Ceylan-Oceanic: Enocean facilities in Erlang

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Status: In development

Dedication: Users and maintainers of the `Ceylan-Oceanic` library.

Abstract: The role of the `Ceylan-Oceanic` library is to provide Erlang-based facilities for the support of the Enocean building automation system.

The latest version of this documentation is to be found at the official Ceylan-Oceanic website (`http://oceanic.esperide.org`).

This documentation is also mirrored here.

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Overview

The Ceylan-Oceanic library provides Erlang-based facilities for the support of the Enocean building automation system, whose devices are generally energy-harvesting/very low-consumption and wireless (generally around 900 MHz, depending on countries; for a range of up to 300 meters in the open, and up to 30 meters inside buildings).

Besides Erlang, Ceylan-Oceanic relies only on Ceykan-Myriad and is a rather autonomous part of the Ceylan project. Ceylan-Oceanic can be readily built and run on most Unices, including of course GNU/Linux.

The project repository is located here.

At least a basic knowledge of Erlang is expected in order to use Ceylan-Oceanic.

Purpose

The main motivation of Oceanic is to provide some basic home automation features, especially in terms of security, in order to be able to:

- **intercept and decode telegrams** emitted by sensors, notably single-input contacts (to detect the opening/closing of doors or windows), temperature/humidity sensors or to detect electricity outages
- **generate and emit telegrams** to control various electrical devices (e.g. lamps), typically for a presence simulator, to turn on an electric heater

Progress & Enocean Coverage

The targeted basic Enocean support has been implemented, so EEP Enocean telegrams can be intercepted and, for the supported EEPs (others may be quite easily added), such telegrams can be properly decoded, as incoming higher-level events.

Reciprocally, telegrams for the supported EEPs can also be encoded and sent.

Yet, for some reason (still unknown), currently our target device (a smart plug) does not seem to accept them (no reaction).

This problem does not seem specific to Oceanic, insofar as recording directly from the command-line an accepted telegram from the USB gateway and sending it exactly as it was (replay) has no effect either on said device - whereas no anti-replay mechanism seems to be enforced here. Investigations are in progress.

Oceanic can also execute a few common commands directly onto the gateway chip.

Testing Ceylan-Oceanic in Two Steps

Now, let's discuss these subjects a bit more in-depth.

Hardware Prerequisites

In terms of Enocean devices, one needs typically:

- any kind of emitter/sensor, for example a single-input contact/rocker button like these ones
- a receiver, typically a USB gateway, which includes a UART for asynchronous serial communication with an integrated RF module

Popular USB dongles, which often relies on the TCM 310 chip, include the USB300 one (around 37 Euros in France), or the USB310 one (around 50 Euros in France) that we prefer as it features a SMA connector, which allows an external antenna to be connected in order to boost emission/reception ranges.

We will rely here on such a configuration.

Operating System Support

Once the USB dongle is connected (here on an Arch Linux box), `lsusb` tells us that it is detected as:

```
Bus 003 Device 009: ID 0403:6001 Future Technology Devices International, Ltd FT232 Se
```

(which applies both to USB300 and USB310)

We will interact with this USB gateway as if it was a serial port.

Rather than having it designated by an obscure, potentially changing name (like `/dev/ttyUSB0`, `/dev/ttyUSB1`, etc.), we prefer assigning it a fixed, well-chosen path, like `/dev/ttyUSBEnOcean`.

For that, one may define a suitable udev rule, typically stored in `/etc/udev/rules.d/99-enocean.rules`, whose content can simply be:

```
SUBSYSTEM=="tty", ATTRS{idVendor}=="0403", ATTRS{idProduct}=="6001", SYMLINK+="ttyUSBE
```

Following option could be added as well, to set the group of this TTY: `GROUP="dialout"` ou `GROUP="uucp"`, in which case your user shall be in that group (rather than running `sudo chmod 777 /dev/ttyUSB0` each time the device is inserted for example).

One may run `sudo udevadm control --reload-rules && sudo udevadm trigger` to ensure that these changes are taken into account.

Then inserting said dongle should generate log entries that `journalctl -xe` can show, like (timestamps and hostname edited):

```
kernel: usb 3-11: new full-speed USB device number 9 using xhci_hcd
kernel: usb 3-11: New USB device found, idVendor=0403, idProduct=6001, bcdDevice= 6.00
kernel: usb 3-11: New USB device strings: Mfr=1, Product=2, SerialNumber=3
kernel: usb 3-11: Product: FT232R USB UART
kernel: usb 3-11: Manufacturer: FTDI
kernel: usb 3-11: SerialNumber: A600AVJD
mtp-probe[74533]: checking bus 3, device 9: "/sys/devices/pci0000:00/0000:00:14.0/usb3
kernel: ftdi_sio 3-11:1.0: FTDI USB Serial Device converter detected
kernel: usb 3-11: Detected FT232RL
```

```
kernel: usb 3-11: FTDI USB Serial Device converter now attached to ttyUSB0
mtp-probe[74533]: bus: 3, device: 9 was not an MTP device
mtp-probe[74548]: checking bus 3, device 9: "/sys/devices/pci0000:00/0000:00:14.0/usb3
mtp-probe[74548]: bus: 3, device: 9 was not an MTP device
```

On insertion we have then:

```
.. code:: bash
```

$ ls -l /dev/ttyUSBEnOcean /dev/ttyUSB0 FIXME

Software Prerequisites

Ceylan-Oceanic relies on general-purpose services offered by Ceylan-Myriad (implying of course Erlang itself), and on an Erlang driver for serial communication.

We chose erlang-serial for that, and we prefer installing it in user space that way:

```
$ mkdir ~/Software && cd ~/Software
$ git clone https://github.com/tonyg/erlang-serial.git
$ cd erlang-serial
$ make && DESTDIR=. make install
```

Then using erlang-serial will be just a matter of adding it to the code path.

One may update the *Erlang-serial section* in Ocenanic's GNUmakevars.inc to take into account any other convention.

One may run, from the root of Oceanic, `make info-serial` to check that `ERLANG_SERIAL_BASE` points indeed to a directory containing serial's `ebin` directory.

To test it (whether or not any dongle is connected):

```
$ erl -pa $HOME/Software/erlang-serial/erlang/lib/serial-1.1/ebin
Erlang/OTP 25 [erts-13.0] [source] [64-bit] [smp:8:8] [ds:8:8:10] [async-threads:1] [j

Eshell V13.0  (abort with ^G)
1> serial:start().
<0.82.0>
```

Perfect!

Testing

Basic, Direct Testing

It is as simple as executing from the command-line (thus without Oceanic or Erlang being involved):

```
$ od -x < /dev/ttyUSBEnOcean
0000000 0055 0707 7a01 10f6 2e00 96e1 0130 ffff
0000020 ffff 0039 554b 0700 0107 f67a 0000 e12e
```

(of course for such a binary content to be received, Enocean telegrams must be emitted; the simplest approach is to trigger any Enocean device able to send on demand such telegrams, like a button/rocker/switch)

`hexdump` can be also used to intercept telegrams. If needing to set the transmission speed beforehand, use `stty -F /dev/ttyUSBEnOcean 57600`.

Incoming data can also be recorded and "replayed" (yet this is not expected to activate an Enocean receiver):

```
$ cat < /dev/ttyUSBEnOcean > my_record.bin
$ cat my_record.bin > /dev/ttyUSBEnOcean
```

Oceanic Testing

From the root of the Ceylan-Oceanic clone, supposing Myriad and erlang-serial are already available and built:

```
# Ensure that Ceylan-Oceanic is built:
$ make all

$ cd test
$ make oceanic_run

       Running unitary test oceanic_run (third form) from oceanic_test

--> Testing module oceanic_test.

Starting the Enocean test based on the gateway TTY '/dev/ttyUSBEnOcean'.
[debug] Using TTY '/dev/ttyUSBEnOcean' to connect to Enocean gateway, corresponding to
[debug] Stopping serial server <0.84.0>.

--> Successful end of test.

(test finished, interpreter halted)
(command success reported)
```

Enocean Documentation

- [ETS]: Enocean Technical Specifications, notably for:
  - [EEP-gen]: EnOcean Equipment Profiles (e.g. version 3.1.4, 36 pages), a short, general view onto the structure of the various telegram types that are available (e.g. the RPS one)
  - [EEP-spec]: EEP Specification (e.g. version 2.6.7, 270 pages), for a detailed specification of the various equipment profiles (e.g. `F6-01-*` being for *Switch Buttons*)
- [ESP3]: Enocean Serial Protocol (ESP3) - SPECIFICATION (e.g. version 1.51, 116 pages), a point-to-point packet-based protocol that is lower-level in the network stack; of less interest here)

Support

Bugs, questions, remarks, patches, requests for enhancements, etc. are to be reported to the project interface (typically issues) or directly at the email address mentioned at the beginning of this longer document.

Additional Information

- EnOcean in Practice (very clear information, in French)

Related Projects

They may be used as sources of inspiration:

- [PY-EN] the rather complete Python EnOcean library, including for its EEP (XML) information
- a Java implementation: enocean4j
- the (Java) OpenEnocean openHAB binding
- a first Rust implementation

Please React!

If you have information more detailed or more recent than those presented in this document, if you noticed errors, neglects or points insufficiently discussed, drop us a line! (for that, follow the Support guidelines).

Ending Word

Have fun with Ceylan-Oceanic!


Oceanic