

# A Bluetooth & ZigBee Comparison For IoT Applications

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As the [low power, wide-area network \(LPWAN\)](#) market expands, there are so many more options for low power protocols for Internet of Things (IoT) applications. Within this article, we're comparing [Bluetooth and Bluetooth Low Energy \(BLE\)](#) to ZigBee, so you can get a better idea which wireless protocol to use for your connected devices.

# The Difference Between Bluetooth & BLE

There are two branches of Bluetooth: traditional Bluetooth and Bluetooth Low Energy (known as BLE). The reason why traditional Bluetooth isn't comparable with ZigBee comes down to power consumption. If an application needs to be battery operated for an extended period of time, traditional Bluetooth simply will not suffice. Traditional Bluetooth design recommends one watt of power consumption. When it comes to wireless IoT applications, this is *a lot*. Both BLE and ZigBee are between 10 to 100 milliwatts (mW), which is 10 to 100 times less than what traditional Bluetooth recommends you design for. However, BLE does compare well to ZigBee, which we will discuss in this article.

## BLE

BLE is a personal area network (PAN), so the range is much shorter than ZigBee. The purpose is to be able to connect to devices near a user. BLE has a much shorter range than ZigBee, but it also has a much higher data rate. Traditional Bluetooth had a data rate between 1 to 3 Mbit/s, and BLE data rate is 1 Mbit/s for short bursts. It “sleeps” in between those bursts—a functionality ZigBee does not have—which requires less data and power usage.

Now, BLE is also supported by many operating systems, including Android, iOS, Windows 8/10, and OS X (spaces ZigBee hasn't branched into). If a user has their smartphone and wants to connect to a device, BLE makes that possible. However, Bluetooth isn't a great choice for high density nodes or long-range applications.

## BLE USE CASE

BLE is ideal for someone traveling through a group of connected things in a defined space. When a person gets into their car, BLE can make the car “smart” by enabling audio dialing and car-to-phone speaker connection. If they switch from their car to a BLE-enabled smart bicycle, the connected application could direct them to the right location. The information doesn't stay with a BLE-enabled device—rather, it leaves with the user.

## ZigBee

ZigBee is a mesh network protocol designed to carry small amounts of data across medium distances. It runs on a mesh topology network, meaning information from a single sensor node travels across a group (or “mesh”) of nodes until the transmission reaches the gateway.

ZigBee is a local area network (LAN), so unlike BLE, it is not intended to connect to devices directly around a user. Instead, it connects to devices that need a wider range. Because of this, it's an ideal protocol for [home automation](#) and [smart lighting](#).

Despite ZigBee's wider range, it is still fairly limited and isn't the best choice for highly instrumented installations, like [industrial IoT](#) applications. And because of their mesh topologies, ZigBee networks have higher latencies, which can cause bottlenecks when multiple nodes try to pass through a single node to get to the gateway. Because of this, ZigBee doesn't shine when there's a high density of nodes (like in a factory, for example). ZigBee also faces a lot of challenges when link budget is highly variable, like mobile nodes or [parking sensors](#).

## ZIGBEE USE CASE

Consider this: You could interface a ZigBee system so when someone walks in their front door, ZigBee would run a whole series of events: turning on their favorite tunes, turning on the lights, turning up the heat, and more. When they leave, a ZigBee application could turn off the [HVAC system](#) to conserve energy and save money. Overall, it offers a practical use case for home automation.

# Comparison Chart: Bluetooth (BLE) Vs. ZigBee

	Bluetooth (BLE)	ZigBee
Network type	Personal area network (PAN), which supports few nodes	Local area network (LAN), which supports many nodes
Range*	77 meters	291 meters
Operating system	Android, iOS, Windows 8, OS X	Not currently compatible
Topology	Mesh and star	Mesh only
Throughput	270 kbps	250 kbps
Modulation	Frequency-hopping spread spectrum (FHSS)	Direct-sequence spread spectrum (DSSS)
Transmit power	10 mW	100 mW

\*This range comparison is based on a specific use case; see the full comparison with additional specifications [in this article](#).

## Takeaway

BLE and ZigBee are actually quite complimentary to each other. There are times someone would want to use BLE for IoT applications, and there are times when ZigBee is a better choice. Only in the last year have ZigBee and Bluetooth started to compete in this space. Some developers are finding that a combination of BLE and ZigBee can make for very strong personal and local area network devices.



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Before starting Link Labs, Brian led a team at the Johns Hopkins University Applied Physics Lab that solved communications and geolocation problems for the national intelligence community. He was also the VP of Engineering at the network security company, Lookingglass, and served for eight years as a submarine officer in the U.S. Navy. He graduated from the U.S. Naval Academy and received his Master's Degree from Oxford University.

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