

The background features a blue sky with white clouds and orange arrows pointing right, set against a white ground line. The overall theme is connectivity and cloud services.

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Blecon

Bluetooth, meet the Cloud.

When you think about Bluetooth, it is consumer devices that immediately come to mind; headphones and smart wearables, wirelessly connected to a phone. But Bluetooth, and specifically Bluetooth Low Energy, has achieved such levels of technical capabilities and commercial success that it is now being used in ways most people wouldn't have ever imagined.

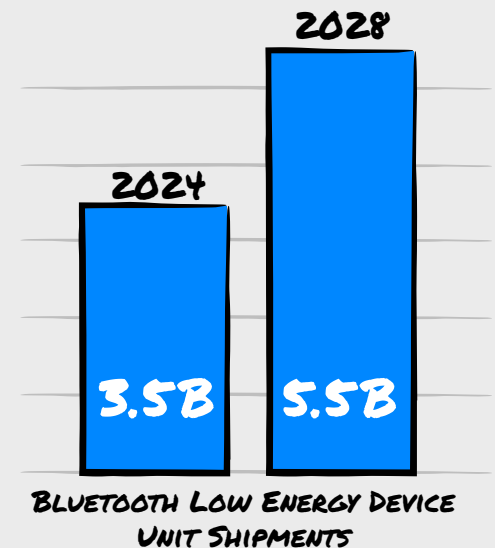
Here we pull back the curtain on Bluetooth Low Energy and why it is quietly becoming a low-cost, low-power IoT Connectivity of choice — hiding in plain sight.

A New Perspective on Bluetooth

In the rapidly evolving IoT landscape, numerous new wireless protocols vie for attention and adoption; NB-IoT, LTE-M, LoRa, Matter. Yet, Bluetooth can often remain in the shadows, primarily seen as a solution for personal cable-replacement use cases, limited to connections of a few metres and with a quirky pairing process.

However, with technical capabilities and a robustness relentlessly evolved over many years, combined with the commercial economies of scale and global adoption that the consumer market has blessed it with, Bluetooth finds itself becoming the pragmatic solution being applied to a wide and growing volume of IoT applications.

By 2028, 97 percent of all Bluetooth devices are expected to include Bluetooth Low Energy, with peripheral device shipments growing from 3.5 billion in 2024 to 5.5 billion in 2028¹.



¹ www.bluetooth.com/2024-market-update

Navigating IoT Connectivity

When assessing potential wireless technologies for IoT Connectivity, it is a balancing act between both technical and commercial compromises, challenges and strengths:

Range, Bandwidth, Latency: You want all three, but with many wireless IoT devices operating in cost or power constrained environments, compromises are inevitable.

Technology Maturity: Are the technologies established? Mature technologies will often benefit from highly integrated silicon and modules, along with comprehensive and robust software stacks; all reducing the risk of development and productisation.

Scalability: Building a small network of wireless nodes is relatively straightforward. But does the technology, economics and logistics scale to hundreds or more devices being deployed by customers across multiple sites?

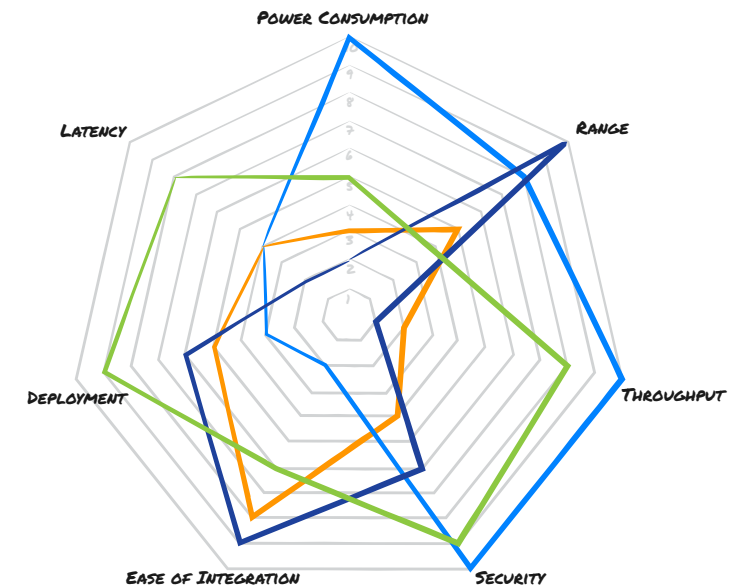
Deployment: Will you rely on existing wireless infrastructure, or will you need to create your own? How will you manage provisioning?

Over-the-Air (OTA) Updates: Low-bandwidth protocols are sufficient for basic data transfer and control, but do they provide enough bandwidth for full or partial firmware updates?

Security: Does the technology offer a robust path to ensure security, from establishing a wireless link to the device-to-cloud connection?

Worldwide Variation: Can the technology be deployed globally as a single SKU, with one software/hardware version? For example, LoRa operates in different frequency bands depending on the region.

Developer Knowledge: Are there enough skilled developers familiar with the chosen protocol to support your project?



Bluetooth Low Energy

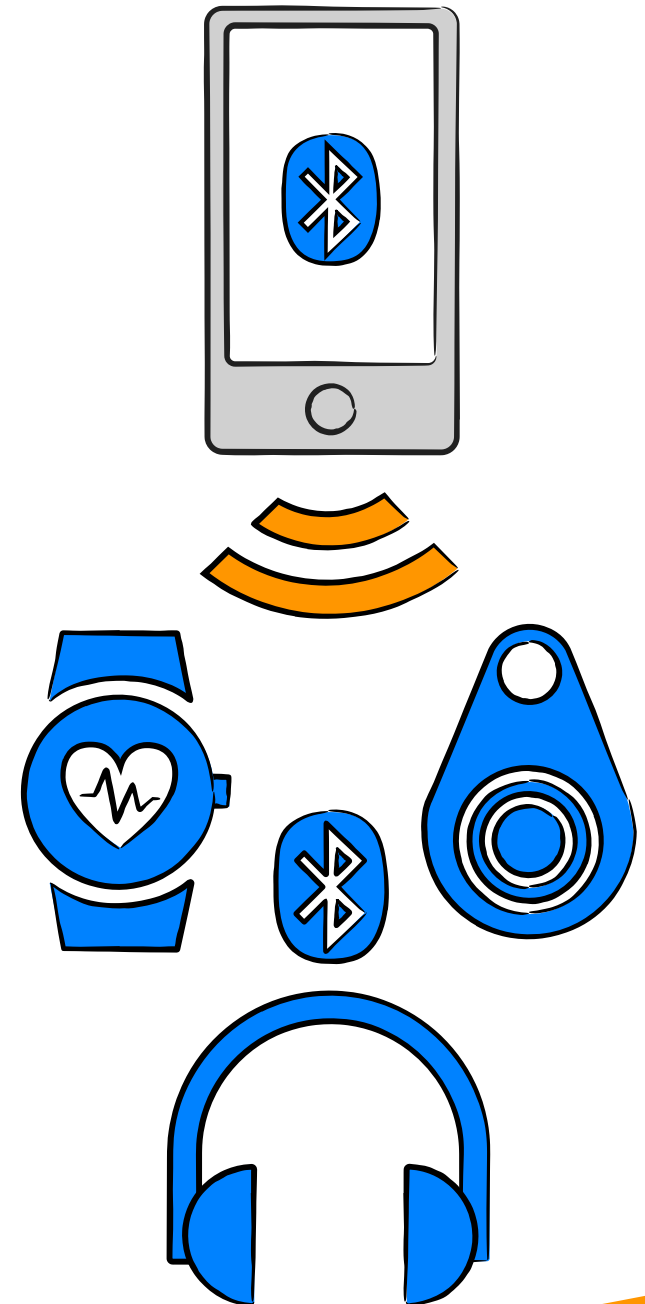
Driven by consumer audio and peripheral applications, Bluetooth has become a ubiquitous protocol, with over 5 billion Bluetooth-enabled devices deployed in 2023².

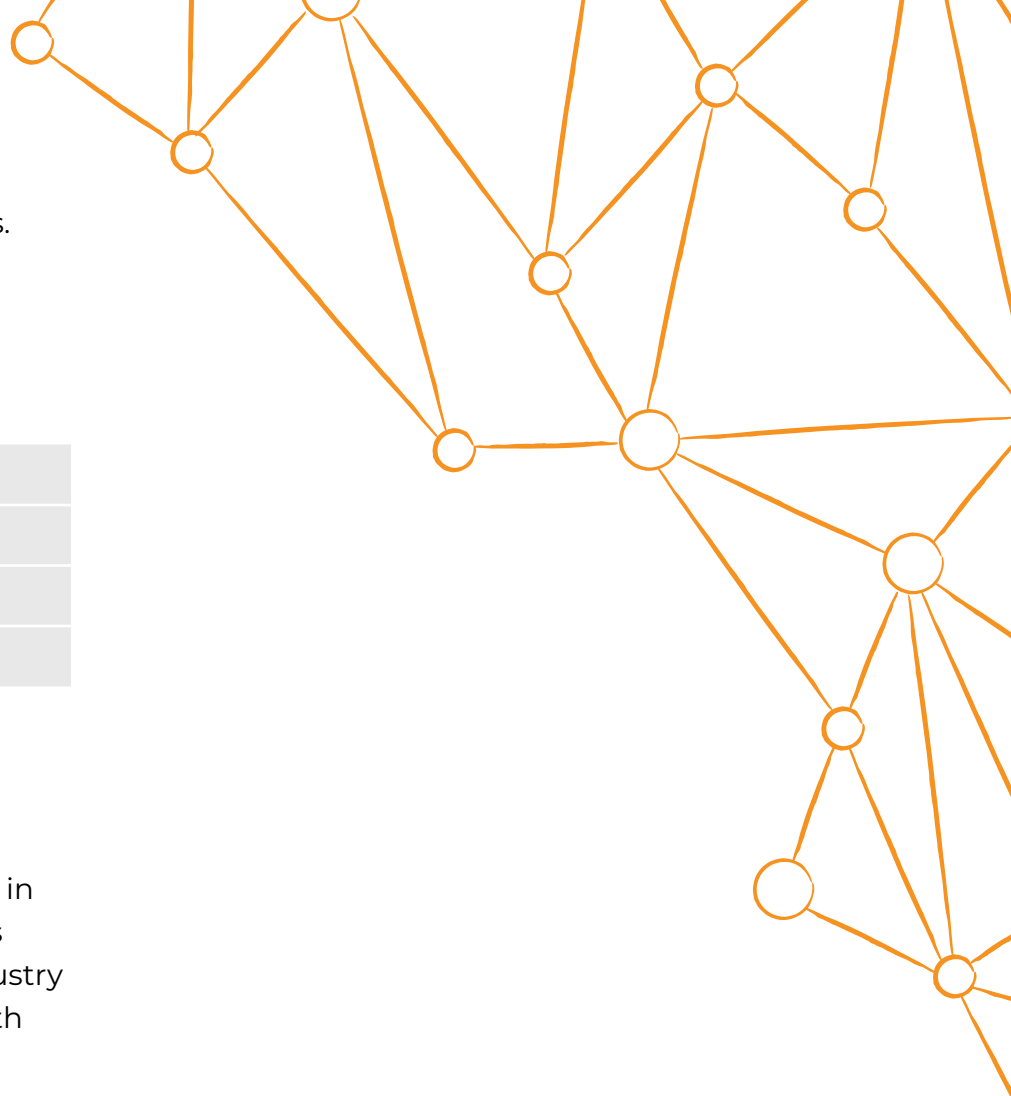
Global Deployment and Robust Performance

Bluetooth LE operates in the 2.4 GHz Industrial, Scientific, and Medical (ISM) band, allowing for global deployment without the need for regional product variants. This global operability simplifies logistics and reduces costs by eliminating the need for multiple SKUs. Bluetooth's error correction and adaptive frequency hopping mechanisms ensure robust performance, even in challenging industrial environments.

Mass Adoption

The Bluetooth stack, the software backbone of the protocol, is supported by all major operating systems, ensuring broad compatibility. Its integration into smartphones, tablets, and laptops makes for an enviable support base and ecosystem, combined with the economies of scale achieved.





Bandwidth and Range

The flexibility of Bluetooth LE is evident in its range of modulation schemes. The latest radios can achieve a maximum data rate of 1,400 kbps, ideal for Over-the-Air (OTA) updates. For applications requiring extended range, the data rate can be dropped as low as 100 kbps, allowing for coverage up to 400 metres indoors or up to 1,000 metres outdoors (free field).

Bluetooth LE PHY	LE 1M	LE Coded S=2	LE Coded S=8	LE 2M
Symbol Rate	1 Ms/s	1 Ms/s	1 Ms/s	2 Ms/s
Approx. Max. Data Rate	800 kbps	400 kbps	100 kbps	1,400 kbps
Range Multiplier	1	2	4	0.8

Source: Bluetooth SIG, Inc.

Beyond the Familiar

Bluetooth LE has evolved innovative features that mean it can be exploited in different ways. A good example is Bluetooth LE's advertising capabilities, as used by asset tracking beacons. This technology became so popular in industry that it was adapted for consumer devices like AirTags, showcasing Bluetooth LE's versatility and reliability.

It is time to consider Bluetooth LE not just as a point-to-point consumer solution, but as the basis for IoT Connectivity solutions.

Common Challenges for use in IoT Connectivity

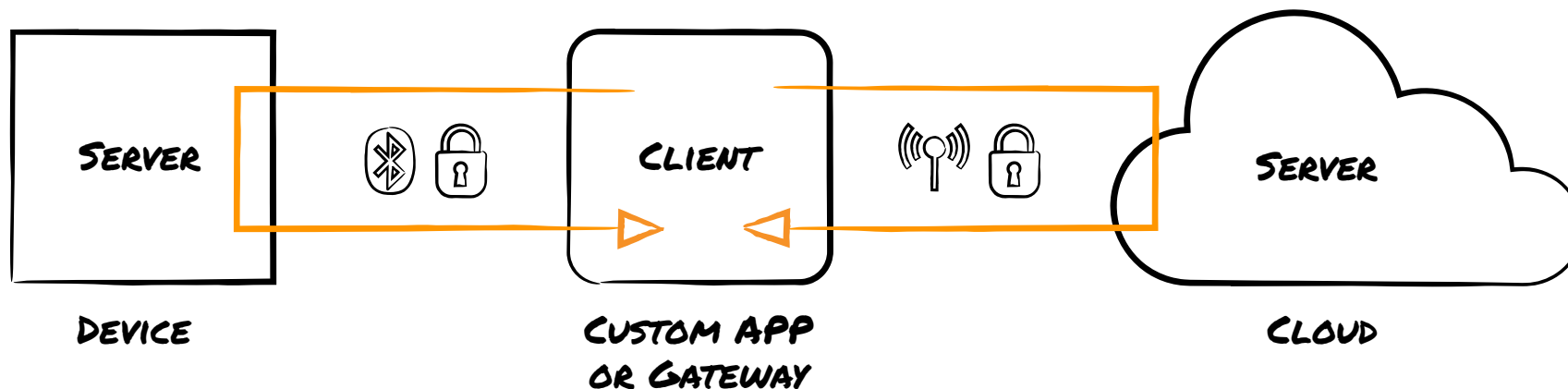
Despite its strengths, Bluetooth LE does face some challenges.

Device Pairing

Many users are familiar with the friction of establishing Bluetooth connections, which typically involves discovering devices and completing a pairing process that requires a user interface for PIN entry or confirmation.

Custom Gateways

Another challenge is cloud connectivity. Bluetooth-based sensors typically rely on a native app on the host device to relay data to the cloud. To circumvent this limitation, Bluetooth-based gateways can be developed to provide backhaul connectivity. However, these gateways need to be specifically tailored to your application domain, and the connection between device and gateway is lost when they are out of range, restricting network topology.

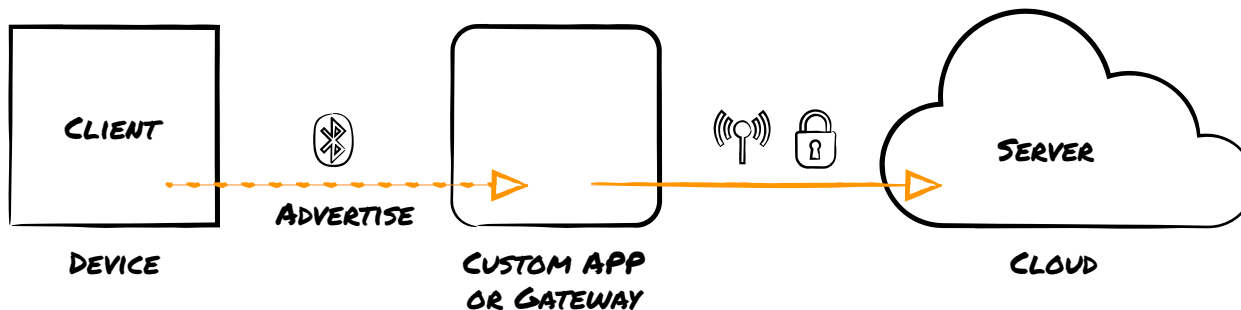


Does Beacon Functionality Offer a Solution?

One feature of Bluetooth that doesn't require establishing a secure wireless connection is advertising, which is used in beacon applications. Beacons have been widely adopted in large-scale deployments for asset tracking and location-based services. However, beacons communicate unidirectionally from the device to the smartphone, offering minimal security and limited data exchange.

Leveraging Bluetooth LE for IoT Connectivity

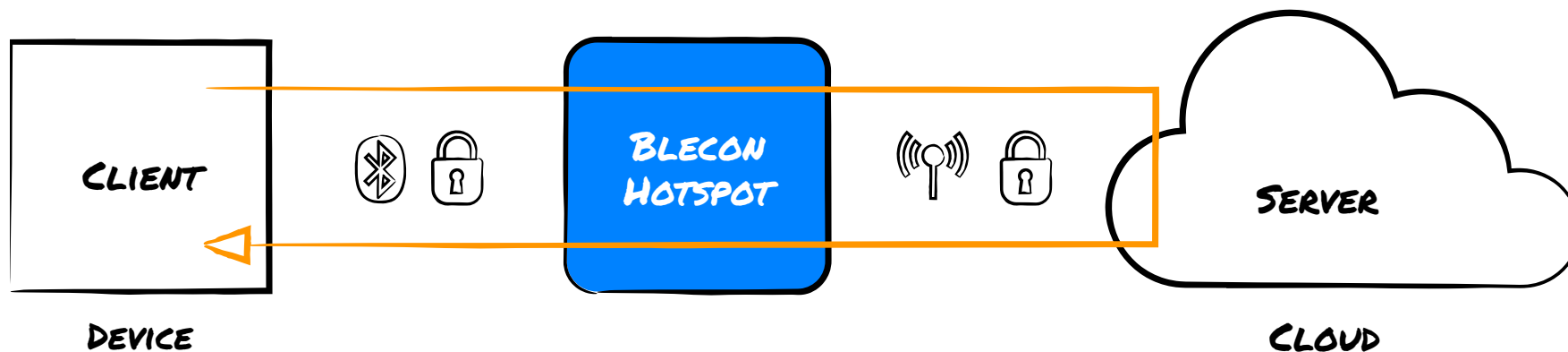
Despite the limitations, many development teams have successfully exploited these opportunities and have created bespoke Bluetooth-based networks that replicate the ease offered by cellular networks. This approach does work, but it requires significant effort to resolve the security, connection robustness, and scalability challenges. Whilst even building a proof-of-concept network is hard, developers often underestimate the effort required to productise and maintain an implementation.



The Blecon Approach to IoT Connectivity

Blecon's implementation starts by focusing on end-to-end security between your device and the cloud.

At the device level, an automatically generated universally unique identifier (UUID) allows for globally identifying a device, whilst an associated public/private keypair enables establishing a secure connection to the cloud without pairing. This enables a device to communicate securely with its cloud applications using Bluetooth Low Energy.



Seamless Connectivity with Blecon Hotspots

Devices using Blecon connect to cloud services through any nearby hotspot. These Blecon devices connect without pairing, and the hotspots are application agnostic, supporting any device-to-cloud application you develop.

The Blecon Hub, a hardware hotspot, can be installed wherever network coverage is needed, much like cellular base stations for smartphones.

Furthermore, internet-connected smartphones, tablets, and laptops can serve as hotspots by installing the Blecon App. This ensures extensive coverage across a site, as most businesses already have laptops and smartphones in place.

With end-to-end security already implemented, Bluetooth pairing is unnecessary, making Hotspots simple to deploy and immediately extending coverage.

Tailored Coverage for Your Needs

The extent of coverage required depends on your application. With Blecon Hotspots carried in employees' pockets, an IoT device can gather data and upload it whenever it comes within range. For applications needing immediate responses, dedicated Blecon Hubs can be strategically installed where your IoT devices operate.



Solving the IoT Connectivity Challenge with Blecon

Bluetooth shines brightly in the wireless world, but is often underestimated as merely a one-to-one consumer connectivity solution. However, its success thanks to consumer devices has made it a pragmatic solution for IoT Connectivity, bringing advantages in terms of cost, power and robustness.

The approach developed by Blecon helps leverage existing Bluetooth hardware and capitalises on the wide deployment of Bluetooth-enabled smartphones and laptops. Operating in the same frequency band worldwide, Blecon eliminates the need for multiple SKUs and regional firmware variations. Functioning like a global cellular network, Blecon uses any available Blecon Hotspot, bypassing the need for pairing and ensuring robust end-to-end security.

To learn more about Blecon, get started by creating an account, or contact us to discuss Blecon further, visit blecon.net

