Demo: Open Gateway Architecture for the Internet of Things

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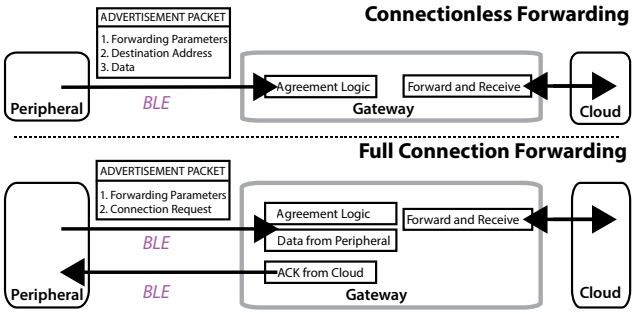

Figure 1: Gateway protocol for BLE devices.

1. INTRODUCTION

Internet connectivity is essential for most mobile applications today. The standardization and pervasiveness of Wi-Fi and cellular networks enables these applications for laptops, smartphones, and tablets and has driven their success. However, the emerging class of BLE based low-power devices such as smart watches, personal health monitors, and embedded sensors, does not enjoy the same level of connectivity. Application specific gateways, both on smartphones and in hardware, and explicit device pairing are the norm today. We propose a new, open gateway architecture based on BLE that allows low-power devices to leverage any smartphone or standalone gateway to communicate with the Internet. Similar to Wi-Fi routers, this open gateway design provides a transparent communication channel for this emerging device class.

2. GATEWAY DESIGN

Our gateway design provides low-power mobile, wearable, and embedded devices with an application-agnostic connection to the Internet by adding an open gateway layer on top of the Bluetooth Low Energy (BLE) protocol. We describe this design in detail within our co-located paper [1].

Our gateway protocol supports two modes of interaction between the BLE device and the gateway: connectionless- and profile-forwarding, as shown in Figure 1. The first, connectionless, allows for very brief communication windows with very small payloads (eight bytes) and is optimized for extremely low energy operation. All forwarding parameters and data are encoded in a single BLE advertisement packet. The BLE device wishing to transmit to the Internet broadcasts a single packet that any gateway can receive, process, and forward to the correct destination. This method effectively represents the minimum requirements for offloading and forwarding data via BLE.

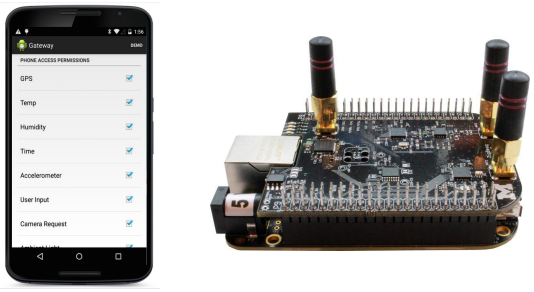

Figure 2: Android and Generic Access Point gateways.

The second mode, profile-forwarding, uses BLE connections to allow gateways to forward the device's BLE profile to a specified host on the Internet. Devices announce that they have a profile to forward by sending a special advertisement packet containing information about the reliability they need the gateway to offer, any incentive (financial or otherwise) they can offer the gateway, and expected data sizes the gateway would have to forward. This information allows the gateway, particularly smartphone gateways, to decide whether to forward data for the device. If the gateway decides to forward, it initiates a connection with the device, learns the destination and transport protocol from attributes in the profile, and transmits the BLE profile presented by the device.

3. GATEWAY IMPLEMENTATION

We have two gateway implementations: an Android app and a standalone gateway device (called GAP) based on the BeagleBone Black platform, shown in Figure 2. The Android app allows any smartphone to act as a gateway and GAP is the Wi-Fi router analog for low-power devices.

4. DEMONSTRATION

We will show a real-time visualization of data passing from multiple BLE devices through our gateways using both connectionless- and profile-forwarding. Each gateway will be able to simultaneously support multiple data streams and will append data, like time or location, to the stream if requested. Additionally, we will provide a GUI to construct arbitrary packets conforming to our protocol to then be forwarded and visualized. Our demo will require power.

5. REFERENCES

[1] T. Zachariah, N. Klugman, B. Campbell, J. Adkins, N. Jackson, and P. Dutta. The internet of things has a gateway problem. HotMobile '15. ACM, February 2015.