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2022 REPORT

Everything you need to know to integrate a Bluetooth antenna solution

Partnership with

DigiKey

Contents

Introduction

Bluetooth is a wireless communication for data transfer via creating local area networks over short distances. It operates within the **2.4GHz frequency band**, striking a balance between short range and high data throughput. Since its introduction, it has become **one of the most used wireless technologies** for IoT applications due to its properties of low power consumption, multiple device connection, and low interference for short range connections.

Bluetooth Low Energy (BLE) is another wireless technology that offers improved efficiency features instead of a focus on throughput, providing better integration for small battery capacity devices. BLE specialises in data transfer with better power consumption and device efficiency, whereas standard Bluetooth is focused on throughput demanding applications such as audio. Understanding the features, applications and integration challenges of this wireless technology is vital in choosing the right antenna solution for your device.

Bluetooth features for wireless devices

Power efficiency

One of the features that is responsible for Bluetooth's widespread adoption for compact and short range IoT devices is due to its power efficiency. These devices often are battery powered, and as such require power optimizations throughout their design.

Bluetooth, and BLE in particular, use a range of methods to reduce its power consumption; modules remain in low-power states until there is a connection, and use efficient packet advertising to only process the amount of data needed for its application.

As a result, low power consuming devices using BLE can **function between 5-10 years on a small coin cell battery** depending on their specific application.

Low interference

Bluetooth shares the popular 2.4GHz frequency band with thousands of technologies including Wi-F, and as such can face significant interference amongst other wireless devices. Moreover, antennas in compact IoT devices can receive noise from other components that can interfere with wireless communications

Recent iterations of Bluetooth technology have implemented reliability features to minimise the impact of interference. Examples of these include **smaller packet sizes** and **Adaptive Frequency Hopping**; Bluetooth has significantly smaller packet sizes than other wireless communications, reducing the probability of signal collisions. Adaptive Frequency hopping also enables Bluetooth devices to identify specific channels with the least interference to communicate through.

Applications

Automative

Bluetooth has **become a cable replacement technology in the automotive industry** for years due to its use for hands free communications and audio connectivity.

- Bluetooth is being tested for use as a **digital key** for automotive designs thanks to its accurate locational properties.
- Bluetooth is used for hands-free communications in vehicles via connecting to mobile devices.
- Bluetooth is being trialled to enable portable devices to monitor specific vehicle **elements such as diagnostics, in-vehicle control and piloted parking.**

Smart homes

The network capabilities of Bluetooth Low Energy allows local networks to be created within homes using IoT devices.

- Bluetooth mesh acts as a decentralised network in smart home applications that allows individual IoT devices to communicate with one another, allowing a wider spread of IoT devices within a smart home without jeopardising connectivity.
- Context and orchestration is the result of Bluetooth devices communicating to perform set tasks depending on information, such as lights turning on after a door opens.
- Bluetooth enables device discovery within a local network using its precise locational properties.

Wearables

Alongside audio and accessory devices, wearables have used Bluetooth for most of their existence and are continuing to grow in demand.

- **Greater need for remote monitoring** in sports and fitness has put greater demand on the wireless capabilities of Bluetooth.
- Not only does Bluetooth extend the battery life of wearables to maintain monitoring for long periods of time, but it eliminates the possibility of interference affecting the results.
- Bluetooth wearables are also used in the medical sector for monitoring purposes, such as to detect irregular heartbeats in cardiovascular patients.

What are the integration challenges for Bluetooth antennas?

Placement

As the devices for Bluetooth are often compact, the size and placement of these antennas can become a significant integration challenge. In order to effectively radiate, these antennas need ample room; SMD antennas, for example, require a ground plane that is at least a quarter the size of the smallest wavelength it is transmitting. Because of this, antennas need to be placed at the corner of a PCB, away from noisy components such as switches with enough distance between itself and the product housing.

Interference

An integration challenge that is affected by placement and other factors is interference. Noisy and nearby components such as clocks and high-speed processors can affect the strength of the antenna signal, and as such can damage connectivity and efficiency. In order to combat interference, the antenna can be tuned and matched to the source impedance, which is a **service offered by Antenova**.

Power efficiency hurdles

Maintaining a good, reliable Bluetooth signal in noisy environments will inevitably use more power than devices operating in smaller, more controlled spaces. In addition, the volume and frequency of data transmitted will have a direct bearing on battery life. Antenna choice is a big variable in these factors that influence efficiency, and choosing the right one for the appropriate design is paramount to ensuring sufficient battery life.

What are the main types of Bluetooth antennas?

SMD

Surface mounted antennas (SMD) are a form of embedded antennas that is mounted directly onto the host PCB alongside other components. It is compact and allows for small designs, is easy/simple to integrate, but can cause efficiency issues if there isn't enough ground plane space.

FPC

Flexible printed circuit (FPC) antennas are malleable and have their own ground plane on the antenna along with an adhesive strip to be placed on the inside of the product housing. This solves ground plane and interference complications through being placed away from PCB components. However, they still require clearance requirements to radiate properly and are less effective for mass production when compared to SMD.

Trace Antennas

Trace antennas are integrated into the PCB board during the manufacturing process. As opposed to chip antennas, they are designed and integrated as a bespoke wireless solution for a device, and are one of the most common choices for Bluetooth devices. That said, there can be i**ssues that arise at the latter stages of development** with trace antennas, such as detuning and undetectability.

Applicable technologies and form factors

Cellular (3G, 4G), W-Fi/BT, NB-IoT
Wearable, handheld, automotive, industrial, smart-home

Browse our range of **FPC Antennas**, including our **flexiiANT** family

Browse our range of **SMD Antennas**, including our **flexiiANT** family

Browse our **TRACE Antennas**

Choosing the right Bluetooth antenna for your device

Understanding the various features and challenges of integrating Bluetooth technology into your device is vital in providing effective performance and connectivity whilst suiting the requirements of its design.

At Antenova, we offer a range of Bluetooth antennas to suit different devices and applications. Click **here** to browse our selection, or use our **integration hub** to help you discover the perfect antenna solution for your device.

Browse our range of **Terminal Antennas**

Bluetooth and Bluetooth Low Energy integration guide

Since its introduction, Bluetooth has become one of the most used wireless technologies for IoT applications due to its properties of low power consumption, multiple device connection, and resistance to interference for short range connections.

Understanding the features, applications and integration challenges of this wireless technology is vital in choosing the right antenna solution for your device.

In our latest whitepaper, you'll discover the various features of Bluetooth, examples of industry applications and the integration challenges when choosing the right antenna solution for your device.

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Download more Quick Guides and browse the full range of antennas at **antenova.com**