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CENTRE FOR SKILL AND ENTREPRENEURSHIP DEVELOPMENT

IIOT3 – BLUETOOTH – USE CASES - APPLICATION

TECHNOLOGY PARTNER

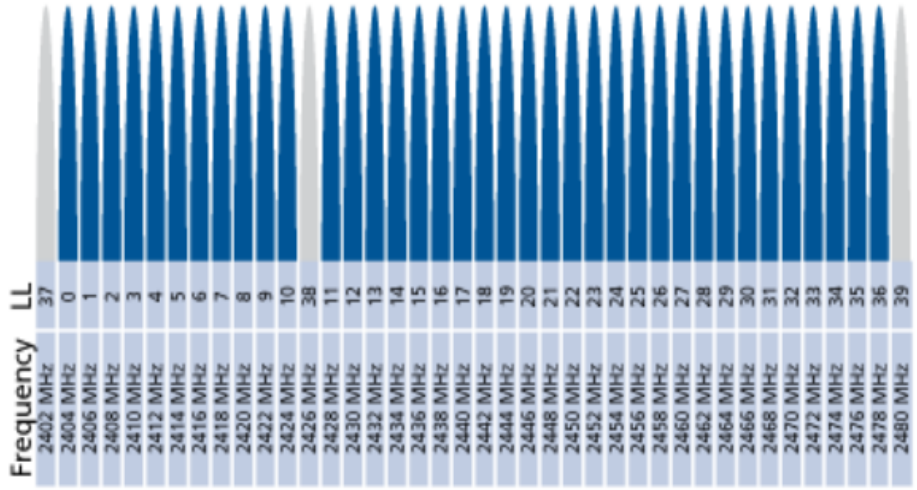
DASSAULT SYSTEMES ptc Mastercam

Bluetooth Use Cases

Radio

In the 2.4 GHz band, Bluetooth low energy uses 40 frequency channels instead of the 79 channels used in Classic Bluetooth

Many features of Classic Bluetooth are inherited in Bluetooth low energy, including Adaptive Frequency Hopping (AFH). These inherited features make Bluetooth low energy easy to set up and makes it robust and reliable in tough environments. To support simpler and cheaper radio chipsets, Bluetooth low energy uses 40 2 MHz wide channels while Classic Bluetooth uses 79 1 MHz channels.



Single-mode and dual-mode module and product examples

Bluetooth Smart Ready (dual-mode) devices include the dual-mode Bluetooth module OBS421 and smart phones. Bluetooth Smart (single-mode) devices include the Bluetooth low energy module OLS425 and temperature sensors.

Client and Server concept in Bluetooth low energy

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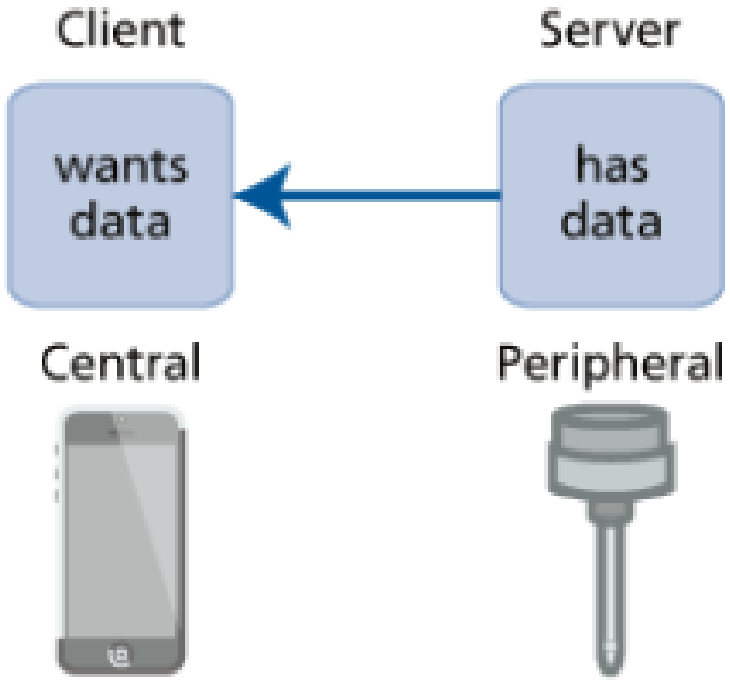
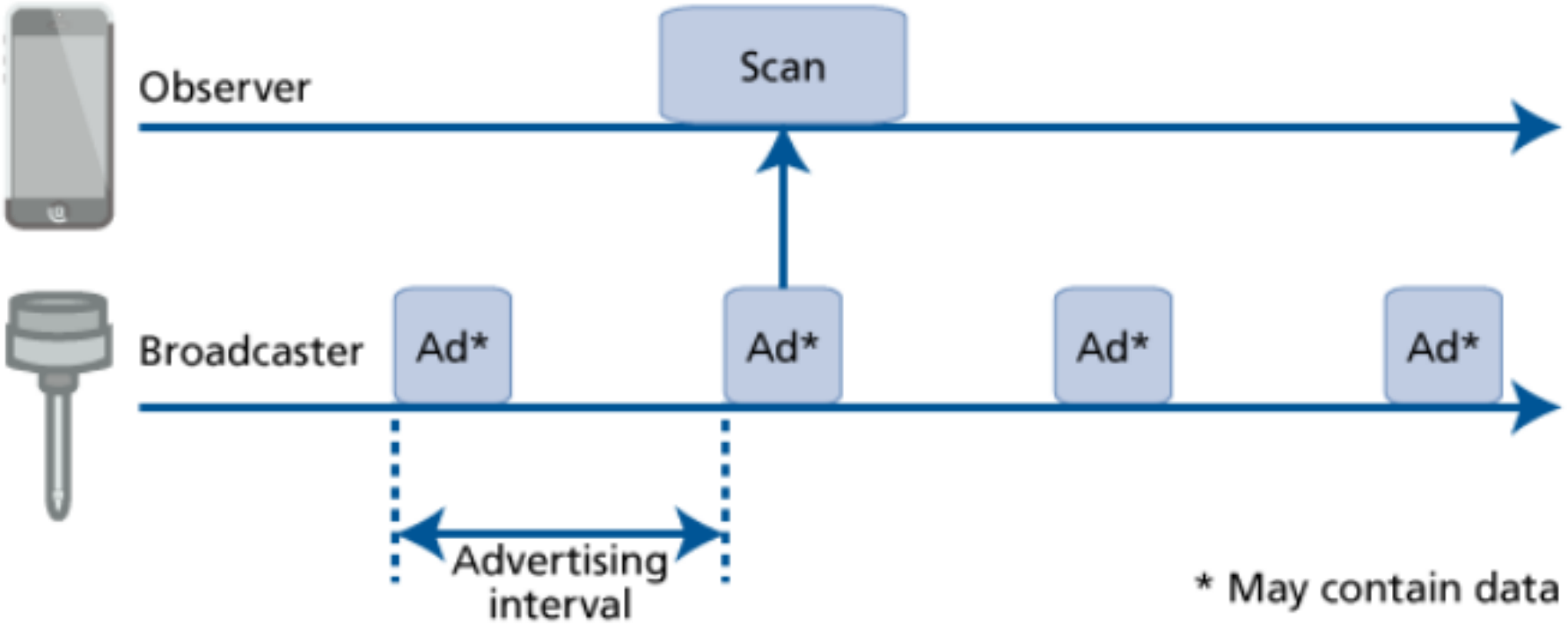


The Client / Server concept

Advertising" is how devices are found in Bluetooth low energy

Bluetooth low energy to keep the power consumption to a minimum. The slave device (now having the Broadcaster role) is "advertising" when he wants to connect. The Client is scanning for new devices (acting in the Observer role). When the Observer finds a device it wants to connect to, it initiates a connection. The advertisement may contain broadcasted data.



The advertising feature of Bluetooth low energy.

Bluetooth low energy software stack

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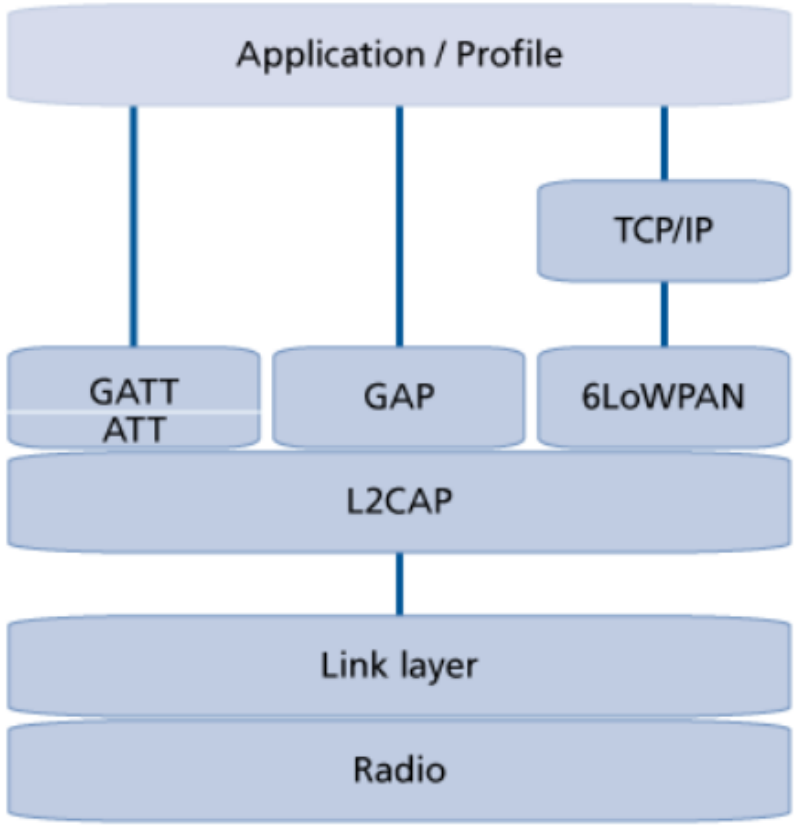

The Bluetooth low energy software stack

Internet of Things (IoT) overview with Bluetooth

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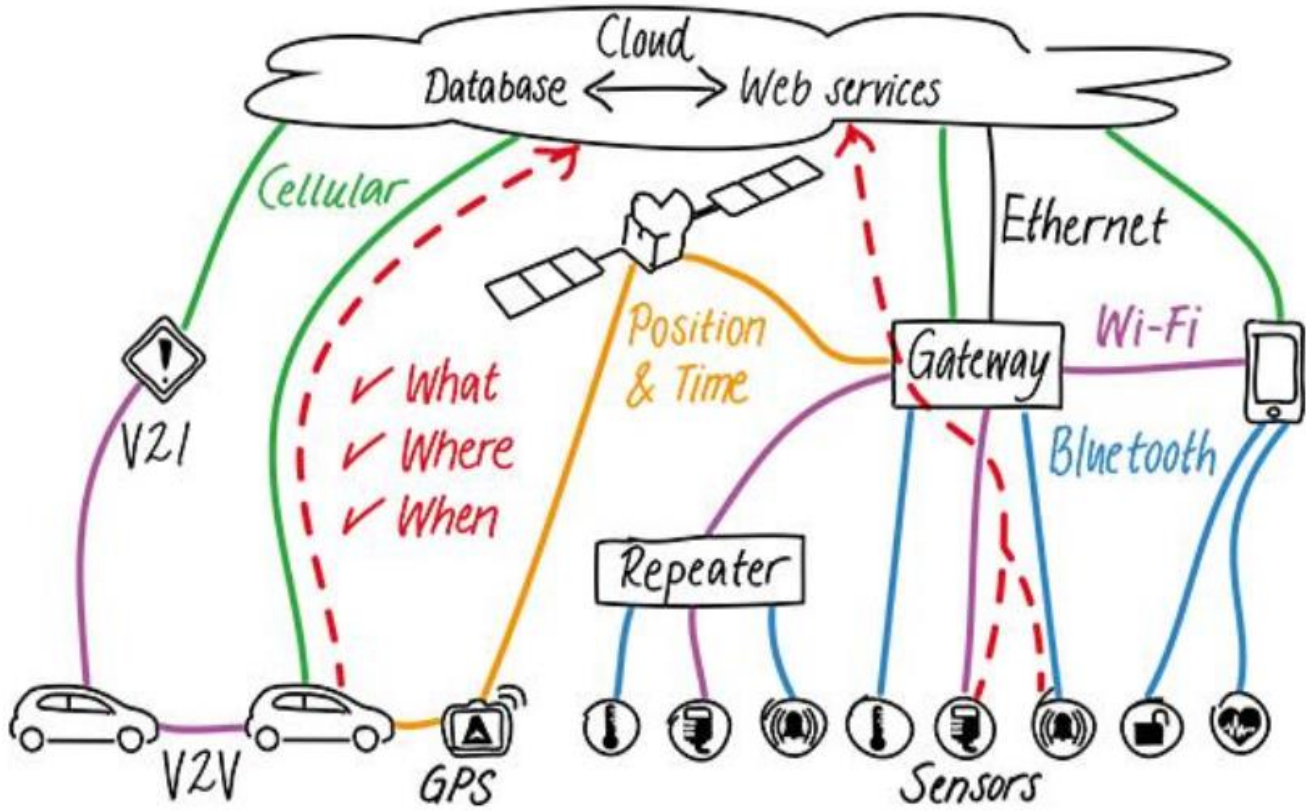
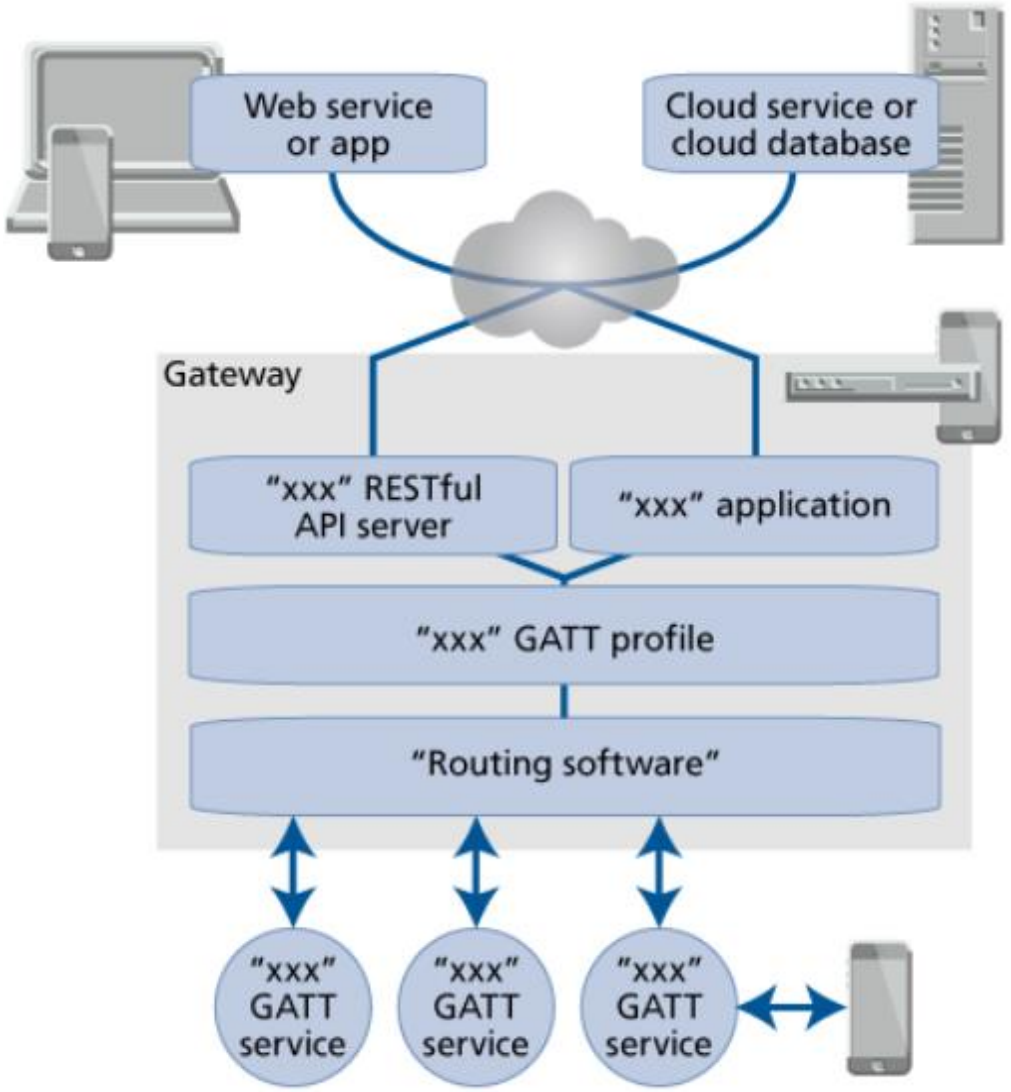


Internet of Things (IoT).

GATT-based device and service / profile-aware gateway

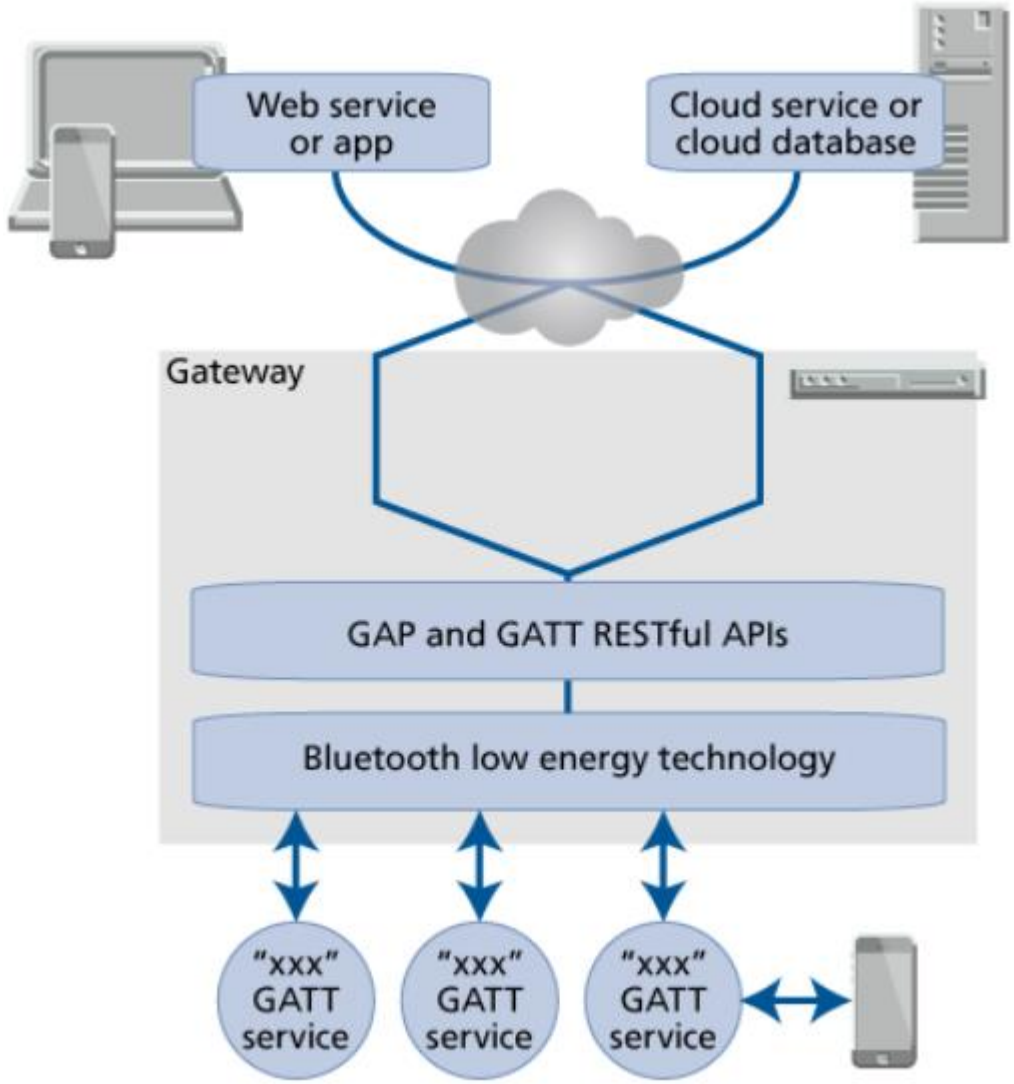
A portable device (e.g. a smartphone or tablet) may use its "xxx" -aware GATT app to access a Bluetooth low energy device directly or – when the network is connected – use an Internet - aware app to access the "xxx" RESTful API or data originating from the Bluetooth low energy device stored in the cloud service or cloud database.



GATT-based device and service / profile-aware gateway

GATT-based device and gateway using the GAP/GATT RESTful API

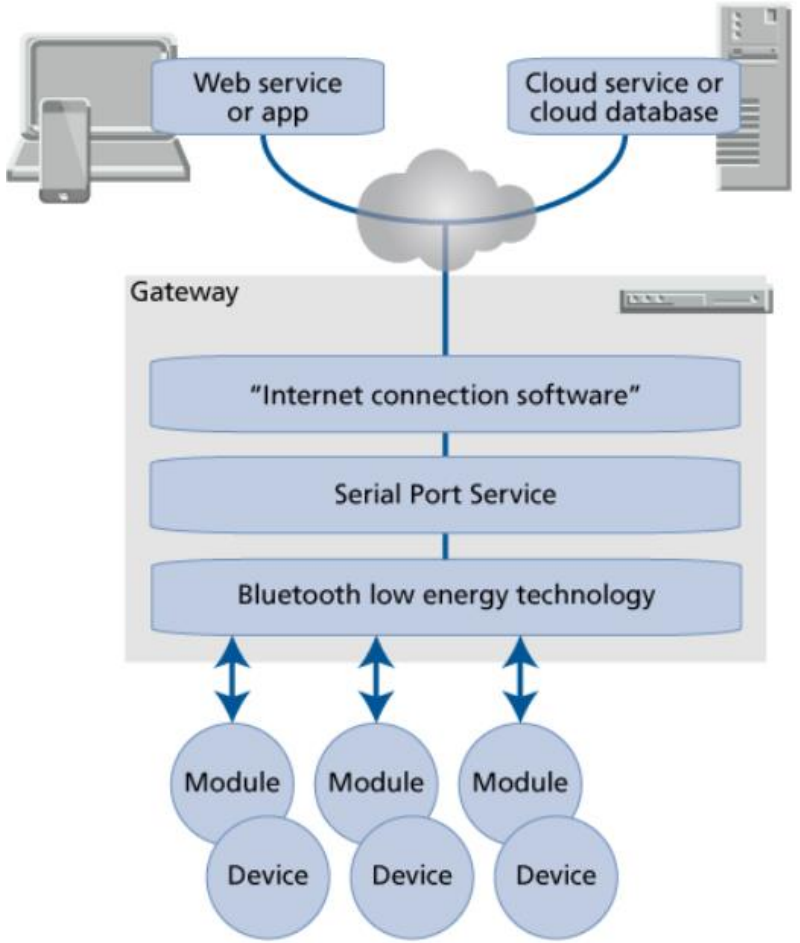
GAP/GATT RESTful APIs are generic methods used to access GATT-based Bluetooth low energy devices via the Internet. The APIs allow for both reading and writing of data as well as subscribing for indication or notification events (when the GATT-based service in the Bluetooth low energy device supports indications and notifications).



Gateway using GATT/GAP REST APIs.

Using the Serial Port Service

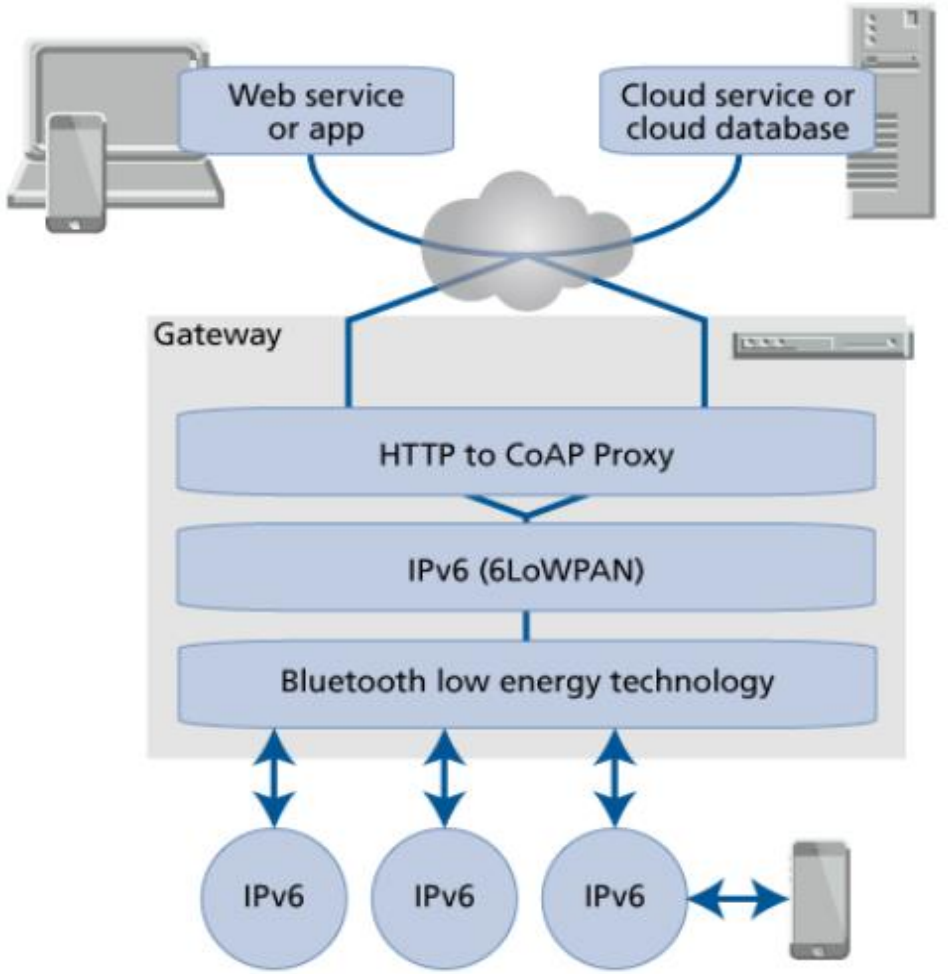
- An IP address and port are configured in the gateway and the data received from this port is sent to the device. Data received from the device is the configured IP address and port.
- An Internet service opens a WebSocket and the transparent data is transferred between the device and the WebSocket.
- The "Internet Connection Software" assumes that data received from the device is a TCP/IP command (such as an HTTP PUT or GET command). This scenario is similar to the Internet service described in a previous section.



GATT-based device and service / profile-aware gateway

IPv6 on Bluetooth low energy transport

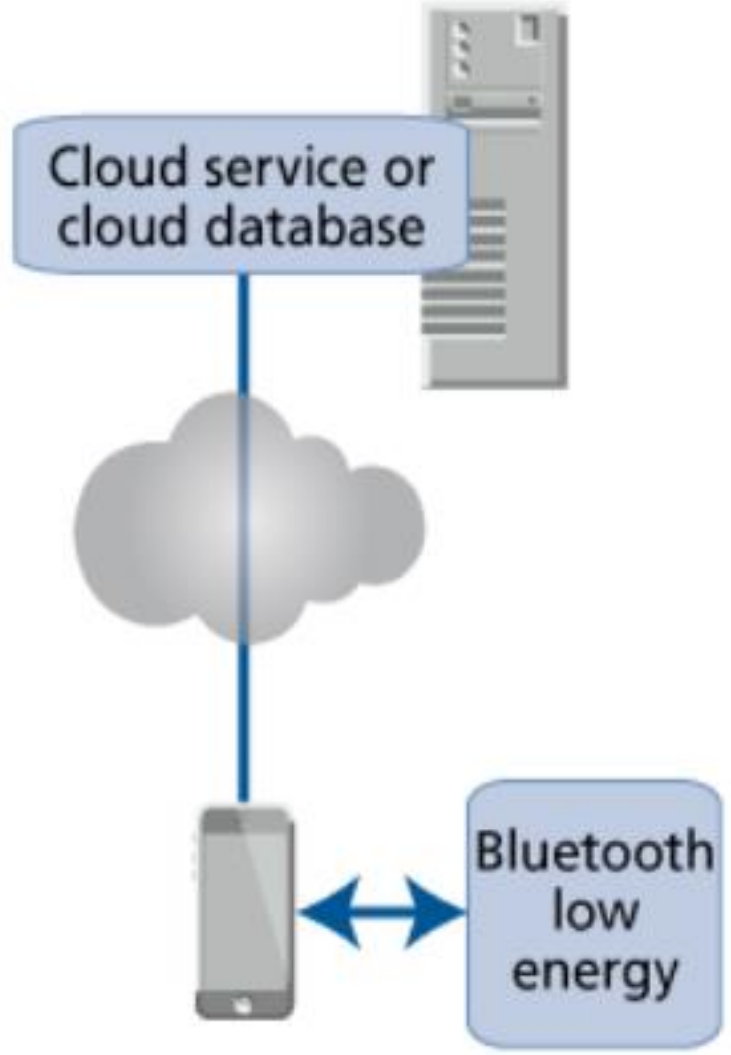
1. Typically CoAP is used as the method to send data to the gateway in order to minimize overhead. The gateway is completely unaware of the application and conversion takes place between CoAP and HTTP. There might also be use cases where HTTP is used all the way down to the device although this will be more resource consuming than CoAP.
2. This use case is flexible and can be used independently of the connected device type. In particular, this implementation is useful for devices that want to comply with an IP-based standard such as when devices using the Smart Energy 2.0 standard want to use Bluetooth low energy instead of 802.15.4 which is the current standard.



GATT-based device and service / profile-aware gateway

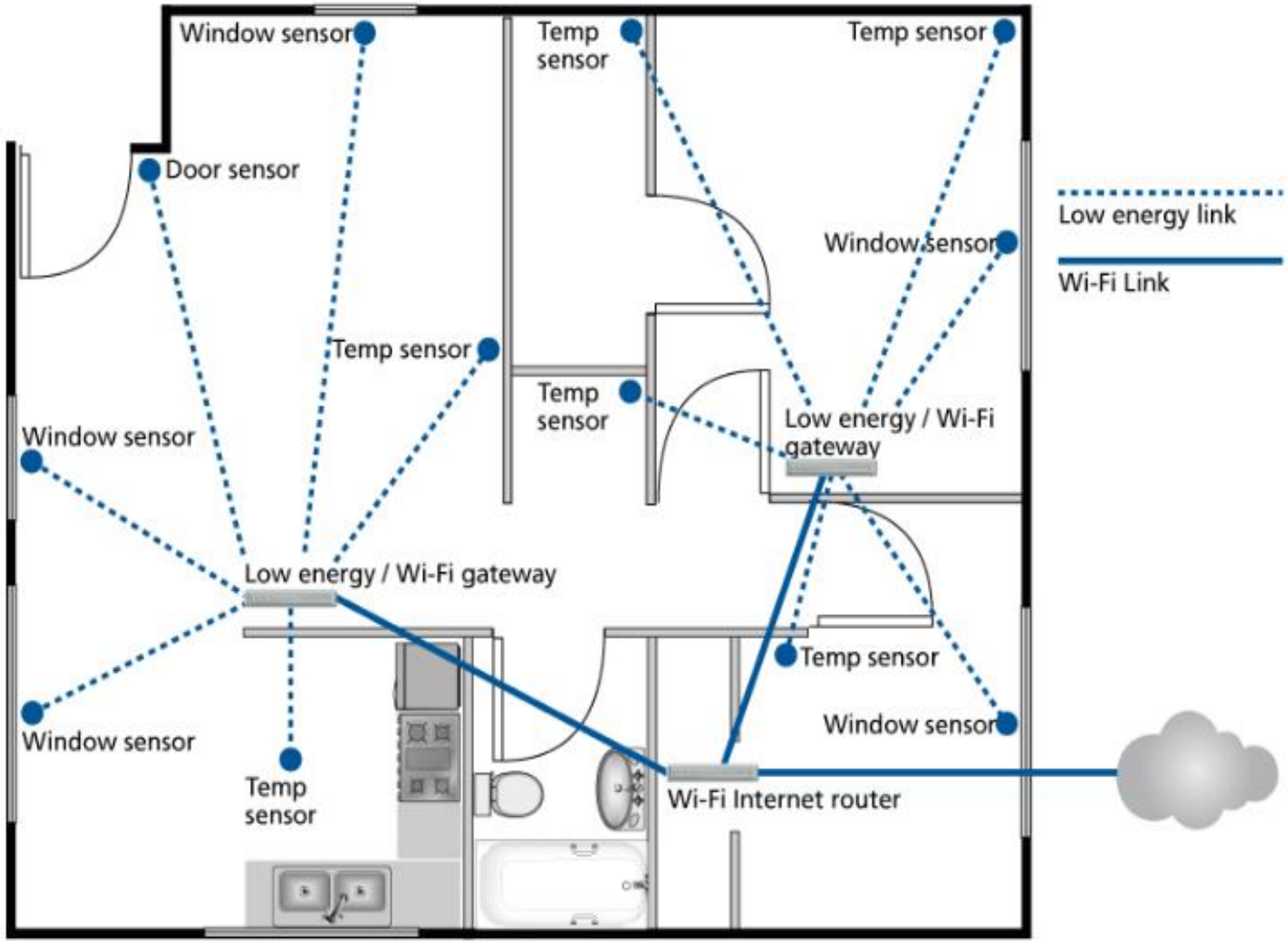
The use of a Smartphone as gateway

In several of the described use cases, a smartphone can act as a gateway and access the cloud through its GSM, 3G, 4G or Wi-Fi connection. The gateway can be a temporary installation such as when an app is running and accessing a certain Bluetooth low energy accessory. The gateway can also be more or less permanent such as when the smartphone is connected to a body-worn Bluetooth low energy sensor.



Extending the covered range with gateways

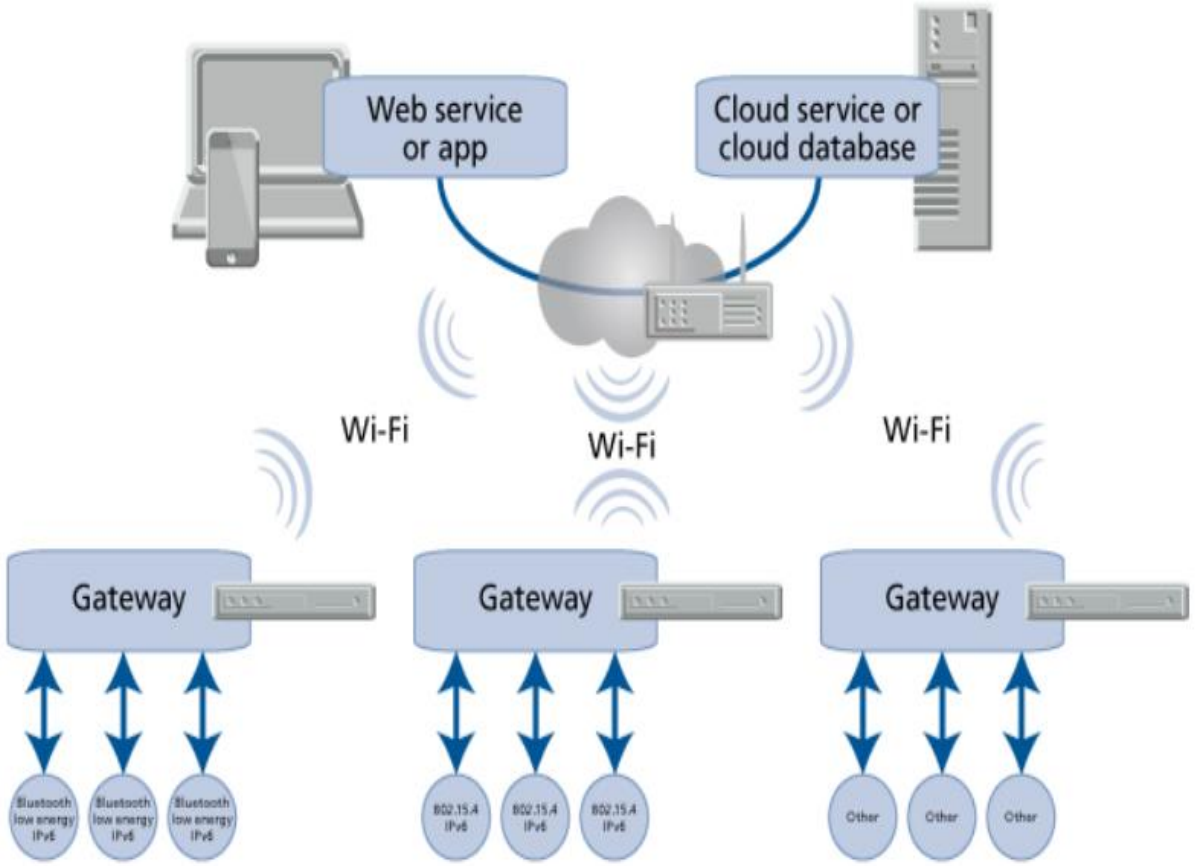
IoT applications, the range can become a limitation as Bluetooth low energy implements a star topology. Competing technologies using the 2.4 GHz ISM band (e.g. 802.15.4 based technologies) often support meshing and routers to extend the coverage; however, such solutions are currently not possible in Bluetooth low energy.



GATT-based device and service / profile-aware gateway

Gateways as range extenders

A possible solution to extend the wireless range by using interconnected gateways. The upstream link can be a cable (Ethernet) or a wireless link (Wi-Fi or Classic Bluetooth) and the downstream can be a Bluetooth low energy link. In the examples, Wi-Fi upstream links are used. Since the upstream connection in all the examples above is based on Internet protocols, the IP protocol contains all the necessary mechanisms to support traffic routing to cloud services and in some cases also between the local Bluetooth low energy devices (e.g. when IPv6 over Bluetooth low energy is used). In this scenario the gateway can be a small light-weight gateway consisting of a low-cost, low-power microcontroller (MCU) in combination with a multi radio solution(a radio chip with built-in support for Bluetooth, Bluetooth low energy and Wi-Fi). The gateway will thus be cost-efficient, physically small and consume a minimum of power



GATT-based device and service / profile-aware gateway

SECURITY

1. Security is always of great importance and so also in IoT scenarios. This white paper does not detail the security options; however, as a summary, the three main strategies that would apply are the following:
2. No security. This will only be used in very specific use cases where security is not required.
3. Link layer security between Bluetooth low energy devices as well as Internet security between the gateway and the Internet / cloud service.
4. Internet security end-to-end. This is valid for the IPv6 use case only.

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THANK YOU

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AND
FOCUSED