ANR026

All about Beacons of Proteus-I, -II and -III

Version 1.2

July 19, 2023

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Revision history

Manual version	Notes	Date
1.0	• Initial version	August 2021
1.1	• Added introduction chapter	January 2022
1.2	• Updated `Important notes`, meta data and document style	July 2023

Contents

1 Introduction

Bluetooth® LE is a connection oriented radio standard that allows data transmission between several entities in a client server architecture. Besides this common way of data transmission, so called Bluetooth® LE beacons can be used for connectionless broadcast data transmission. This document answers the questions what Bluetooth® LE beacons are, and how a Proteus-I, -II and -III radio module can be used to transmit and receive Würth Elektronik eiSos specific beacons.

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2 Beacons - What is it?

One of the main states of a Bluetooth® LE peripheral device is the so called advertising, where it periodically transmits its advertising information on three different advertising radio channels to offer a Bluetooth® LE connection to a central device.

This advertising information is inserted into two radio packets. First the advertising packet, that is sent each advertising interval, and the scan response packet, that is only sent if a central device reacts on the advertising packet with a scan request. The advertising interval can be chosen between 20 ms and 10.24 s.
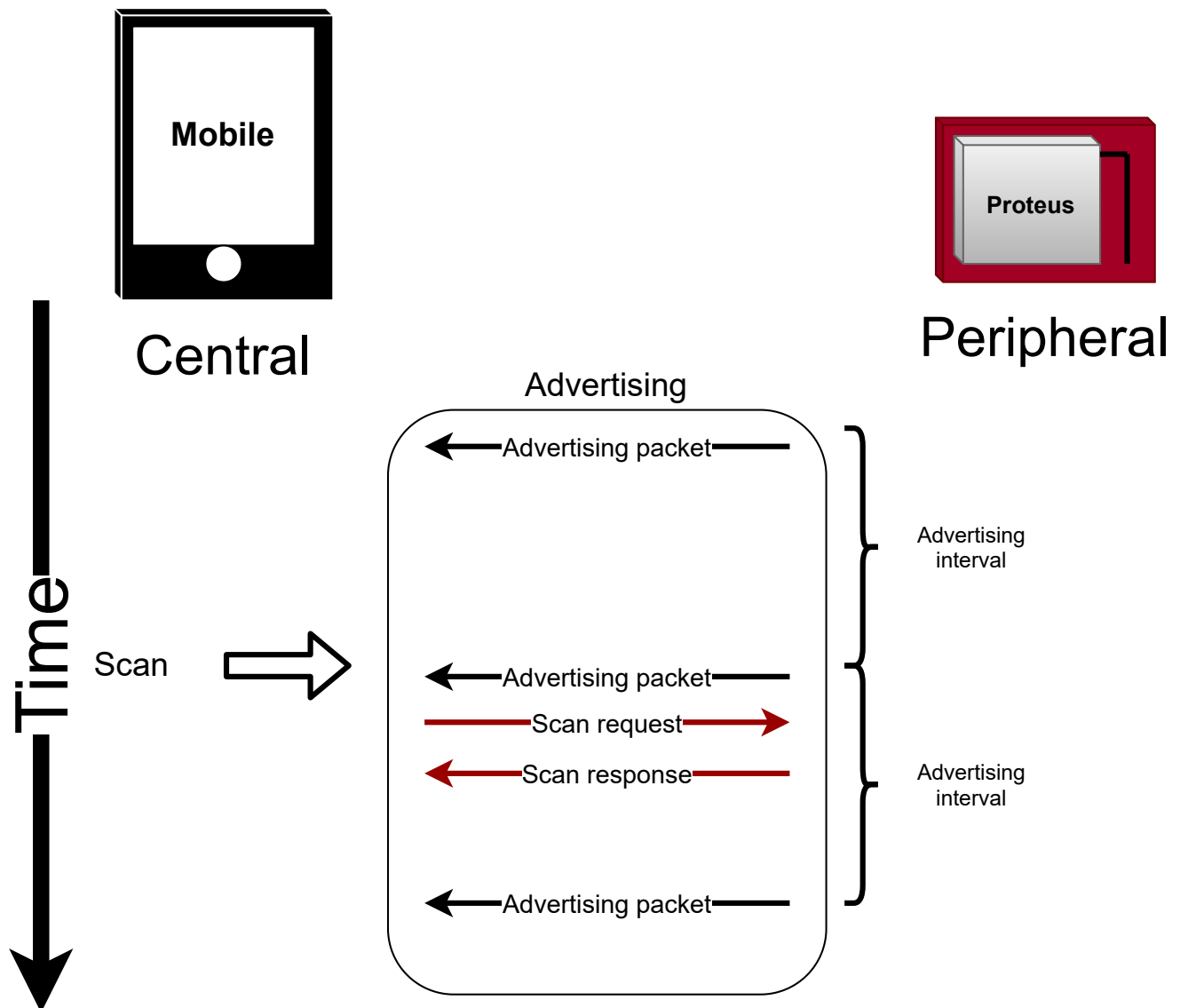

Figure 1: Advertising

In case a peripheral device is sending beacons with custom data, this data is placed in the advertising and/or scan response packet, and thus sent periodically to all scanning Bluetooth® LE devices in range.

2.1 Beacon format

The format of beacon data can be distinguished between standard beacon formats, like Eddystone (Google [1]) or iBeacon (Apple [2]), and custom beacon formats.
The Proteus series uses a custom format, that allows to use the beacon function and the remaining radio functions, like connection oriented data transmission, at the same time.
The data of the Proteus beacons is placed in the "manufacturer data" field of the scan response packet. This data is prepended by the header byte 0x01, that identifies the data as payload data, and the company identifier 0x031A of Würth Elektronik eiSos.

Length	ID	Company identifier (LSB first)	Header	Payload (MSB first)
1 Byte	0xFF	0x1A 0x03	0x01	up to 19 Bytes

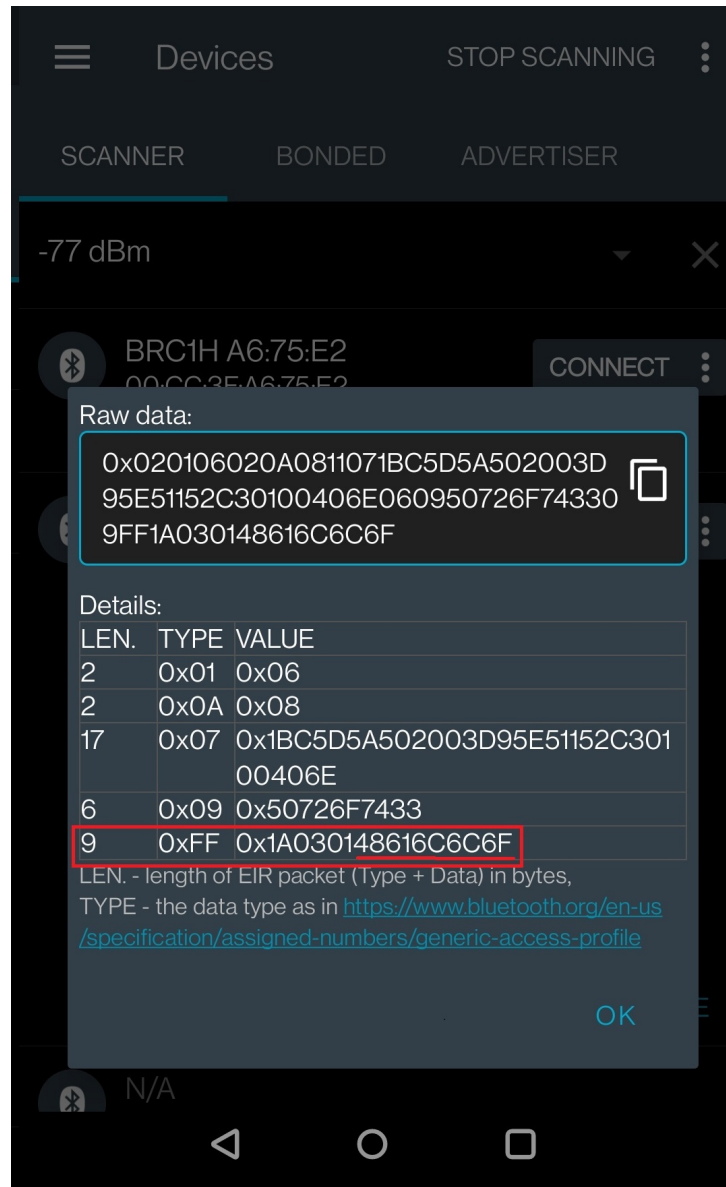Table 1: Raw Proteus beacon format in scan response packet

Figure 2: Example: The payload is "Hallo" (0x48616C6C6F)

3 Examples

3.1 Transmitting beacons with a Proteus radio module

To transmit beacons using a Proteus radio module, the command `CMD_SETBEACON_REQ` can be used. The user data of up to 19 bytes must be placed in the Payload field of the `CMD_SETBEACON_REQ` command.
Format:

Start signal	Command	Length	Payload	CS
0x02	0x0C	2 Bytes	Length Bytes	1 Byte

Response (`CMD_SETBEACON_CNF`):

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Start signal	Command | 0x40	Length	Status	CS
0x02	0x4C	0x01 0x00	1 Byte	1 Byte

Status:

0x00: Request received, will place data now

0x01: Operation failed

0xFF: Operation not permitted

> The below commands are in hexadecimal notation. The arrow in the left column describes, whether it's a message from host to radio module, or vice versa. A request command is always sent from host to module ($\Rightarrow$). An indication, confirmation or response message is always sent from module to host ($\Leftarrow$).

Example:

Info	Module
$\Leftarrow$ Reset the module using */RESET* pin, `CMD_GETSTATE_CNF`	02 41 02 00 01 01 41
$\Rightarrow$ `CMD_SETBEACON_REQ`, content "Hallo"	02 0C 05 00 48 61 6C 6C 6F 4D
$\Leftarrow$ `CMD_SETBEACON_CNF`, status success	02 4C 01 00 00 4F

3.2 Receiving beacons with a Proteus radio module

To receive beacons with the Proteus radio module, the user setting `RF_BeaconFlags` must be modified first to enable this feature. Then a scan must be done to receive the beacons via radio (see example below).

> Please note, that in general only beacon data is received, that matches the beacon format of the Proteus radio module. Other beacons, like Eddystone or iBeacons are rejected. Proteus-III has the option to receive all kind of beacons, if the user setting `RF_BeaconFlags` has been set to 0x02.

> The below commands are in hexadecimal notation. The arrow in the left column describes, whether it's a message from host to radio module, or vice versa. A request command is always sent from host to module ($\Rightarrow$). An indication, confirmation or response message is always sent from module to host ($\Leftarrow$).

Example:

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Info	Module
⇐ Reset the module using */RESET* pin, `CMD_GETSTATE_CNF`	02 41 02 00 01 01 41
⇒ Configure `RF_BeaconFlags` using `CMD_SET_REQ` to "beacon rx enabled, no filter"	02 11 02 00 0E 01 1E
⇐ `CMD_SET_CNF`, status success	02 51 01 00 00 52
⇐ Module reset such that the change in the user setting takes effect (`CMD_GETSTATE_CNF`)	02 41 02 00 01 01 41
⇒ Activate scanning on module	02 09 00 00 0B
⇐ Response `CMD_SCANSTART_CNF`	02 49 01 00 00 4A
⇐ receiving multiple `CMD_BEACON_IND`, in case another device is transmitting beacons of the right format. In this example the payload is "Hallo" (0x48616C6C6F)	02 8C 0C 00 02 00 00 DA 18 00 B5 48 61 6C 6C 6F B1 02 8C 0C 00 02 00 00 DA 18 00 B1 48 61 6C 6C 6F B5
⋮	⋮
⇒ Deactivate scanning on module, `CMD_SCANSTOP_REQ`	02 0A 00 00 08
⇐ Response `CMD_SCANSTOP_CNF`	02 4A 01 00 00 49

3.3 Receiving beacons with the Nordic "nRF Connect for Mobile" app

To receive the Proteus beacons with the nRF Connect [3] [4] app perform the following steps:

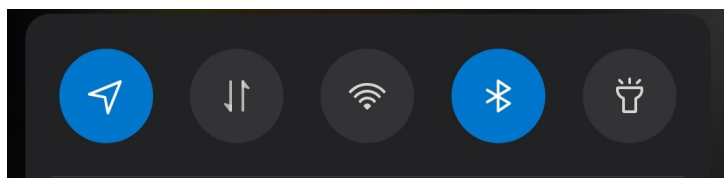1. Enable the Bluetooth® LE feature and location services on the smart phone.

Figure 3: Enable Bluetooth and the location services

2. Open the nRFConnect app and press "SCAN".

3. As soon as the Proteus appears in the scan list, unfold that entry by selecting it. Be sure that you do not press "CONNECT".

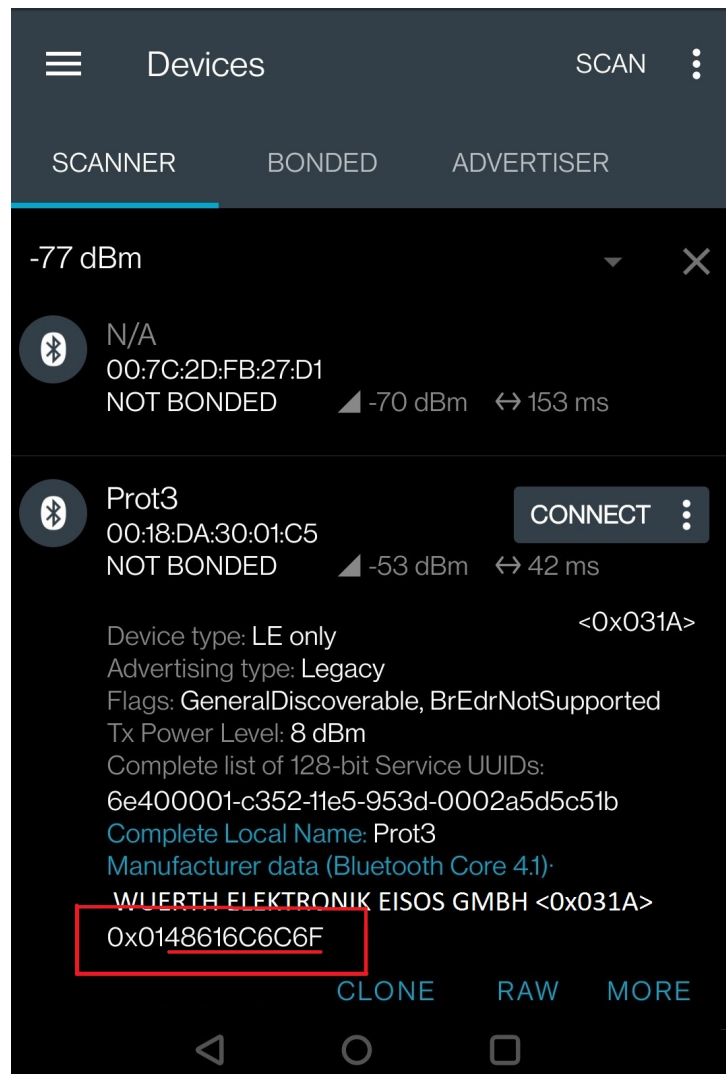4. In case the Proteus sends beacon data, find it in the "Manufacturer data" field.

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Figure 4: Example: The payload is "Hallo" (0x48616C6C6F)

4 References

[1] Eddystone Beacon. `https://en.wikipedia.org/wiki/Eddystone_(Google)`.

[2] iBeacon. `https://en.wikipedia.org/wiki/IBeacon`.

[3] Nordic Semiconductor. nRF Connect app for Android. `https://play.google.com/store/apps/details?id=no.nordicsemi.android.mcp`.

[4] Nordic Semiconductor. nRF Connect app for iOS. `https://apps.apple.com/us/app/nrf-connect-for-mobile/id1054362403`.

5 Important notes

The Application Note and its containing information ("Information") is based on Würth Elektronik eiSos GmbH & Co. KG and its subsidiaries and affiliates ("WE eiSos") knowledge and experience of typical requirements concerning these areas. It serves as general guidance and shall not be construed as a commitment for the suitability for customer applications by WE eiSos. While WE eiSos has used reasonable efforts to ensure the accuracy of the Information, WE eiSos does not guarantee that the Information is error-free, nor makes any other representation, warranty or guarantee that the Information is completely accurate or up-to-date. The Information is subject to change without notice. To the extent permitted by law, the Information shall not be reproduced or copied without WE eiSos' prior written permission. In any case, the Information, in full or in parts, may not be altered, falsified or distorted nor be used for any unauthorized purpose.

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