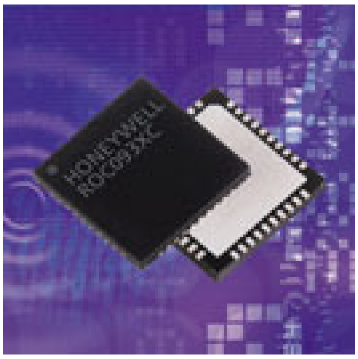
Radio On a Chip For Easy Conversion To Wireless Networking

By Tom Romanko, Honeywell
Radio communications is becoming recognizable as a cost effective solution in the data communications industry as well as in the embedded electronics world. Radio On a Chip and other emerging radios all have the potential to replace wired electronics, but complete solutions for radio designers and non-radio savvy designers does not come so easy.

Adding wireless data communications eliminates the need for cumbersome wires and expense of internal infrastructures, but the jump to go from wired to wireless can be a big leap considering the software and systems required to make wireless come to life. You must also provide a long-term cost-effective solution and deliver reliable radio communications.

The answer to the grey area that makes wireless communications a reality comes in three forms: Hardware and two levels of software. The hardware is the radio system component and the software satisfies the communications over the air protocol, and the networking protocol. The Radio On a Chip transceiver described in this article addresses the hardware and communications protocol.



Packaged transceiver

A Radio Transceiver Solution

In addressing these issues for products emerging in the shorter range and lower data rate wireless link environments, customer-friendly characteristics are added this Radio On a Chip, thereby minimizing or eliminating the need for any radio knowledge in making the conversion to wireless.

The Radio On a Chip model is designed for wireless, digital data applications to satisfy a broad number of industries. It operates in the 902 to 928 MHz ISM frequency band, providing up to 128kb/s of speed ideal for private, wireless networking systems.

Integrated Features

The transceiver includes many features such as a RF signal synthesis, FSK transmitter, direct down-conversion receiver and feature rich digital interface. Data is simply written into the transceiver and the Radio On a Chip does the rest, including notifying the microcontroller that a message has arrived. It operates under license-free FCC Part 15.247 and 15.249 and can be used as single-frequency or as a frequency-hopping spread spectrum (FHSS) radio. Frequency hopping provides the benefits of using higher transmit power (longer range) and multiple channels to nearly eliminate interference from other radios.

Figure 1 shows the basic external component functions of a typical application of the transceiver.

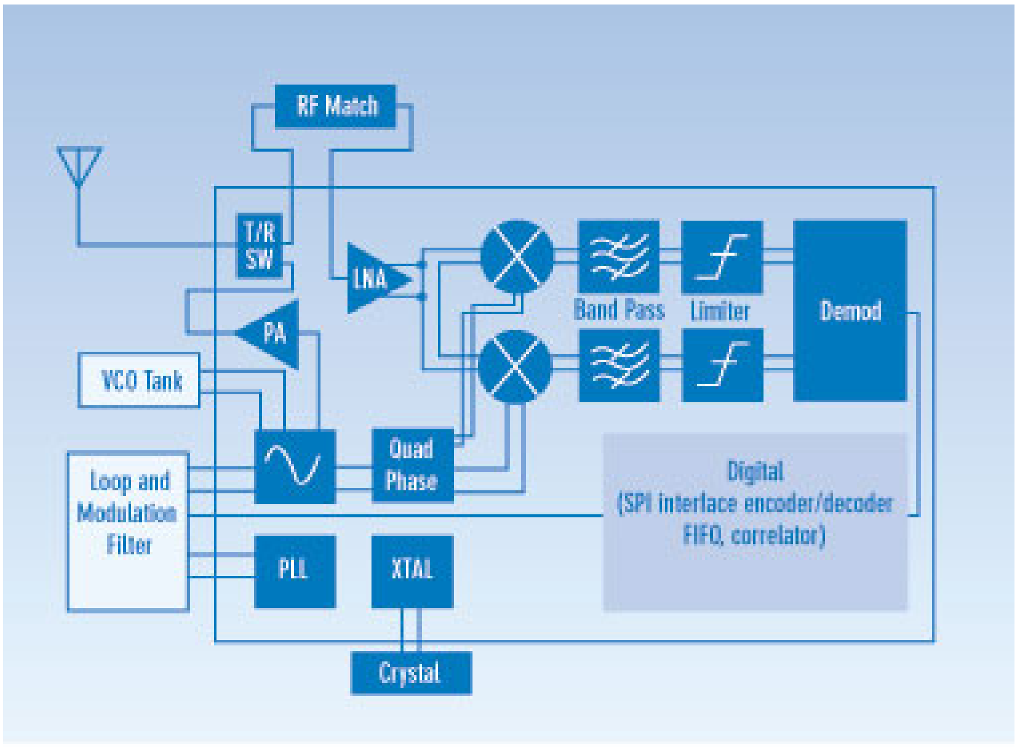


Figure 1. The basic external component functions of a typical application of the transceiver.Simplified Path To Wireless

Building a wireless transceiver on a circuit board at 915 MHz can be a risky proposition. Coupling of unwanted signals and noise can cause several cycles of boards and lead to extended FCC certification. By including all the reference design materials including schematics, assembly, board layout files, and a parts list, implementation is fast and low risk. Performance of they typical radio is shown in Table 1.

How Is It Cost Effective?

The Radio On a Chip transceiver was developed to lower the cost of migration to wireless a number of different ways.
&#149 Low transceiver cost and low quantity Bill of Materials (BOM).
&#149 High level of Digital Integration: Reduces microcontroller and software development cost.
&#149 Honeywell Frequency Hopping software: Provides a jump-start on software development.
&#149 Wiring Cost: Less expensive than installing wire in many industrial environments.
&#149 License Free: Operates in the license free 915MHz ISM frequency band.

Additional Digital Functions Simplify Embedded Integration

To make it easy and cost effective to integrate Honeywell's transceiver into embedded applications, several features were added to the ROC093XC model to reduce the microprocessor's workload. It starts with a standard microcontroller interface, the Serial Peripheral Interface (SPI) bus &#151 the 6MHz pipeline for control and data transfer between the Radio On a Chip and the uC.

Through the SPI, the user has great control over the operation through the transceiver registers. Control functions includes:
&#149 Transceiver Operating Mode (Tx/Rx/Sleep)
&#149 RF Operating Frequency
&#149 Transmitter Power
&#149 Data Rate
&#149 Manchester Encode/Decode
&#149 Device or Message Address

In many systems, software is required to perform many wireless communication functions. This includes formatting messages, encoding and decoding data, and differentiating if the message was meant for a particular device. Since the data is usually in the 10kb/s to 100kb/s range, it results in very inefficient use of processor resources. This transceiver integrates functions to improve efficiency by performing packet formatting and transmission functions, including Manchester Encoding the data. It also includes a programmable 32-bit address, appends a preamble and sends data to the modulator. Special software is included to control the RF transmissions and communications between devices.

Wireless Communications Software

Although many features of the Radio On a Chip minimize software development, software is required to perform the media access protocol. This is particularly true in systems that incorporate frequency hopping &#151 the ability to automatically hop between channels. Honeywell has developed frequency-hopping software, written in C, to provide flexibility and wider possibilities by supporting several communication system architectures such as:

&#149 Base station/remote device
&#149 Broadcast
&#149 Point to Point
&#149 Point to Multi-point

The functions provided by the software are:
&#149 Establish Communication: The algorithms will establish a link between devices and keeps
them synchronized.
&#149 Reliable Message Transport: Incorporates an ACK/NACK and re-Send protocol. &#149 Re-Synchronization: If the RF link is broken and regained, software will automatically re-synchronize and continue sending data.

Wireless Communications Standards

Wireless standards are becoming a topic of discussion in radio communications. One of the first, most mature, is the IEE 802.11 for wireless LANs. Standards are crucial for systems that must communicate with devices from multiple manufacturers. However, many applications are part of closed, private networks that will only communicate with same-type devices.

The Radio On a Chip talks to a variety of device styles and designed for simple, low cost, private networks requiring low to medium data rates. When compared to other radio systems, such as Bluetooth, the Radio On a Chip is ideally suited to ranges beyond 900 feet and does not require the complexity in the radio protocol that Bluetooth does. As a result, it is lower cost, lower power and requires less memory space.

Many sensors, modem and control applications do not require the high data rates (up to 1 Mb/s) and complex multi-tier networking supported by Bluetooth. Therefore, Radio On a Chip can be implemented easily with simplified wireless communication protocols that are tailored to meet the unique needs of each application.

When looking at the emerging ZigBee/IEEE 802.15.4 radios, several differences exist.
&#149 Data Rates: The Radio On a Chip supports data rates up to a maximum of 128 kb/s in the 915 MHz band and ZigBee/IEEE 802.15.4 is at 40 kb/s.
&#149 Spread Spectrum Technique: The Radio On a Chip is Frequency Hopping Spread Spectrum (FHSS) and the ZigBee/IEEE 802.15.4 is Direct Sequence Spread Spectrum (DSSS).
&#149 Communication Protocol: ZigBee will license the networking and media access protocol with the 802.15.4 radio. This may or may not suit the applications requiring higher data throughput. The Radio On a Chip allows the user to implement its own protocol with peak efficiency to that specific application.

Applications and Product Development

The application space for the Radio On a Chip is wide ranged and encompasses traditional as well as new industries. Traditional arenas are the lower data rate for remote medical alert sensors, real-time remote industrial metering, robotic machine control for hazardous environments, and home control.

The higher data rate transceiver extends the application space to handheld games, digital voice communications, image transfer, wireless modems, personalized convenience store key chains and multiple node data networks. These radios, with minimal additional infrastructure and/or networking software, can be used for networks that support multiple devices and longer range such as industrial buildings, hotels, farms and marinas.

Tom Romanko is an applications engineer for RF/Microwave Solutions for Honeywell. For More information visit www.mysoiservices.com.