Zürcher Hochschule für Angewandte Wissenschaften
School of Engineering

Bidirectional Communication for Bluetooth Low Energy without establishing a connection

This paper discusses different concepts and ideas for implementing a bidirectional communication for Bluetooth low energy devices without establishing a connection. Some of these possibilities were tested on their feasibility in an experimental set-up. Other ideas exist only theoretically and are associated with high energy consumption or slow transmission rates. Nevertheless, there is a desire for a simple bidirectional communication using the advertising mode for certain applications.

Introduction

The Bluetooth SIG pursues a different goal by implementing Bluetooth Low Energy (BLE). Compared with the older Bluetooth standard new main focus is on ultra-low power consumption instead of enhanced data rates. This allows for many sensors and gadgets to communicate with the environment by running with a small battery.

By using BLE there are several possibilities to communicate with other devices. Besides entering a connection, it is also possible to broadcast data (also known as advertising data). Advertising is a unidirectional communication. In this mode a beacon transmits its measurements over the air without knowing whether someone is listening to it or not.

Concepts for a bidirectional communication in advertising mode

In many cases a peripheral device advertises its data without having a feedback from any central device if the data was received. Therefore the implementation of such a device is very cheap, energy efficient and easy to build. Nevertheless receiving a few bits in advertising mode would bring remarkable benefits. For exchanging a few bits a connection is not an appropriate solution because of the higher energy consumption and the more complex need of a Bluetooth stack. For this reason several ideas were developed.

Scan request and scan response as feedback channel

This concept describes the use of a scan request and a scan response for a bidirectional communication.

Role reversal of central and peripheral

By changing the roles for synchronized times during operation, a bidirectional communication path is implemented in advertising mode.

Envelope detection

Measuring the received signals on the antenna is used for enabling a feedback channel.

Connection Request

By omitting a connection response a bidirectional communication is possible.

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