ZigBee™ Technology from Freescale

Start with a Leader. Finish Strong.
Freescale Semiconductor, Inc. draws on extensive radio frequency (RF) and wireless experience accumulated from more than 50 years of developing semiconductor products. With our depth of experience in this area, we are qualified to offer a comprehensive IEEE® 802.15.4 standard-compliant, ZigBee™-compliant platform solution.

With our depth of experience in this area, we are qualified to offer a comprehensive IEEE® 802.15.4 standard-compliant, ZigBee™-compliant platform solution. Freescale makes wireless simple by providing a one-stop shop for customers, complete with RF transceivers, MCUs, sensors, MAC software, Z-Stack™ ZigBee software and a flexible development tool suite. Virtually any low-data-rate, monitoring, control or automation application that requires long battery life and networking capability can benefit from the wireless connectivity solutions provided by the IEEE 802.15.4 standard and ZigBee technology.

The ZigBee Alliance announced its public release of the 1.0 ZigBee specification in 2005. The alliance is comprised of more than 180 companies working together to drive stack and application profiles for home and commercial use. Application profiles in progress include: Home Automation (HA), Commercial Building Automation (CBA), Industrial Plant Monitoring (IPM) and Heating, Ventilation and Air Condition (HVAC). Other proposals in progress include automated reading, medical and sensor applications.

**Wireless Made Simple**

The IEEE 802.15.4 standard is a simple packet data protocol for lightweight wireless networks and specifies the MAC and PHY networking layers. ZigBee technology takes full advantage of the IEEE 802.15.4 standard and adds the logical network, security and application software. ZigBee technology provides static and dynamic star, cluster tree and mesh networking structures that allow large area network coverage, scalable networks and single point-of-failure avoidance. Now, customers do not have to be tied to complex, costly proprietary solutions that increase their design time. They can use a standards-based solution, such as ZigBee technology.

Because ZigBee technology is based on an industry standard, it provides interoperability, allowing communication amongst devices from different manufacturers, and offers system integrators and consumers flexible purchasing options. ZigBee technology also offers simplicity and a cost-effective approach to building construction and remodeling with wireless technology. Furthermore, these battery-powered networks are sustained by the low power consumption features of ZigBee technology.

In addition to retrofitting, technology based on the ZigBee protocol may help to reduce costs for Original Equipment Manufacturers (OEMs) because typical target applications already use an MCU; there is only a minimal incremental cost needed for additional memory added to the MCU to house the MAC and ZigBee software. Freescale’s 2.4 GHz band ZigBee-ready RF transceivers can be used worldwide, eliminating the need to redesign and certify a product for various markets or regions.

---

**INDUSTRIAL PRODUCT ZIGBEE™ EXAMPLES**

Making Connections Everywhere

The benefits of simple, cost-effective, low-power wireless connectivity that ZigBee technology provides address a variety of markets, including industrial and home monitoring, control and automation, as well as health care diagnostics.

In the industrial sector, ZigBee technology can help improve utility and energy management, logistics and inventory tracking, as well as security and access control. Other systems can be tracked for preventative maintenance and performance monitoring. Seismic detectors, inclinometers, robotics and security systems are just a few examples. Many other applications can apply.
Freescale's Advantage

From its position in cell phone technology and extensive knowledge of RF semiconductor processes, Freescale is positioned to offer a wide platform of ZigBee-ready transceivers. The MC1319x legacy family has proven success in the market with its feature-rich, dual-data modem that can be used in ZigBee technology applications. It has an optimized digital core with functionality to help reduce MCU processing power and execution cycle time. Four timer comparators can reduce cost by using a low-performance and affordable MCU. Extensive interrupt servicing options provide software development flexibility. A simple serial peripheral interface (SPI) between the RF IC and MCU allows the use of virtually any MCU in Freescale’s vast portfolio. Link quality and energy detection provide necessary data for network formation and maintenance.

Freescale’s latest ZigBee solution builds on the MC1319x Family. The MC1320x is the next-generation family of IEEE® 802.15.4-compliant radios. It maintains exceptional RF performance and flexible architecture for application design. Enhanced features include an integrated Tx/Rx switch and reduction of external components that reduce the bill of materials (BOM) and overall development cost. These radios support Freescale’s widely used software stack options, the Simple MAC (SMAC), the 802.15.4 MAC and the full ZigBee stack.

The most impressive and newest family introduction is the MC1321x System in Package (SiP) series. These devices integrate the MC9S08GT MCU with the MC1320x transceiver in a single 9 mm x 9 mm LGA package. Three memory configurations are provided in this family ranging from 16 KB to 60 KB of Flash memory. No matter what your application needs—simple point-to-point connectivity or a complete ZigBee mesh network—the MC1321x Family can scale to meet them. The MC13211 provides 16 KB of Flash and 1 KB of RAM memory and is an ideal solution for cost-effective proprietary applications that need wireless point-to-point or star network connectivity. The MC13211 combined with the Freescale SMAC provides the foundation for proprietary applications by supplying the necessary source code and application examples to get you started on implementing wireless connectivity. If you need larger scale networking options, combine the MC13212, containing 32 KB of Flash and 2 KB of RAM memory, with the Freescale fully compliant IEEE 802.15.4 MAC to customize the network to fit your requirements. For a fully compliant ZigBee platform, use the MC13213, which contains 60 KB of Flash and 4 KB of RAM memory, and the ZigBee protocol stack to help you develop certifiable ZigBee products. The MC13214 has the same features as the MC13213, and also includes the Figure 8 Wireless ZigBee Stack (Z-Stack™) software. The devices in this family are pin-compatible, allowing the user to select the device that perfectly fits the application.

> Designed to the IEEE 802.15.4 standard and for ZigBee technology
> Full-spectrum encoding and decoding
> Cost-effective CMOS design requires few external components
> Programmable clock out for use by baseband MCU
> Standard four-wire SPI that can operate at 4 MHz or greater (SPI not available in the MC1321x Family)
> Extended range capability using an external low-noise amplifier (LNA) and/or power amplifier (PA)
> Programmable output power, 0 dB typical
> Ultralow power modes

Consumer products in the home using ZigBee technology include home automation systems with lighting and HVAC control devices, security systems, blind and curtain controls, as well as remote controls for set-top boxes and other entertainment devices. Consumer products with accessory interfaces can add ZigBee technology functionality after purchase. CompactFlash or PCMCIA slots in PDAs or notebook PCs are examples. The health care and fitness markets can also benefit from ZigBee technology. Health tracking devices, such as pedometers and heart rate monitors, are typical target applications. Equipment used in sports medicine and physical therapy can become more mobile by introducing a wireless component.

HOME AND DIAGNOSTICS ZIGBEE™ EXAMPLES
**Microcontrollers and Beyond**

The RF transceiver is just one component in our ZigBee-compliant platform solution. A processing device, such as an MCU or DSP, is required to complete the entire solution by housing the IEEE 802.15.4 MAC and ZigBee software. In this regard, Freescale offers a comprehensive, ZigBee-compliant solution with the necessary pieces of the system.

Freescale offers a vast array of microcontroller families and development tools. Freescale has unveiled the HCS08 family of low-voltage, low-power microcontrollers, targeted for use with the MC13193 in ZigBee technology applications. These cost-effective, high-performance 8-bit MCUs offer features to extend battery life, deliver high performance and integrate peripheral and memory combinations. They include:

- MC9S08GB32
- MC9S08GB60
- MC9S08GT32
- MC9S08GT60
- MC9S08RG32
- MC9S08RG60

For applications that require higher performance, other Freescale processor families that could be used include ColdFire® processors, HCS12 16-bit MCUs, i.MX applications processors, 56800/E hybrid controllers and PowerQUICC™ integrated communications processors containing PowerPC® cores.

**Sensors**

Freescale also has developed a family of ZigBee technology-compatible sensors. Customers using wireline control networks can easily incorporate Freescale’s ZigBee technology-compatible acceleration and pressure sensors into their applications. Based on micro-electromechanical systems (MEMS) technology, the sensors use standard OEM hardware interfaces. Customers can choose from a broad range of Freescale sensor solutions featuring the MMA series accelerometers, MPX series pressure sensors and the MC series ion and photo smoke ICs.

**MAC Layer Software**

Freescale has developed the IEEE 802.15.4 MAC software as part of its ZigBee-compliant platform solution. It is standards-compliant and is considerably smaller in size than Bluetooth™ technology; thus, IEEE 802.15.4 technology requires less on-chip memory and minimal processing power from a microcontroller. The following highlights some features:

- Designed to support peer-to-peer, star and mesh network topologies
- Designed to support optional upper Z-Stack ZigBee layers
- Power-saving modes (doze and hibernate, application configurable)
- Security
- Carrier sense multiple access with collision avoidance (CSMA-CA) channel access
- Optional super-frame structure with beacons
- Guaranteed time slot (GTS) mechanism

**Freescale—The One-Stop Shop**

Freescale provides all the building blocks used in a complete ZigBee-compliant platform solution: the RF transceiver, MAC and ZigBee software, microcontrollers and sensors. One solution, one provider—built, tested, compatible and ready for integration.

To learn more about Freescale’s ZigBee technology portfolio, go to [www.freescale.com/ZigBee](http://www.freescale.com/ZigBee).