weigh the cost, performance and time-to-market tradeoffs of each approach against their core competencies and the expertise and abilities of their engineering resources.

Networking technology is advancing rapidly, making it easier, faster, and more cost-effective to deliver information and services, thus providing OEMs with lucrative opportunities to serve a wide range of industries. This paper will examine the size of the undertaking and outline the considerations OEMs will need to make in developing and building an embedded or external device server.

The Basics of Device Networking

For many devices, the only access available to a network manager or programmer is via a serial port. Device networking starts with a device server, which allows almost any device with a serial port (TTL, RS-232, RS-422/485) to connect to the network. A device server has been defined as "a specialized network-based hardware and software device designed to perform a single or specialized set of functions with client access (device servers can be configured as a Server or Client) independent of any operating system or proprietary protocol." Terminal, print and recently one-port terminal servers, also known as device servers, have come to embody this notion of independence from proprietary protocols and the ability to provide a number of different functions. Device servers include all of the elements needed for device networking - a processor, real-time operating system (RTOS), a TCP/IP stack, Web server and a network connection.

To add network connectivity, the device must enable the connection between the serial device and the server, and enable the connection between the server

and the network which includes any other networked devices. The server, once given the necessary configuration information, now makes that serial port a networked port with its own IP address. Having now become network enabled, it can be managed or controlled from anywhere via the network or the Internet.

In the past, terminal, print and serial servers were developed as networked devices specifically for the tasks of connecting terminals, printers and modems to the network. Servers, because of the increased demand for networking other devices, now need to become more generic and flexible in their handling of devices. The development of the single-port device server now makes it economically possible to connect even single devices with serial ports to the network. Prior to this development, users had only multiport solutions which were sometimes too expensive when the serial devices were very far apart.

Key Considerations in the Build vs. Buy Decision

Adding network connectivity to existing or new products will add tremendous value and is a key differentiator. As with all new product introductions, OEMs will need to ask themselves some very difficult questions and make several decisions before they build instead of buy.

Key considerations include:

- Cost – both internal costs and what an OEM can charge for the product
- Learning curve – what it takes to become a networking expert
- Time to market and the market window
- Internal resource allocation
- Opportunity cost – taking time away from a company's core competency
- Networking technology complexity – full understanding of hardware and software
- Customer satisfaction and profitability
- Warranty, service and support

While all of these seem like straightforward product management decisions, each one contains issues if a company does not have comprehensive networking knowledge.

Cost

It's important to have a full understanding of the real internal costs of adding network connectivity to a device when making a build versus buy decision. Internal cost evaluation should include engineering and other labor costs, cost of materials and support costs. The reality is that it does take immense engineering resources. To fully evaluate all of the engineering costs involved, companies need to take stock of the lengthy design task list that includes:

- Processor hardware design – taking into consideration the MAC, PHY, memory, timing, bandwidth and EMC
- Operating system and RTOS development
- Development of the TCP/IP stack

- Designing additional network functionality such as e-mail, SNMP, Web servers and TFTP
- Software integration for a successful working design
- Firmware testing
- System testing
- EMC testing

Developing networking functionality can take between nine and 18 months, and this design cycle can be further lengthened without specific expertise. That time and resource allocation can equate to substantial internal costs which may be unnecessary given available proven networking solutions.

Learning Curve

It is a real possibility that it will take longer than planned the first time out to add network connectivity to your application. First time efforts always have more problems, and it takes time for engineers and programmers to get up to speed. If that development takes too long, market realities may prevent you from being able to charge a price premium to recoup your development costs. Also, during the time it takes to advance on the networking learning curve, your competitors could have easily caught up with you because they have purchased an existing solution.

Time to Market

Faster time-to-market is the key to gaining market share, so it's imperative to know the market window of your application. There are a great many other issues and details a company must focus on when designing and introducing a new product and adding design complexity prolongs the time-to-market process. Without specific networking design or RF expertise, internal resources could be wasted learning how to get FCC approval, gaining a full understanding of network protocols or just getting up to speed on the integration and implementation ramifications of a network device. Will the market for your product wait for your engineers to add network or wireless connectivity? Depending upon a company's experience and resources, the design cycle can typically take from 12 to 18 months.

Internal Resource Allocations

The profitable dedication of internal resources to the right tasks is a key challenge for a successful business. What are the strengths of your engineering team? Deciding to build network connectivity into your next product should not put your company at a disadvantage compared to companies solving the same problem by buying a fully integrated solution from a supplier. Allocating time and effort into a design that isn't part of a company's core competency could mean that other strategic product timelines suffer.

Opportunity Cost

What would be the cost of lost opportunities or distractions that occur when resources are used on projects that are not the company's core competency? Experience shows that successful products capitalize on a company's strengths. If engineers or programmers need to be trained or your design is held up because you need to hire the right talent to finish the job, opportunities in other areas of your business could certainly be lost.

Risks of Developing Your Own Solution

Some hardware engineers believe that adding an Ethernet interface to a product is a relatively simple project. That probably is a fair statement if the design simply needs either a serial or parallel interface for the network block, adding some memory, an Ethernet Controller, PHY, magnetics, RJ45 and glue logic. The hardware design can be done with board layout and bill of materials in a short period of time.

However, integrating the processor to work properly with the memory or getting the timing specifications done correctly is not a simple job. It must be determined whether the existing processor has sufficient memory and processor cycles to support the additional applications. Security is also an important issue that should be addressed with some sort of encryption. But the task gets much more complex if the project requires changing the current design or there needs to be a re-layout of the main board. The project may require a whole new re-spin of the main board due to EMI issues, UL requirements, power consumption or new clock frequencies. Now instead of a single design implementation, the project may require two to three rounds of design for the circuit board to run with marginal performance. The design is still not finished. It will then require environmental testing, documentation, measurements and certification.

If your design requires embedded wireless functionality, your engineering team will need to have sufficient RF experience. There are only a small number of engineers who are truly experts in wireless technology. To integrate an application processor, radio, baseband controller, antenna, Media Access Controller (MAC) driver, protocol stack, application software, Flash memory and management interfaces, an engineer needs to have substantial wireless networking experience.

With market windows becoming shorter for profitability, it is a riskier proposition to bring a product to market if your engineering department is not completely proficient in all areas of networking design. Market opportunities do not wait for a company's learning curve.

Software and Communications Standards

The list of standards or protocols that a networking device should support is quite long and constantly in flux. There may be an older standard that is widely used while the latest ones have yet to be adopted, making them virtually unusable. A thorough understanding of networking protocols and

standards is vital for a successful design implementation. It takes an ongoing effort to know what's current, realize the different variations, and know how they work and how to make them work.

Because of this complexity, new designs must be flexible, providing agile movement between the various standards. Designers need to be network savvy in the alphabet soup of supported protocols and develop IP firmware that supports such features or applications as: WEP, ARP, UDP/IP, TCP/IP, ICMP, SNMP, AutoIP, DHCP, TFTP, Telnet, HTTP and 802.11b.

Most embedded operating systems do not support both TCP/IP stack and the radio MAC driver. Thus, for a wireless design, developers must be able to select a suitable operating system that supports wireless capability. Some designs require expertise in real-time operating systems, which is a unique skill. Additional requirements might include support for common industrial equipment data interfaces, including RS-232, RS-422 and RS-485, as well as General Purpose (digital) IO (GPIO) and analog inputs. Leveraging a standards-based approach assures customers that their products will work with a wide variety of high-quality, proven products that are competitively priced. However, your team has to have a working knowledge of current standards in order to turn out a successful product.

The typical communications suite is made up of a full set of communications protocols that includes the various software layers and all of the high-level protocols. If the network or application protocols need to be changed, it will take time and sufficient knowledge to write a network stack or the communications interface to the main CPU. Adding network connectivity really results in a project that is multiple projects in one: hardware, network stack software, application protocols and so on. Each sub-project needs a slightly different skill set. Some of the engineering work can be done in parallel, but other work cannot. It's time-consuming and requires considerable expertise.

Customer Satisfaction and Profitability

Minimizing expenditures and quicker time-to-market are fundamental in accelerating time to profitability. To ensure profitability, you will need the confidence that you have engineered a prototype that will perform to your customer's satisfaction. That prototype must be able to accommodate all of your customer's requirements for network connections, Web interface, data security, application protocols and configuration. Each time there is a bug or rework; it results in an additional expenditure and lengthens the design cycle, which eats away at profitability.

Support

All customers expect that if you build a product, you will service and support it. There are numerous factors to be considered in supporting a network-enabled product, such as making sure the product works with the customer's production network, or understanding the AES encryption certification process. If you built your product with a purchased chip, and there is an issue with the chip working with the rest of the design, your run rate will need to

be high enough with your chip supplier to get the issue resolved. There are also unforeseen issues that arise when the chip you have purchased is put on end-of-life status. You will need a contingency plan for dealing with these issues.

There are other support issues that plague OEMs. Your team must have the talent and the time to troubleshoot end-user corporate networks. You will also need to establish what type of warranty is standard in your industry. Your customers may expect that your company will warranty every aspect of your product including the networking functionality.

Advantages of Buying

Buying a proven networking solution allows a company to focus on its core competencies and benefit from purchasing a time-tested device that can add value. The main advantage of buying a device server solution is that it has been tried, tested and deployed successfully for a wide range of applications in a variety of industries. Companies can introduce a new product without spending internal resources or time on the design, implementation and testing. It can also give a company a competitive edge by simplifying the market introduction process, often with a lead-time of days or weeks instead of many months.
It is also shown to be more costly and riskier to build a networking solution instead of buying it from a well-qualified and experienced supplier with a proven product line. Buying a proven solution allows a company to take advantage of existing products and an experienced supplier's customization capabilities.

Device Server Solutions from Lantronix

For nearly 15 years, Lantronix has been a leader in networking technology and has been an innovator in the areas of micro print server and single-port device server technology. Lantronix engineers are networking experts who have successfully developed server products for the widest array of applications. They are committed to be at the forefront of device server technology.

Lantronix strives to make the complex amazingly simple. The company's device servers are reasonably priced and provide excellent value. The firmware is well tested and network-hardened. It is packed full of features for serial or network configuration, and provides encryption for data security. Whether it's an embedded XPort™ or WiPort™ Device Server that connects directly to the existing serial port UART on the CPU, or an external WiBox™ or CoBox Device Server for legacy products that connects directly to a product's DB-9 or DB-25 serial ports, Lantronix's fully integrated solutions allow OEMs to add networking connectivity in hours or days, not months or years.

WiPort™

Significantly reducing product development time, risk and cost, WiPort is the most compact, integrated solution available to add 802.11b wireless network connectivity to any edge device with a serial interface. WiPort offers the highest level of integration available in a device server with flexibility to support additional 802.11x wireless standards without requiring redesign. It is a complete networking solution in a compact package, featuring a DSTni x86 controller, memory, 802.11b transceiver, a 10/100 Ethernet transceiver and dual high-speed serial ports.

To enable access to a local network or the Internet, the WiPort integrates a fully developed TCP/IP network stack and OS. The WiPort also includes an embedded Web server that can be used to remotely configure, monitor, or troubleshoot the networked device. WiPort can serve webpages to a Web browser when there is a need to gather information or communicate with a networked device. The WiPort becomes a conduit between you and your device over the network or internet.

XPort™

Speeding time to market while reducing engineering risk and eliminating the need for networking expertise, the XPort embedded device server is the most compact, integrated solution available to web-enable any edge device with a serial interface. Removing all the networking complexity OEMs would face, the XPort provides all the essential networking features, including a 10Base-T/100Base-TX Ethernet connection, a proven operating system, an embedded Web server, e-mail alerts, a full TCP/IP protocol stack, and 256-bit AES encryption for secure communications. The development cycle to add network connectivity is cut from six to nine months down to just a few weeks.

WiBox™

Allowing access to remote devices where cabling is prohibited or mobility is required, WiBox merges wireless communications with Lantronix's device server technology. WiBox is a dual port wireless device server that provides connectivity, control, management and monitoring of serial devices over an 802.11b wireless network or the Internet. Serial RS-232/422/485 flexibility, WEP security, robust data handling capabilities and high serial speeds are all built in. Lantronix has made network connectivity to attached devices transparent, so there is no need to develop special software or change operations.

UDS and Micro Board Level Device Server Lines

Eliminating the need for additional engineering resources and greatly reducing time-to-market, Lantronix's the UDS and Micro products network-enable virtually any electronic device at the board level. These compact devices are designed to be integrated onto the circuit board of devices used in applications such as factory automation, security systems, HVAC or lighting control systems, allowing them to be remotely monitored, managed, and controlled over the Internet or shared network.

UDS board products provide a cost-effective alternative to dedicated PCs or lengthy serial cables, offering fast and reliable networking technology.

Lantronix Support

Lantronix maintains a staff of highly skilled networking specialists to assist customers in the implementation of embedded device server technology. The company's engineers possess in-depth knowledge of bridging serial and network connectivity. Expertise includes serial protocols RS232, RS422/485, RS423, networking protocols, IP routing, and network trace analysis. Support ranges from basic configuration and troubleshooting to guidance in creating custom web pages and use of configurable I/O pins to read or set triggers for unique signal indicators.

Technical support is available to Lantronix customers at no additional charge via phone, e-mail, and the Web. We provide an 800 number for clients in the United States, an online knowledgebase and networking tutorials. Lantronix also provides chat and "live assist" service. Live assist is a virtual onsite systems engineer, allowing secure, shared control of your personal computer.