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Transmission of IPv6 Packets over Bluetooth Low Energy
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Abstract

Bluetooth low energy is a low power air interface technology that is defined by the bluetooth SIG. The standard bluetooth radio has been widely implemented and available in mobile phones, notebook computers, audio headsets and many other devices. The low power version of bluetooth is a new specification and enables the use of this air interface with devices such as sensors, smart meters, applicances, etc. There is an added value in the ability to communicate with sensors over IPv6. This document describes how IPv6 is transported over bluetooth low energy using 6LoWPAN techniques.

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1. Introduction

Bluetooth Low Energy (BT-LE) is a radio technology targeted for devices that operate with coin cell batteries, which means that low power consumption is essential. BT-LE can also be integrated into existing Bluetooth (BT) devices so that devices such as mobile phones and PCs can operate with existing BT accessories as well as BT-LE accessories. An example of a use case for BT-LE accessory is a heart rate monitor that sends data via the mobile phone to a server on the Internet. BT-LE is designed for transferring small amount of data (in most cases less than 10bytes) less frequently (e.g. every 500ms) at modest data rates (e.g. 300kbps). BT-LE enables low cost sensors to send their data over the Internet via a gateway such as a mobile phone. BT-LE is especially attractive technology for Internet of Things applications, such as health monitors, environmental sensing and proximity applications.

Considering the expected explosion in the number of sensors, IPv6 is an ideal protocol due to the large address space it provides. This document describes how IPv6 is used on Bluetooth Low Energy links in a power efficient manner along with efficient application protocols that enable the integration of BT-LE devices into services.

[RFC4944] specifies the transmission of IPv6 over IEEE 802.15.4. The bluetooth low energy link in many respects has similar characteristics to that of IEEE 802.15.4. Many of the mechanisms defined in [RFC4944] can be applied to the transmission of IPv6 on bluetooth low energy links. This document specifies the details of IPv6 transmission over blue-tooth low energy links.

1.1. Requirements Language

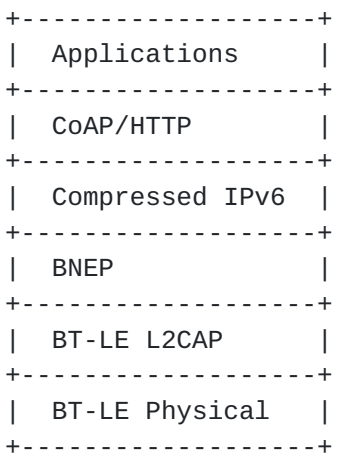
The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

2. Bluetooth Low Energy protocol stack

The Bluetooth Network Encapsulation Protocol (BNEP) has been developed for encapsulating any network protocol for Bluetooth Logical Link Control and Adaptation Protocol(L2CAP). BNEP assumes that L2CAP supports connection oriented channel. A connection oriented channel needs to be added to the current BT-LE specification, over which BNEP, parts of 6LoWPAN, IPv6 and application protocols can be run. Figure 1 illustrates IPv6 over BT-LE stack.

Constrained Application Protocol (CoAP) is an application protocol specifically designed for resource constrained environments. CoAP could be run on top of IPv6 supporting requests from the server and requests of cached replies from a CoAP/HTTP proxy in the BT-LE gateway.

BT-LE technology sets limitations to protocol overhead such as header sizes.



IPv6 over BT-LE stack

3. IPv6 profile for BT-LE

3.1. Base specifications

A BT-LE needs to support following specifications in order to support IPv6:

1. Transmission of IPv6 Packets over IEEE 802.15.4 Networks [RFC4994]

2. Compression Format for IPv6 Datagrams in Low Power and Lossy Networks (6LoWPAN) [I-D.ietf-6lowpan-hc]

3. Neighbor Discovery Optimization for Low-power and Lossy Networks [I-D.ietf-6lowpan-hc]

3.2. BT-LE specific properties

3.2.1. Header Compression

In BT-LE link with header compression IPv6 header (originally 40 Bytes) can be compressed to only 2 Bytes with link-local addresses

and 26 Bytes with Global addresses. UDP header (originally 8 Bytes) can be compressed to 4 Bytes.

4. Additional contributors

Kanji Kerai and Jari Mutikainen from Nokia have contributed significantly to this document.

5. IANA Considerations

This document does not have any IANA requests at this time. This may change with further development of the specification.

6. Security Considerations

The transmission of IPv6 over bluetooth low energy links has similar requirements and concerns for security as zigbee. Security at the IP layer needs to be reviewed as part of the development of the IPv6 over bluetooth low energy specification.

7. Normative References

[I-D.ietf-6lowpan-hc]
Hui, J. and P. Thubert, "Compression Format for IPv6 Datagrams in Low Power and Lossy Networks (6LoWPAN)", draft-ietf-6lowpan-hc-15 (work in progress), February 2011.

[I-D.ietf-6lowpan-nd]
Shelby, Z., Chakrabarti, S., and E. Nordmark, "Neighbor Discovery Optimization for Low-power and Lossy Networks", draft-ietf-6lowpan-nd-15 (work in progress), December 2010.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4944] Montenegro, G., Kushalnagar, N., Hui, J., and D. Culler, "Transmission of IPv6 Packets over IEEE 802.15.4 Networks", RFC 4944, September 2007.

[RFC4994] Zeng, S., Volz, B., Kinnear, K., and J. Brzozowski, "DHCPv6 Relay Agent Echo Request Option", RFC 4994, September 2007.

Appendix A. Bluetooth Low energy basics

This section will provide background material on the basics of bluetooth low energy.

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