

## BLUETOOTH SMART AND BLUETOOTH SMART READY

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Present in nearly all wireless phones and an ever-growing number of wireless devices, Bluetooth technology has become an exceptional performer for audio and data transmission. Bluetooth 4.0 introduces Bluetooth Low Energy (BLE), a new protocol that allows for long-term operation of Bluetooth devices in low-volume data transmission. BLE enables smaller form factors, better power optimization, and power cells that last for years on a single charge.

BLE works by engaging in brief bursts of low-bitrate data transmission, as opposed to the continuous operation of devices like wireless headsets. These brief bursts are a new data type known as an “attribute,” and are handled by the ATT protocol layer within the Bluetooth stack. While previous Bluetooth versions have required about 100 milliseconds (100 ms) to establish a connection, transmit data, and terminate the connection, BLE devices reportedly can achieve the same results in 3 ms. By drastically reducing the time spent at peak power consumption, BLE devices can operate for significantly longer periods of time with the same total power usage.

### Bluetooth Smart Ready vs. Bluetooth Smart devices

**Bluetooth Smart Ready** devices are considered dual-mode devices because they can communicate with both BLE devices and classic Bluetooth devices. **Bluetooth Smart** devices are considered single-mode devices because they cannot communicate with classic Bluetooth devices. Smart devices always enjoy the benefits of low-energy operation. Classic Bluetooth remains unchanged.



Figure 1: Smart, Smart Ready, and Classic Bluetooth

### Roles in Bluetooth Low Energy

The two most common roles for BLE devices are central and peripheral. In BLE, the central role acts as a hub to one or more peripheral devices. Two central devices cannot directly communicate, and neither can two peripheral devices except through the GATT layer (see sidebar).

Theoretically, a device in the central-role is capable of connecting to over a million peripherals. Central devices are typically configured via a profile to acquire and use status data (attributes) from a peripheral. Devices in the peripheral role may act as information gatherers that transmit their status to the central device. Central devices may then display, re-route, or store gathered data.

While both Smart and Smart Ready devices can act in both central and peripheral roles, some of the most compelling use cases arise when a Smart Ready device (particularly a mobile phone) is central, and can share its resources with a small network of Smart devices.

#### Intercommunication of Peripheral Devices (the GATT layer)

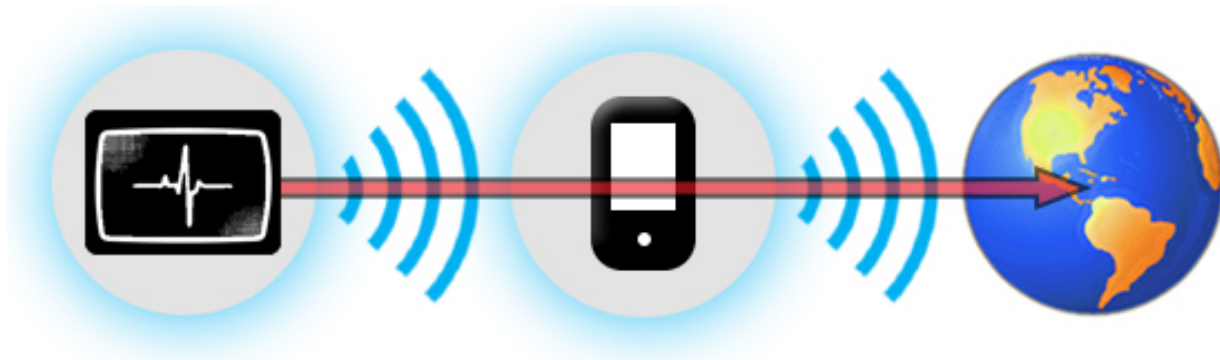
Typically, Bluetooth Smart devices may only communicate to each other by channelling through the central or host device via Bluetooth’s Generic Attribute (GATT) layer. Attribute data is the primary type of data sent and received in Bluetooth Low Energy communication.

Peripheral devices may act as the GATT client to a GATT server (typically the central device). Once connected, the peripheral may simultaneously act as a server to another peripheral, allowing mediated bi-directional communications through the Bluetooth network.

## Use Cases

In a commonly cited use case, a Bluetooth Smart heart monitor collects data on a patient's vitals and transmits that data to a device in the central mode – in this example, a Smart Ready mobile phone. In this use case, the heart monitor (with its low-energy wireless communications) can potentially go years without a battery change. The Smart monitor's job is simple, specific, and only requires one connection at a time, ideal for the peripheral role. Also, the Smart Ready phone may communicate simultaneously with other medical devices that require its advanced resources. Most importantly, data from the heart monitor, a glucose monitor, or other devices may be sent to a physician over the Smart Ready phone's internet connection. Smart Ready devices in this way can provide Smart Devices with a gateway to the entire internet's resources.

The Smart Ready phone is just one way to extend internet access to Smart devices. Other gateways, such as Bluetooth Smart wireless routers, can extend internet functionality in a similar way. In a small network of Bluetooth devices, low energy hardware can communicate important data to the web for years through Smart or Smart Ready gateways without being directly internet-connected. This decreases the scale and cost for web-accessibility in Bluetooth devices.



*Figure 2: Smart device web connectivity*

Other potential use cases include a Bluetooth Smart router that delivers arrival and departure times in high-interference airport terminals, pill bottles that remind patients to take their medication, and point-to-point communication and action-triggering on a Bluetooth Smart insulin pump. Such configurations can alleviate common problems using the existing hardware owned by most users.

Ultimately, the introduction of BLE signals a major scale-down of the requirements of Bluetooth hardware configurations leading to devices that are smaller, cheaper, and easier to embed into other products. Low power profiles means that a device's battery may outlive the device itself; Bluetooth Smart chips can be embedded securely without the need for a battery access.