

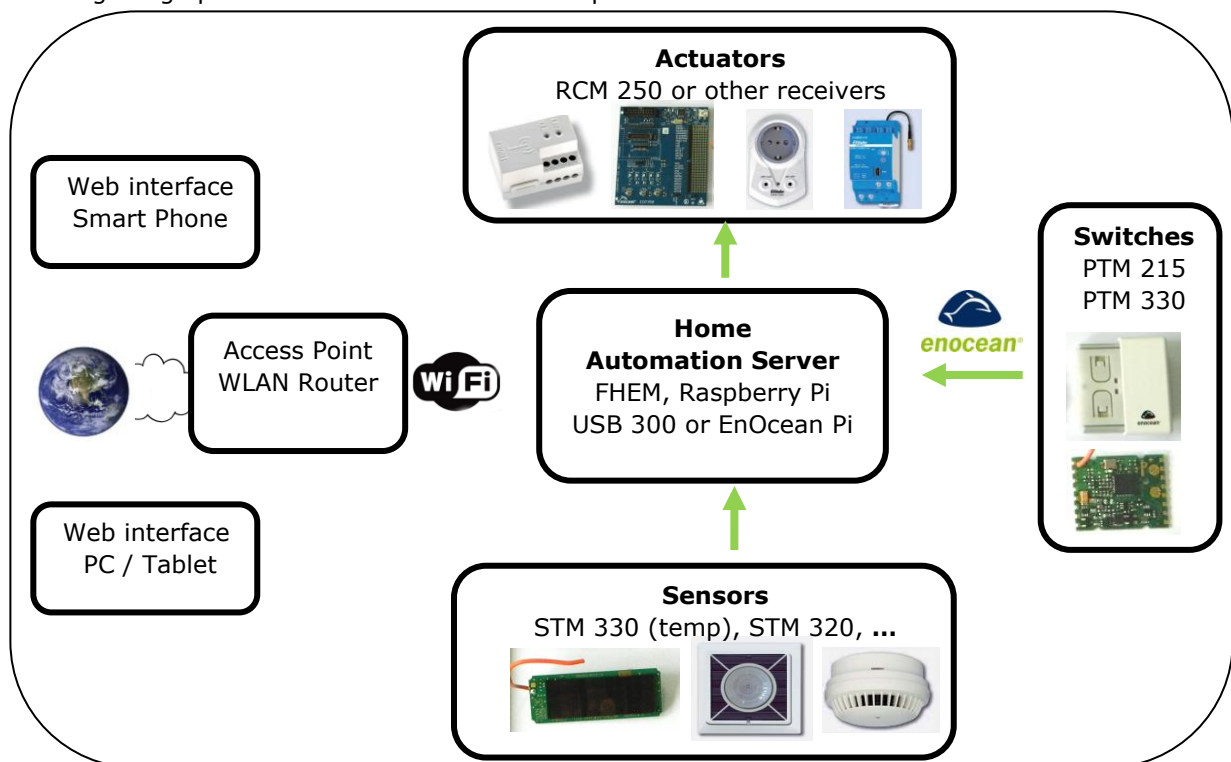
Raspberry Pi talks EnOcean - How to setup a home automation server with EnOcean Pi or USB 300

1. Introduction

Self-powered sensors and switches are ideal for enthusiasts to start up with home automation. No cable is required to switch lights, control blinds and get sensor information like temperature, humidity or presence detection.

Sensors and actuators can directly communicate to each other or they can additionally be controlled with an intelligent smart home server. This allows enthusiasts to get home automation for remote sensing and remote control via PC or smart phones. Raspberry Pi is the ideal platform to setup a smart home server. A USB 300 or EnOcean Pi will act as a bridge (GatewayController) to the EnOcean radio world. Self-powered switches and sensor from the EnOcean starter kit ESK 300 or developer kit EDK 350 can be used for the first installation.

Following image provides an overview of the components:



Raspberry Pi with FHEM server acts as home automation server. The server can be used to automate common tasks like switching lamps, scene illuminations or pulling blinds, measure and visualize power consumption, temperature and humidity.

The server receives and sends EnOcean radio telegrams via USB 300 or EnOcean Pi. Solar powered radio sensors (e.g. STM 330 temperature sensor or STM 320 reed contact sensor) periodically send values which will be interpreted and displayed via FHEM web interface. Self-powered switches and FHEM send on/off and dim commands to actuators.

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1.1 Covered Topics

- Installation of Raspberry Pi and preparation for smart home projects
- Connection of a USB 300 or EnOcean Pi to Raspberry Pi
- Installation of the FHEM server for home automation
- Configuration of FHEM for EnOcean switches, sensors and actuators

1.2 Necessary components

- PC with internet browser
- Raspberry Pi board (model B)
- Raspberry Pi accessories:
power supply (~1A) with micro
USB plug, HDMI cable, SD card
(e.g. 4GB), Ethernet cable or
USB WLAN stick
- USB 300 e.g. from EnOcean
starter kit ESK 300 or developer
kit EDK 350

or

- EnOcean Pi



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2. Step by step installation of Raspberry Pi

2.1 Installation of Raspian

If Raspian image is not already installed on the SD card, the following two steps are required:

1. Download Raspian wheezy image (Debian Linux for Raspberry Pi)
<http://www.raspberrypi.org/downloads>
2. Copy Raspian "wheezy" to SD card
 Use Win32Diskimager to copy the image to the SD card
<http://sourceforge.net/projects/win32diskimager/>

2.2 Basic configuration via "raspi-config" command

1. Plug SD card into Raspberry Pi and connect with keyboard and monitor
2. Connect to internet via Ethernet (just plug connector) or WiFi (needs to be configured). If there is already a device driver installed (e.g. Wi-Pi or EdiMax). Start GUI with `startx` and click on WiFi config.
3. Login with user `pi` and password `raspberrypi`
4. Configuration menu starts automatically after booting, if not just type `sudo raspi-config`

```

Setup Options
  1 Expand Filesystem      Ensures that all of the SD card storage is available to the OS
  2 Change User Password   Change password for the default user (pi)
  3 Enable Boot to Desktop Choose whether to boot into a desktop environment or the command-line
  4 Internationalisation Options Set up language and regional settings to match your location
  5 Enable Camera          Enable this Pi to work with the Raspberry Pi Camera
  6 Add to Rastrack        Add this Pi to the online Raspberry Pi Map (Rastrack)
  7 Overclock              Configure overclocking for your Pi
  8 Advanced Options       Configure advanced settings
  9 About raspi-config     Information about this configuration tool

                                <Select>                                <Finish>
  
```

5. Select following items to configure:
 - `expand_rootfs` to use the full SD card size
 - `configure_keyboard` to have the right keyboard settings
 - `change_timezone` for correct time & date
 - `change_location` for country specific characters etc.

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2.3 Software and Firmware update

Several shell commands need root (super user) rights; therefore "sudo" is used as prefix. Raspian (Linux operating system) can be updated via APT (Advanced Package Tool).

RPI-update (<https://github.com/Hexxeh/rpi-update>) is used to update the firmware (hardware driver) of Raspberry Pi. In order to have an up to date system (e.g. to recognize USB 300) both updates are required.

1. Get latest updates of Raspian and Raspberry Pi firmware:

```
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install rpi-update
```

2. Reboot

```
sudo restart
```

2.4 Connecting Raspberry with USB 300

1. Connect USB 300 to Raspberry Pi board
2. Check availability of USB 300 with `lsusb`



Example:

```
Bus 001 Device 002: ID 0424:9512 Standard Microsystems Corp.
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 001 Device 003: ID 0424:ec00 Standard Microsystems Corp.
Bus 001 Device 004: ID 0403:6001 Future Technology Devices
International, Ltd FT232 US B-Serial (UART) IC
-> USB 300 with FT332 chip has been recognized
```

3. To get raw data from the EnOcean radio interface you enter following commands:

Set serial interface to 57.600 Baud for USB 300:

```
stty -F /dev/ttyUSB0 57600
```

Display USB / serial data:

```
hexdump </dev/ttyUSB0
```

Example output:

```
0000000 0055 5d0a 00f4 ff01 ffff 5cff 3000 0055
0000010 070a eb01 00d1 21b0 0001 db8a 002e ff01
0000020 ffff 36ff 7e00 0055 070a eb01 00d1 21b0
0000030 0000 db8a 002e ff01 ffff 34ff c000 0055
0000040 070a eb01 00d1 21b0 0001 db8a 002e ff01
```

-> USB 300 provides a serial stream of EnOcean radio telegrams according to ESP3 protocol. For details see <http://www.enocean.com/esp>

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2.4 Connecting Raspberry with EnOcean Pi

1. Connect EnOcean Pi on top of Raspberry Pi board



2. Disable Linux using the serial port

As default the serial port of the GPIO interface is used for console debug outputs. In order to use this port for EnOcean Pi, this feature has to be disabled. Read more about this at: http://elinux.org/RPi_Serial_Connection

A script can be downloaded from Github, it will automatically adapt boot up settings: <https://github.com/lurch/rpi-serial-console>

3. Download script:

```
sudo wget https://raw.githubusercontent.com/lurch/rpi-serial-console/master/rpi-serial-console -O /usr/bin/rpi-serial-console && sudo chmod +x /usr/bin/rpi-serial-console
```

4. Execute script:

```
sudo rpi-serial-console disable
```

5. Test connection with raw data from EnOcean Pi by using hexdump:

```
hexdump </dev/ttyAMA0
```

Example output:

```
0000000 0055 5d0a 00f4 ff01 ffff 5cff 3000 0055
0000010 070a eb01 00d1 21b0 0001 db8a 002e ff01
0000020 ffff 36ff 7e00 0055 070a eb01 00d1 21b0
0000030 0000 db8a 002e ff01 ffff 34ff c000 0055
0000040 070a eb01 00d1 21b0 0001 db8a 002e ff01
```

-> EnOcean Pi provides a serial stream of EnOcean radio telegrams according to ESP3 protocol. For details see <http://www.enocean.com/esp>

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2.5 Find out the IP address of your Raspberry Pi

In most cases the IP address is provided via DHCP server. For remote control via TTY (e.g. PuTTY) or HTML server connections (FHEM server) the IP address of Raspberry Pi is needed.

You can get your allocated IP address (e.g. by DHCP server) by typing in following command: `ifconfig`

Example output:

```
pi@raspberrypi ~ $ ifconfig
eth0      Link encap:Ethernet  HWaddr b8:27:eb:c3:32:73
          inet addr:192.167.1.121  Bcast:192.167.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1077688  errors:0  dropped:0  overruns:0  frame:0
          TX packets:68259  errors:0  dropped:0  overruns:0  carrier:0
          collisions:0  txqueuelen:1000
          RX bytes:119175561 (113.6 MiB)  TX bytes:6098823 (5.8 MiB)
```

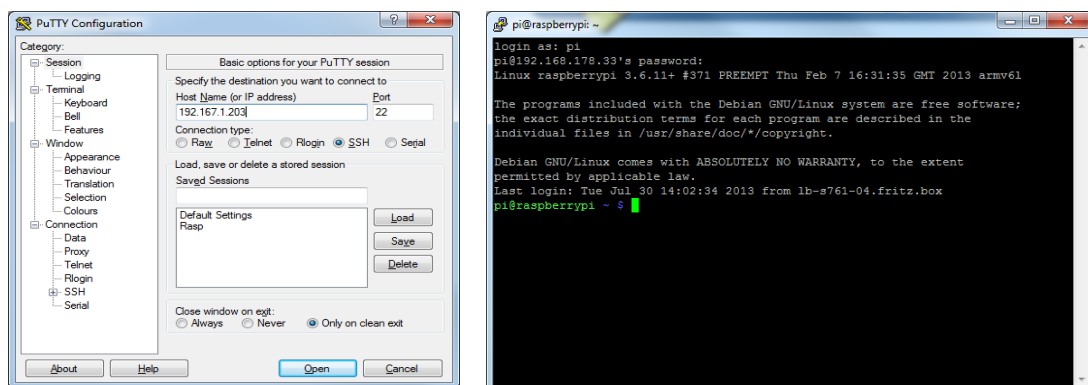
2.6 A remote control of your Raspberry Pi

If your desktop is too small for an additional Raspberry Pi display screen and keyboard, a remote control of your tiny computer is the best solution. Get the command line or Linux shell via SSH client to the PC browser.

1. Download and install PuTTY on PC

<http://www.chiark.greenend.org.uk/~sgtatham/putty/>

2. Execute PuTTY with IP address from your Raspberry Pi and login



➔ Now you have a command line interface to remotely control your Raspberry Pi via PC

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2.7 Installation of the building automation server

This example project uses the FHEM server available under GPL license. More details can be found on the FHEM website: <http://fhem.de/fhem.html>

1. Installation of Perl environment including libraries for FHEM

FHEM runs as server on a Perl interpreter, which needs to be installed.

```
sudo apt-get install perl libdevice-serialport-perl libio-socket-ssl-perl libwww-perl
sudo apt-get install -f
```

2. Installation FHEM

```
wget http://fhem.de/fhem-5.4.deb
sudo dpkg -I fhem-5.4.deb
```

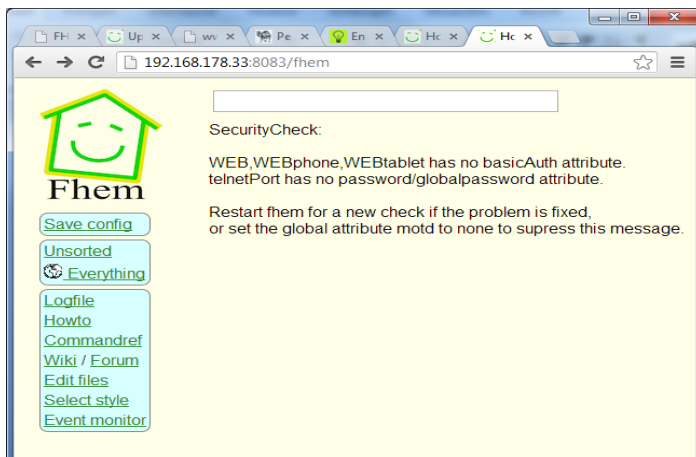
-> FHEM has been installed within the folder `/opt/fhem`. It starts automatically.
Check fhem.de for updates and path to new version.

2.8 Display FHEM Web Interface

Start your browser and type following to the link field:

<http://<Raspberry Pi IP>:8083/fhem>

You will get the following user interface on the screen:



FHEM recognizes automatically USB 300 and receives radio telegrams from EnOcean devices. Additionally it generates by default device entities for each new received EnOcean ID. With the user interface you can visualize and configure graphical user elements to visualize events and send control telegrams to actuators.

A small guide "how to" can be found at: <http://fhem.de/HOWTO.html>

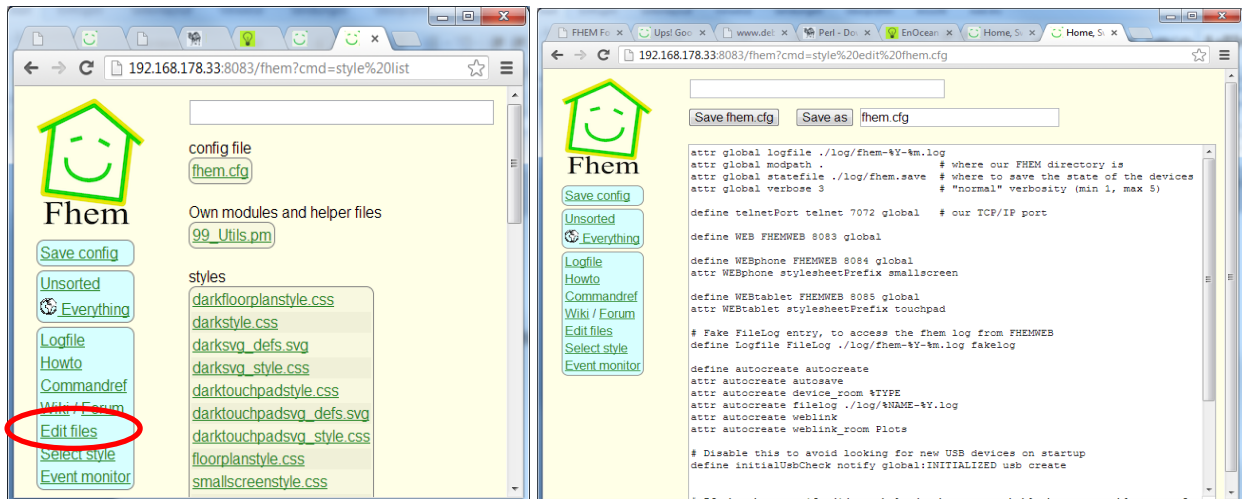
For German users there is an additional forum available: <http://forum.fhem.de/>

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2.9 Configuring FHEM Server

FHEM server is configured via the configuration file `fhem.cfg`.

Start the configuration file editor via the FHEM menu item "Edit files".



A reference of FHEM commands for EnOcean can be found at:

<http://fhem.de/commandref.html#EnOcean>

Configure USB 300:

If USB 300 is plugged and configured to the Raspberry Pi correctly following code will be generated automatically:

```
define TCM310_0 TCM 310 /dev/ttyUSB0@57600
```

Configure EnOcean Pi:

FHEM might not recognize EnOcean Pi as EnOcean GatewayController. You can manually enter following definition:

```
define TCM310_0 TCM 310 /dev/ttyAMA0@57600
```


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Configure PTM switch:

Click on PTM switch and you will get following entries (ID will be different):

```
define EnO_switch_001396B9 EnOcean 001396B9
attr EnO_switch_001396B9 room EnOcean
attr EnO_switch_001396B9 subType switch
define FileLog_EnO_switch_001396B9 FileLog ./log/EnO_switch_001396B9-%Y.log
EnO_switch_001396B9
attr FileLog_EnO_switch_001396B9 logtype text
attr FileLog_EnO_switch_001396B9 room EnOcean
```

Configure STM sensor:

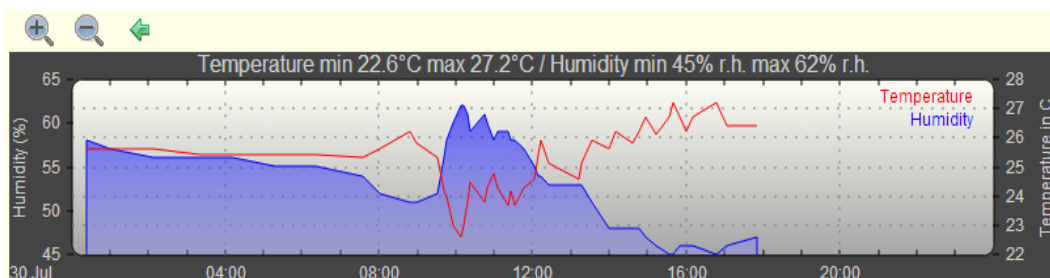
Press learn button of STM 330 sensor and you will get (ID will be different):

```
define EnO_contact_0181FA67 EnOcean 0181FA67
attr EnO_contact_0181FA67 room EnOcean
attr EnO_contact_0181FA67 subType contact
define FileLog_EnO_contact_0181FA67 FileLog ./log/EnO_contact_0181FA67-%Y.log
EnO_contact_0181FA67
attr FileLog_EnO_contact_0181FA67 logtype text
attr FileLog_EnO_contact_0181FA67 room EnOcean
```

Visualization:

Following visualization example has been generated by STM 330 (temperature sensor) with HSM 100 (humidity sensor plugged):

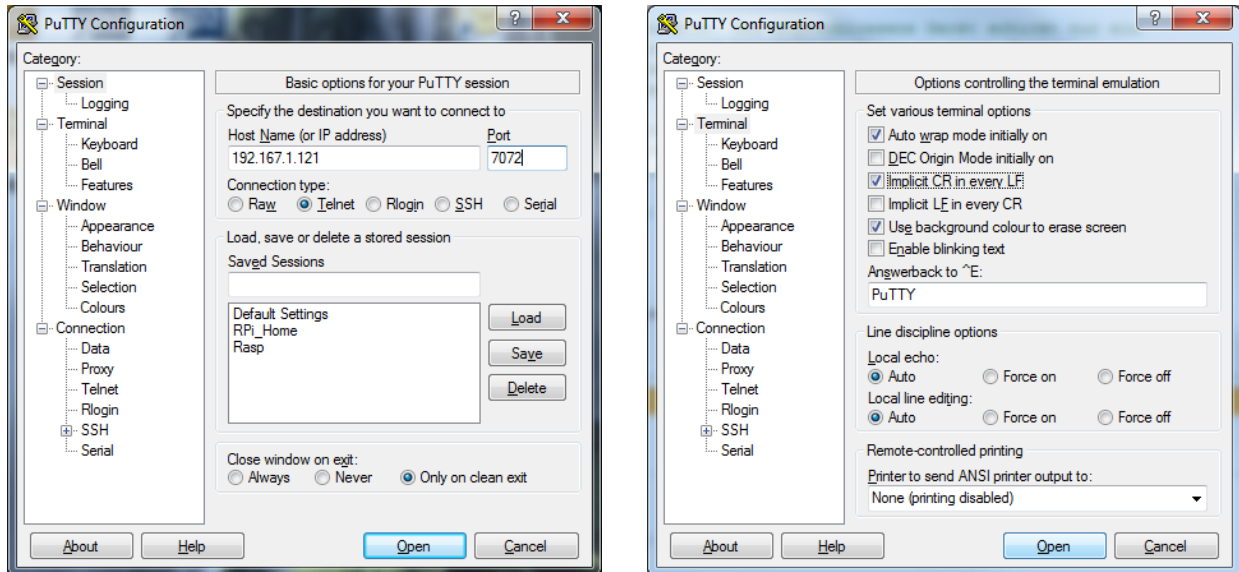
```
#ID:0088F03E STM_330 temperatur & humidty sensor
define Sensor_0088F03E EnOcean 0088F03E
attr Sensor_0088F03E manifID 00B
attr Sensor_0088F03E room EnOcean
attr Sensor_0088F03E subType roomSensorControl.01
define FileLog_EnO_sensor_0088F03E FileLog ./log/EnO_sensor_0088F03E-%Y.log Sensor_0088F03E
attr FileLog_EnO_sensor_0088F03E logtype text
attr FileLog_EnO_sensor_0088F03E room EnOcean
```



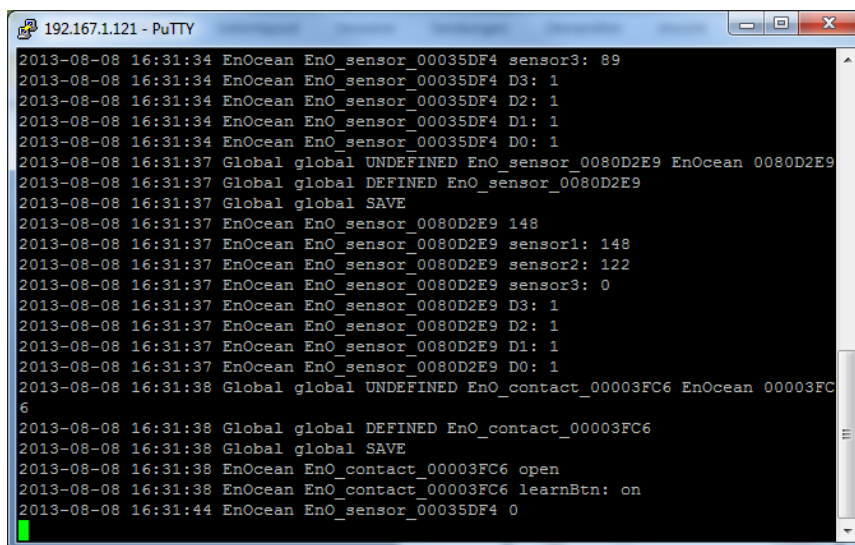
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2.10 Interpret EnOcean radio telegrams with FHEM event monitor

Start Putty and configure Putty to IP address of Raspberry PI with telnet port 7072. Switch on "implicit CR in every LF" within Terminal configuration to get a line feed after carriage return.



Start telnet session and type `inform timer` to get FHEM event monitor. Receiving events with EnOcean telegrams will be shown with time stamp.



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3. Useful links

EnOcean radio modules:

http://www.enocean.com/en/enocean_modules/epk-350/

http://www.enocean.com/de/enocean_module/usb-300-oem/

<http://www.enocean.com/de/enocean-pi/>

<http://www.enocean.com/en/knowledge-base/>

Farnell element 14 Raspberry Pi® and accessories:

<http://www.element14.com/raspberrypi>

http://www.element14.com/enocean_pi

Raspberry Pi®

<http://www.debian.org/doc/manuals/refcard/refcard.en.pdf>

<http://www.danielspage.de/index.php/technik/raspberry-pi-blog/44-enocean-auf-dem-pi>

<http://developer-blog.net/hardware/raspberry-pi-backup/>

<http://www.datenreise.de/raspberry-pi-wlan-einrichten-edimax/>

http://www.mikrocontroller.net/articles/Raspberry_Pi

<http://pibeginners.com/ftp-server/>

FHEM:

<http://fhem.de/fhem.html>

<http://forum.fhem.de/>

<http://fhem.de/Heimautomatisierung-mit-fhem.pdf>