“Don’t I need Linux to add Wi-Fi to my embedded design?”

Leveraging a Fully Integrated WLAN Module for Embedded Wi-Fi™ Product Design
“Don’t I need Linux to add Wi-Fi?”

Embedded system designers face many challenges when selecting the right components to meet functional, budgetary, and regulatory requirements, especially when it involves wireless technologies. Until recently, adding Wi-Fi meant learning and implementing complex software subsystems just to provide a seemingly simple wireless network connection. This typically would involve a deep dive into embedded operating systems such as Linux, complex development environments to compile Wi-Fi drivers, rebuilding kernels, and countless hours spent wrestling with tools unrelated to your actual product functionality.

In addition, the complexity of these subsystems often times can lead to processing and RAM performance requirements that are far greater than what the product application itself would need. Technology has evolved, though, and the software required to support Wi-Fi has been dramatically reduced by pushing the networking stack, Wi-Fi driver, and connection management further into the RF module itself. The latest WLAN modules simplify integration by providing Wi-Fi connectivity in a single package, with intuitive software that is directly compatible with existing host MCU interfaces.

Why has there historically been a reliance on sizeable operating systems such as Linux to enable Wi-Fi? In the past, embedded system designers had few options other than to integrate high-end microprocessors running complex operating systems in order to utilize software platforms compatible with the WLAN radio drivers provided by the manufacturer (see Figure 1).

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Figure 1: Historical Wi-Fi integration approaches required several components as well as a high-speed ARM core processor
Those manufacturers often chose Linux due to the large amount of existing support for network interface software. In many cases, though, features provided by Linux are "overkill" for simple embedded applications and can lead to unnecessary added costs in terms of software complexity, power consumption, PCB layout, and hardware components.

**Wi-Fi Design Freedoms via Fully Integrated Modules**

Technology for supporting Wi-Fi in embedded product design has progressed dramatically in terms of both affordability and ease of use, thanks to System-on-Chip (SoC) WLAN radio modules with embedded networking stack and applications processors (see Figure 2). These fully integrated modules provide enough RAM and processing power to integrate all the software components necessary to provide a full-fledged internet-connected data stream to a microcontroller, without burdening the application software with running the network stack. This solution brings the additional design benefits of lower power and cost than full-featured processors. The trade-off is in network performance, as Linux-based Wi-Fi implementations (running on full-featured ~800MHz core processors) typically provide higher throughput than fully embedded module applications (running on sub-100MHz cores). Hence, keep your product application's network performance requirements in mind when evaluating Wi-Fi design options.

In some cases, systems can also run their application-specific firmware directly on the module’s applications processor, eliminating the reliance on an external host MCU. This translates to improved encapsulation of functionality, bill of materials cost savings, and less design time for adding Wi-Fi connectivity to a product design.

With this type of integrated module solution, the dependence on a large, complex operating system to support Wi-Fi connectivity has become a thing of the past. For example, the new
TiWi-C-W™ Wi-Fi module can be easily integrated into an existing product requiring just a small amount of PCB space for the 10.5 x 10.5mm package, a chip antenna or connector (two if diversity is desired) and optionally a serial interface to an existing host MCU. Application-specific firmware can communicate directly with the Wi-Fi driver if developed within the TiWi-C-W applications processor, or by using a simple ASCII-based serial protocol if an external host MCU is used. To extend the convenience of the integrated module design, LSR also provides reference designs for both 2-layer and 4-layer PCBs.

In the configuration where a host MCU is used, the TiWi-C-W module offers an innovative, modern approach for radio configuration, establishing a network connection and communicating with a server by using popular communications protocols and data formats. Provisioning requires little interaction from the host MCU when using the built-in ‘Soft AP’ functionality for “Configuration Mode”, allowing a smartphone to connect directly with the module and select the Wi-Fi network to join from an interactive web interface served right from the module. Once connected, the module includes features for establishing HTTP/HTTPS connections with native support for RESTful client requests, JSON-RPC, and raw data tunneling.

The Benefits of Employing a Wireless Module
Making use of an RF module solution to add wireless connectivity such as Wi-Fi provides significant benefits in minimizing your development risk, costs, and timeline. Using an RF module that is certified for the appropriate regulatory entities (such as FCC for the US, IC for Canada, etc.) dramatically simplifies your design and certification efforts.

Bringing it All Together

Wi-Fi has become a prevailing networking technology for the Internet, providing an infrastructure to instantly communicate with other networked devices and unlock a whole host of new user experience opportunities for your product. With its pervasiveness across existing networked devices, Wi-Fi brings your product the ability to easily communicate with mobile phones, laptops and cloud servers, enhancing the capabilities of your product in terms of both user interaction and data collection.

“Wi-Fi brings your product the ability to easily communicate with mobile phones, laptops and cloud servers”
With the latest SoC technologies, the complexity of Wi-Fi has been pushed into the wireless module, allowing developers to focus on their application data instead of designing a platform to support Wi-Fi. LSR’s TiWi-C-W offers just such an alternative to a full-fledged Linux-based embedded system with external Wi-Fi radio and other components. For low-to-medium data rate applications, the TiWi-C-W offers a competitive option whether application firmware is integrated directly into the internal ARM Cortex-M3 or used as a communications peripheral via serial port.

In many cases, the efforts to embed Wi-Fi capability is a critical first step to creating an Internet-connected product. In those cases, the capabilities and design benefits that TiWi-C-W can provide spans even further. That’s because TiWi-C-W is part of the TiWiConnect™ IoT ecosystem, providing a comprehensive end-to-end solution for connecting a Wi-Fi enabled product to a cloud-server, empowering your product to be remotely monitored and controlled by clients such as mobile apps and web portals.

Elevate your products with TiWiConnect™

LSR introduces the TiWiConnect cloud-connectivity platform, the first true end-to-end IoT solution for wirelessly connecting products to the cloud. This IoT platform enables smartphone apps and web portals that can re-define the product experience for both your customers and service professionals alike.

TiWiConnect simplifies your product development efforts by providing all the components of a comprehensive solution, all built from the ground up to connect seamlessly: Embedded wireless modules, cloud platform and mobile apps.

Learn more at www.tiwiconnect.com.

Inspiring through Wireless Innovations.

Bringing a winning product to market in today’s competitive environment requires greater skill, creativity and experience than ever before. More and more, your customers demand intuitive, reliable wireless capabilities that give them the real-time information and controls to be more connected.

Since 1980, our partners, spanning a wide range of industries, have trusted LSR to help develop solutions that exceed their customers’ expectations. We provide an unmatched suite of both integrated services and wireless products that improve speed to market and return on your development investment.

Our experienced professionals are passionate and committed to partnering with you, allowing your team to focus on the most important element of product development: the unique needs of your customers.

Visit us at www.lsr.com and follow us on LinkedIn and Twitter (@LSResearch).