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RSL10 Demo Application Note - Beacons based on Eddystone™

APPLICATION NOTE

What is Eddystone?

Eddystone is an open Bluetooth® Smart beacon format from Google which quickly deploys real−world context to users. These beacons can be used to mark important places and objects. Typically, a beacon is visible to a user's device from a range of a few meters, allowing for highly context−sensitive use cases. They can be deployed at fixed places such as airports, museums, and bus stops, and attached to movable objects such as bicycles, kiosks, and taxis [1]. Furthermore, beacons based on Eddystone are capable of working across Android and iOS devices. Several different types of payload can be included in the frame format [2]:

- **Eddystone–UID:** A unique, static ID with a 10–byte Namespace component and a 6–byte Instance component.
- **Eddystone–URL:** A compressed URL that, once parsed and decompressed, is directly usable by the client.
- **Eddystone–TLM:** Beacon status data that is useful for beacon fleet maintenance.
- **Eddystone–EID:** A time−varying beacon frame that can be resolved to a stable identifier by a linked resolver.

The protocol specification is available at

https://github.com/google/eddystone/blob/master/protocol–specification.md

Format of an Eddystone Beacon

Beacons are based on advertising packets and in order to support Eddystone they need to be formatted to the specified guidelines. An advertising package consists of a maximum of 31 Byte. In case of Eddystone the packet should be structured as following [3]:
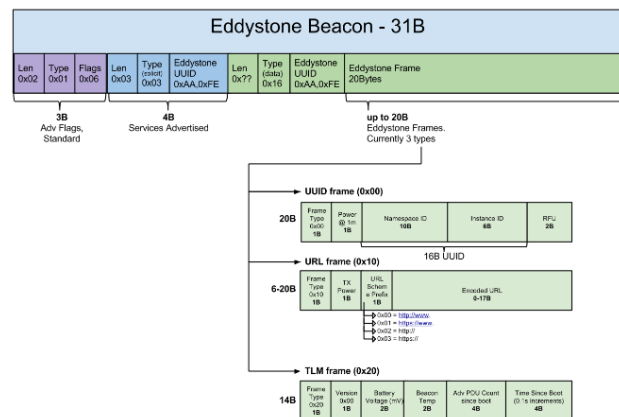
The first 3 bytes are standard advertising flags, followed by 4 bytes which indicate the type of the service. The next two bytes specify the length of the remaining packet as well as the data type. This is followed by the Eddystone Service UUID (0xFEAA) which is then included two times in the advertising package. This allows background scanning on iOS devices. The frame type is encoded in the first four bits of the first octet in the Service Data [4]. Possible values are:

Frame Type	First 4 Bits	Byte Value
UUID	0000	0x00
URL	0001	0x10
TLM	0010	0x20
EID	0011	0x30
RESERVED	0100	0x40

The four low−order bits are reserved for future use and must be 0000. The next field determines the transmitted power at one meter distance. The transmit power is further used for accurate proximity estimation. The remaining 18 Bytes of the payload include the encoded URL link. Note that the beginning of the URL (http, https, www…) is encoded as shown in the previous figure.

**Implementation of Eddystone Beacons on the RSL10 SoC**

To modify and configure the beacon settings of the RSL10 evaluation board you need the following:

- RSL10 Evaluation Board
- Standalone Flash Loader
- Google Beaconfig APK file
- Android Smartphone

To load the RSL10 Evaluation Board with Eddystone code, please flash the hex file onto the RSL10 Board using the Standalone Flash Loader which is provided in the RSL10 Development Environment. The software can be downloaded from the official RSL10 website: http://www.onsemi.com/PowerSolutions/product.do?id=RSL10. In the download folder extract the *RSL10_Utility_Apps* folder and execute the *RSL10_StandAlone_Flash_Loader* file. Make sure you have the newest JLink drivers:

(https://www.segger.com/downloads/jlink)

installed on your PC. The flash process should look like following:
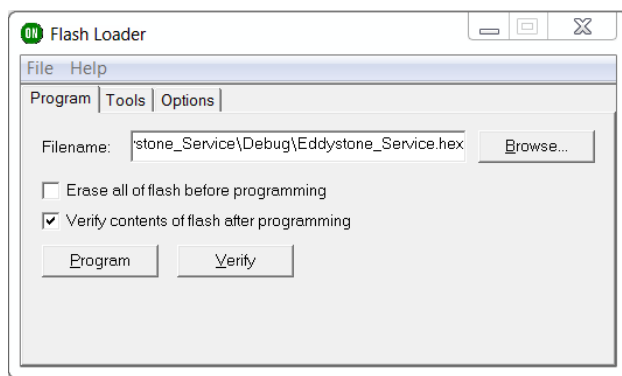
Select the *Beacon_Service.hex* file and click *Program*. If the process is successful, the LED on the RSL10 should start blinking and the RSL10 transmits the standard Eddystone URL Beacon. This default beacon is a redirection to the link with official RLS10 YouTube video. The actual link to the Youtube video

https://www.youtube.com/watch?v=BzwWLrSTJ8Q

is too long to be packed into the payload of the advertising package, it needs to be shortened. Therefore any URL shortening service is sufficient. In this case the goog.gl service was used and the resulting short URL which links to the video is:

https://goo.gl/MJW6V5

To configure the Beacon Settings with your phone, you first need to install the APK file on your smartphone. To allow third party app installation on Android phones please go to *Settings−>Security* and enable *"Unknown Sources"*.

Afterwards copy the APK file onto your phone and install the application by executing the APK file in your smartphone file browser.

After starting the Beaconfig application you should see the default beacon advertising. The Beacon is locked with an initial 128 bit lock key :

$$\text{0xFF 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF}$$
$$\text{0xFF 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF}$$

When you connect to the beacon, the Beaconfig application automatically tries two different standard lock keys, the one stated above and one key only consisting of zeros. Therefore, in default settings, it is possible to connect to the beacon without entering a password. If password security is preferred, the password can be changed to your personal one after you are connected to the beacon. All Bluetooth read and write processes are encrypted with an AES128 encryption, which means unless someone knows the 128 bit key, the beacon settings cannot be changed.
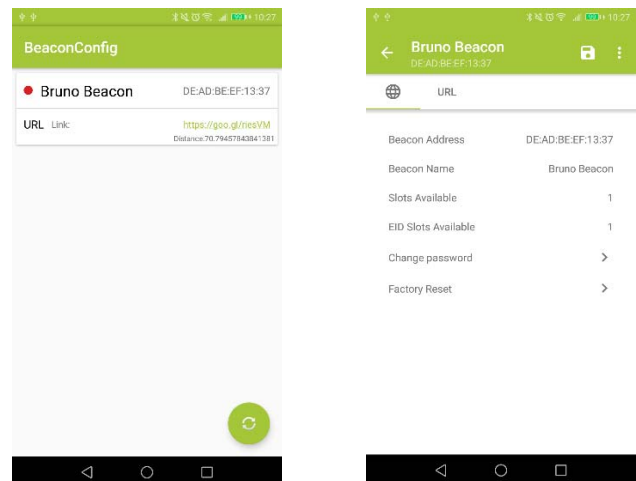
In the current implementation, the password, advertising interval and advertising power are able to be changed. By pressing the URL tab, the URL address of the Eddystone beacons can be adjusted (TLM, UID and EID frames are not supported so far). Due to the Beacon specifications the length of the URLs has to be 18 bytes or less. If your desired URL is longer please use an URL Shortener (like goo.gl). After you made all changes, disconnect from the beacon, so that the advertising process can start again with modified settings. This can be done by pressing the save icon first and then the "<−"−icon in the top left corner of the application. Once the Evaluation Board is in advertising mode, the LED starts blinking. Only in the advertising mode, beacons can be received by the smartphone.

Receive Eddystone–URL on Android Phones

To use the Physical Web (including the Eddystone – URL) the following requirements need to be met:

- Android phone or tablet with version 4.3.2 and up
- Bluetooth and Location (GPS) turned on
- Internet connection enabled (Wi–Fi or cellular)
- Location permission for Chrome (on Android 6.0 and up). Please turn on "Location services" on your smart device.

When a Physical Web object is in the close vicinity, the Android phone should list notification. Please tap on the link associated with the notification to resolve the linked webpage.

To get the RSL10 Eddystone notification into your smartphone please power up the demo evaluation board. The notification on your smartphone should look like following:
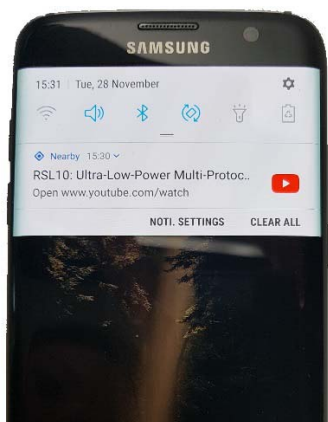
Once the notification is tapped, the user is directed to the RSL10 Youtube video within the Chrome browser.

See Eddystone–URL in Google Nearby

Another way to access the beacons is by going into the **Nearby** section of your phone. Please select **Settings –> Google –> Nearby**. From this section it is possible to see and interact with all devices that support beacons in the proximity of the smartphone or tablet.
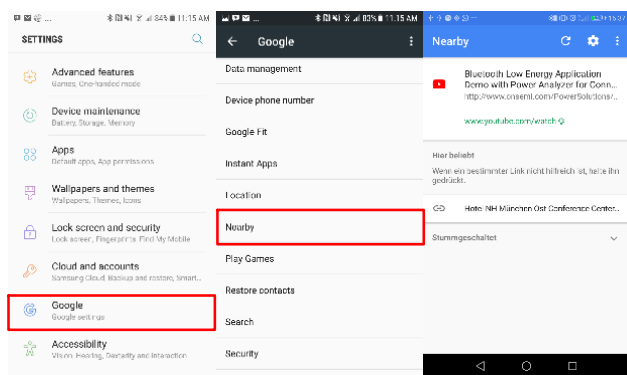

Current consumption and Lifespan of Beacon Demo

The RSL10 in the beacon mode is continually advertising. Hence, the current consumption is mainly dependent on the selected advertising intervals. For a complete advertising event with a 24–byte payload (Transmit power 0dBm), the RSL10 will consume approximately 700 µA for a duration of 7 ms. The remaining time the application is in Sleep Mode which means it is not transmitting or receiving data. In this state the current consumption is 40 nA. The current consumption was measured using a standard 3 Volt V 2032 coin cell battery [5].

For an advertising interval of 700 ms and a battery capacity of 250 mAh, the RSL10 radio SoC can be powered during more than 3 years.

Jumper Configuration – USB and Coin Cell Operation

To operate the beacon demo with USB power supply, make sure that the jumpers are set as following:
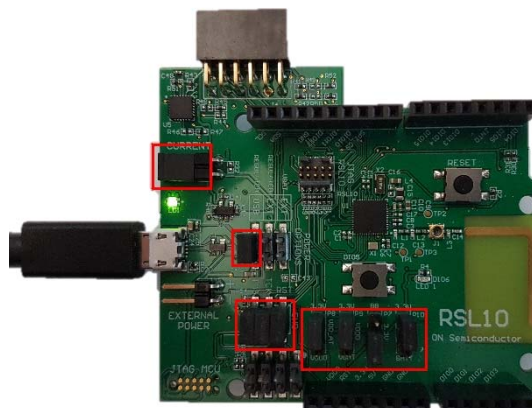
To operate the beacon demo with a coin cell, change jumpers to the configuration depicted in the next picture:
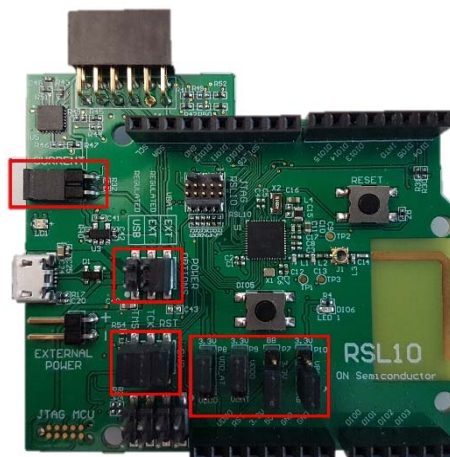
Do not forget to insert a coin cell into the battery holder at the back of the evaluation board. Please note, when the power source of QFN RSL10 evaluation board is a coin cell battery the LED is disabled and the only indication for advertising of beacons is the notification on the smartphone.

References

[1] google.com, "Google Beacon Platform," 9 February 2017. [Online]. Available: https://developers.google.com/beacons/overview. [Accessed 30 11 2017].

[2] google.com, "Google Beacon Platform," 6 November 2017. [Online]. Available: https://developers.google.com/beacons/eddystone. [Accessed 30 November 2017].

[3] R. Want, "Mbed Bluetooth Low Energy," 11 August 2015. [Online]. Available: https://os.mbed.com/teams/Bluetooth-Low-Energy /code/BLE_EddystoneBeacon_Service/. [Accessed 30 11 2017].

[4] M. Ashbridge, "Github Eddystone," 14 April 2016. [Online]. Available: https://github.com/google/eddystone/blob/master /protocol-specification.md. [Accessed 30 11 2017].

[5] J. Nielsen, "Bringing Industry's Lowest Power to Bluetooth Low Energy Technology," On Semiconductor, 12 05 2017. [Online]. Available: http://www.onsemi.com/community/blog/post/Bri nging-Industry-Lowest-Power-to-BLE-Technology. [Accessed 30 11 2017].

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