

Raspberry Pi talks EnOcean –

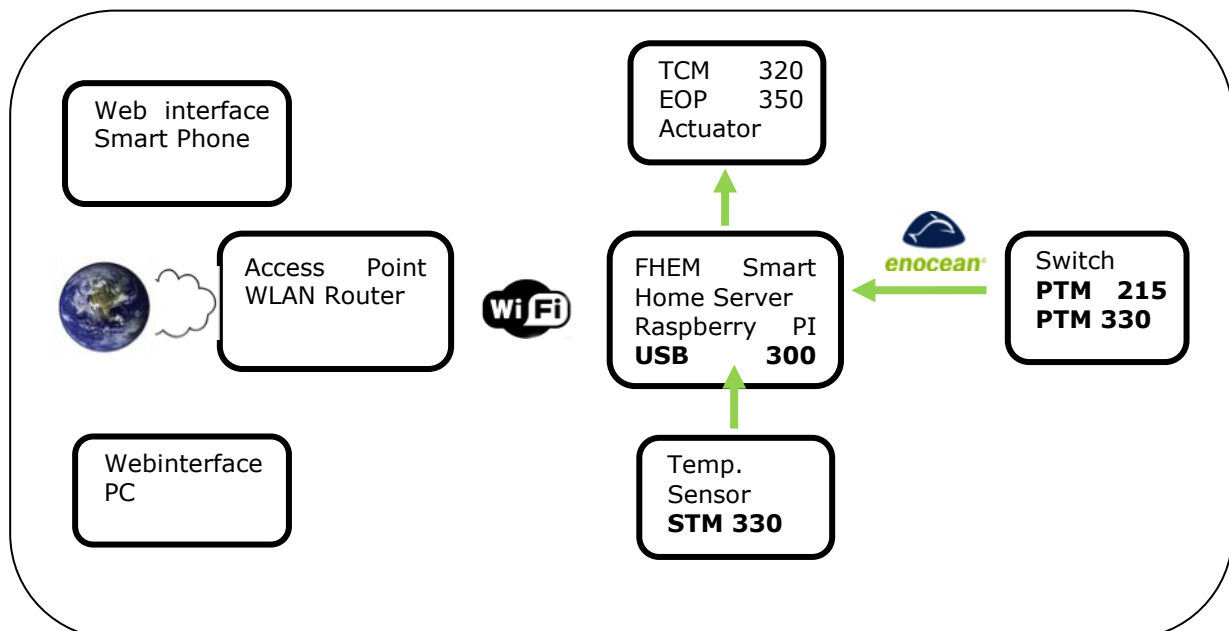
How to combine your Raspberry Pi board with the EnOcean Developer Kit

1. Introduction

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

Sensors and actuators can communicate directly to each other, or they can be controlled with an intelligent smart home server. This allows enthusiasts to use 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. With the components of the EnOcean developer kit EDK 350 you can easily start your first smart home installation.

The following image provides an overview of the components:



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

The server receives and sends EnOcean radio telegrams via USB 300 (EnOcean Gateway Controller). The solar powered radio sensor STM 330 periodically sends temperature values which will be displayed via FHEM web interface. Self-powered switches control the actuator, simulated by the evaluation board with TCM 320 directly or via the home automation server.

1.1 Covered Topics

- Installation of Raspberry Pi and preparation for Smart Home projects
- Installation of an FHEM server for home automation
- Configure FHEM for EnOcean switches, sensors, and actuators
- Example with floor plan of EDK 350 components

Raspberry Pi talks EnOcean –

How to combine your Raspberry Pi board with the EnOcean Developer Kit

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
- EnOcean EDK 350 with self-powered switches, temperature sensor, and evaluation board



2. Step by step installation of Raspberry Pi

2.1 Installation of Raspian

1. If the Raspian image is not already installed on the SD card, the following two steps are required:
2. Download the Raspian Jessie image (Debian Linux for Raspberry Pi)
<http://www.raspberrypi.org/downloads>
3. Copy Raspian "Jessie" to SD card
You need to make sure the card is formatted properly; a good formatting program is located here:
https://www.sdcard.org/downloads/formatter_4/
Once formatted, use Win32Diskimager to copy the image to the SD card:
<http://sourceforge.net/projects/win32diskimager/>

2.2 Basic configuration via "raspi-config" command

Plug the SD card into the Raspberry pi and connect a monitor and keyboard. Connect either an Ethernet cable or a Wi-Fi dongle for internet access. The raspberry pi must first be configured if using a wireless connection.

When Raspian Jessie boots, the GUI should be automatically started and uses 'pi' as the default user. If the GUI does not start, use the command `startx` to run it. If using a Wi-Fi, click on the Wi-Fi icon at the top-right corner of the screen and enter the necessary security information to connect to the network.

Open a Terminal window and type the following command:

```
sudo raspi-config
```

The raspberry pi configuration window will be opened.

Raspberry Pi talks EnOcean – How to combine your Raspberry Pi board with the EnOcean Developer Kit

```
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>
```

Configure the following settings:

1. expand_rootfs to use the full SD card size (required)
2. configure_keyboard to have the right keyboard settings
3. change_timezone for correct time & date
4. change_locale for country specific characters, etc.

2.3 Software and Firmware update

Several shell commands need root (super user) rights; therefore “sudo” is used as prefix. The 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.

To get latest updates of Raspian and Raspberry Pi firmware:

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

sudo apt-get dist-upgrade

sudo rpi-update

sudo reboot now
```

Raspberry Pi talks EnOcean –

How to combine your Raspberry Pi board with the EnOcean Developer Kit

2.4 Connecting Raspberry with EnOcean's World

2.4.1 Connecting via EnOcean's USB

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

```
lsusb
```

Example output:

```
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 UL B-Series (UART) IC  
-> USB 300 with FT332 chip has been recognized
```

3. To get raw data from the EnOcean radio interface, use the following commands:

Set serial interface to 57600 Baud for USB 300:

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

Display USB / serial data:

```
hexdump -C < /dev/ttyUSB0
```

Example output:

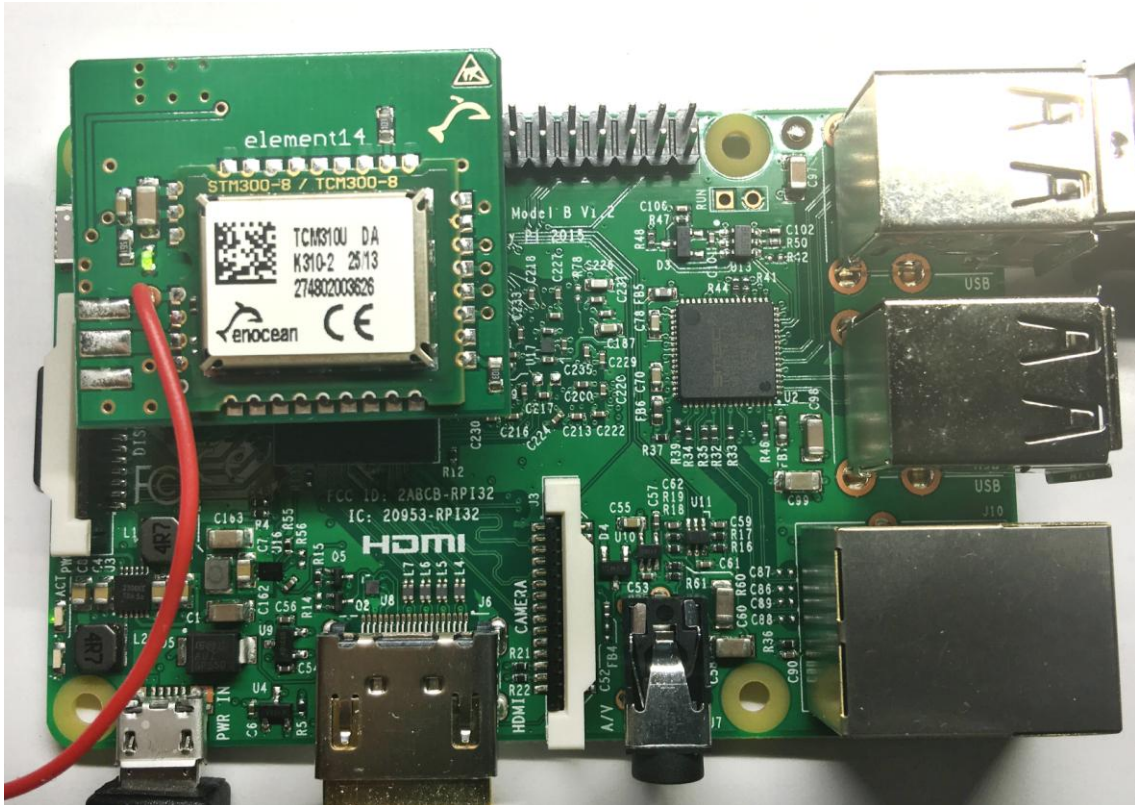
```
00000000 0055 5d0a 00f4 ff01 ffff 5cff 3000 0055  
00000010 070a eb01 00d1 21b0 0001 db8a 002e ff01  
00000020 ffff 36ff 7e00 0055 070a eb01 00d1 21b0  
00000030 0000 db8a 002e ff01 ffff 34ff c000 0055  
00000040 070a eb01 00d1 21b0 0001 db8a 002e ff01
```

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

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2.4.2 Connecting with Element 14 EnOcean Pi HAT

While the power is off to the Pi board, connect the EnOcean Pi to the Raspberry connector. The figure below indicates the placement of the Pi HAT:



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The serial port of the GPIO must be disabled, as it is normally used for a TTY console in the standard configuration. Open the raspberry pi configuration window again.

```
sudo raspi-config
```

Open the “Advanced Options” window and select “A7 Serial”. In the next window, select “<No>” and then “<Finish>”. Reboot the raspberry pi when prompted.

2.4.3 Disable the Pi3 onboard Bluetooth

Because the Pi3 has Bluetooth on board, the UART used to control the Bluetooth is what is expected to control the UART that manages the Pi HATs. While it is possible to alter the Operating System to change this, it is quite difficult and not recommended. It is noted in the link below that a fix for this may be in development.

Please refer to this link for more information:

<https://openenergymonitor.org/emon/node/12311>

(This link was valid as of March 8, 2016.

Do the following in order to disable the onboard Pi3 Bluetooth and restore the UART0/ttyAMA0 over GPIOs 14 & 15:

```
sudo nano /boot/config.txt
```

Add to the end of the file:

```
enable_uart=1  
dtoverlay=pi3-disable-bt
```

Ctrl-X, then answer Y to save the file and overwrite.

We also need to stop the Bluetooth modem trying to use UART:

```
sudo systemctl disable hciuart
```

See [RasPi device tree commit for pi3-disable-bt](#) and raspi [forum thread discussion](#).

Reboot and test serial output with:

```
sudo reboot now
```

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```
stty -F /dev/ttyAMA0 57600
```

Display the serial data:

```
hexdump -C < /dev/ttyAMA0
```

2.5 Find out 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 the Raspberry Pi is needed.

You can get an allocated IP address (e.g., by DHCP server) by typing following command:

```
ifconfig
```

Example output: (Note, the Pi3 will have a wireless IP as well)

```
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 Remote control of your Raspberry PI

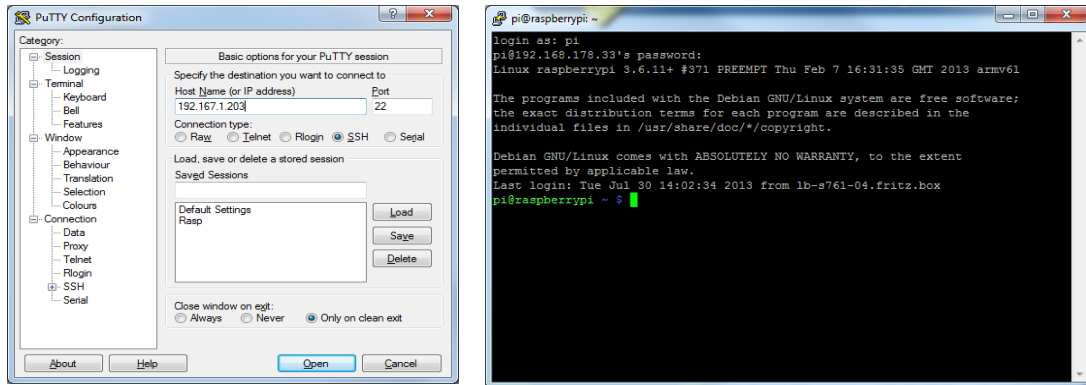
If your work area is too small for an additional Raspberry Pi monitor and keyboard, remote control of your tiny computer is the best solution. Get the command line or linux shell via SSH client to the PC browser.

1. Download and install PuTTY on PC

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

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2. Execute PuTTY with the IP address from your Raspberry Pi and log in:



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

2.7 Installation of the Building Automation Server

This example project uses the FHEM server available under a 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. This 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 of FHEM (See fhem.de for more information).

```
wget http://fhem.de/fhem-5.7.deb
sudo dpkg -i fhem-5.7.deb
```

FHEM is installed in the folder `/opt/fhem`. It starts automatically during boot process.

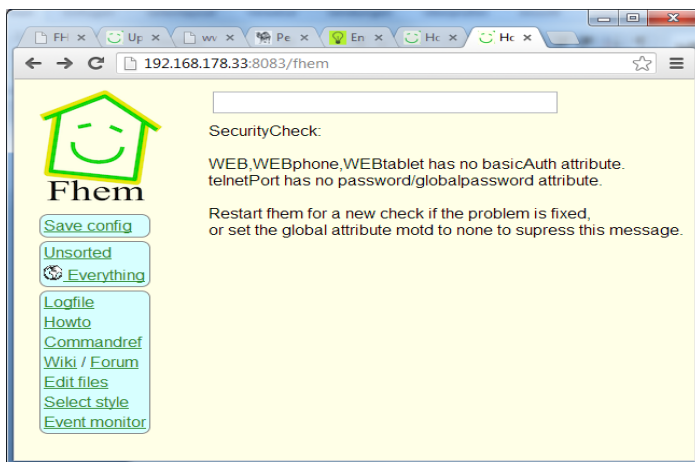
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2.8 Display FHEM Web Interface

Start your browser and type the following to the link field:

```
http://<Raspberry_Pi_IP>:8083/fhem
```

You will get following user interface on the screen:



If the FHEM program recognizes the EnOcean device (USB or HAT), it 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 configure graphical user elements to visualize events and send control telegrams to actuators.

For more information, please see:

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

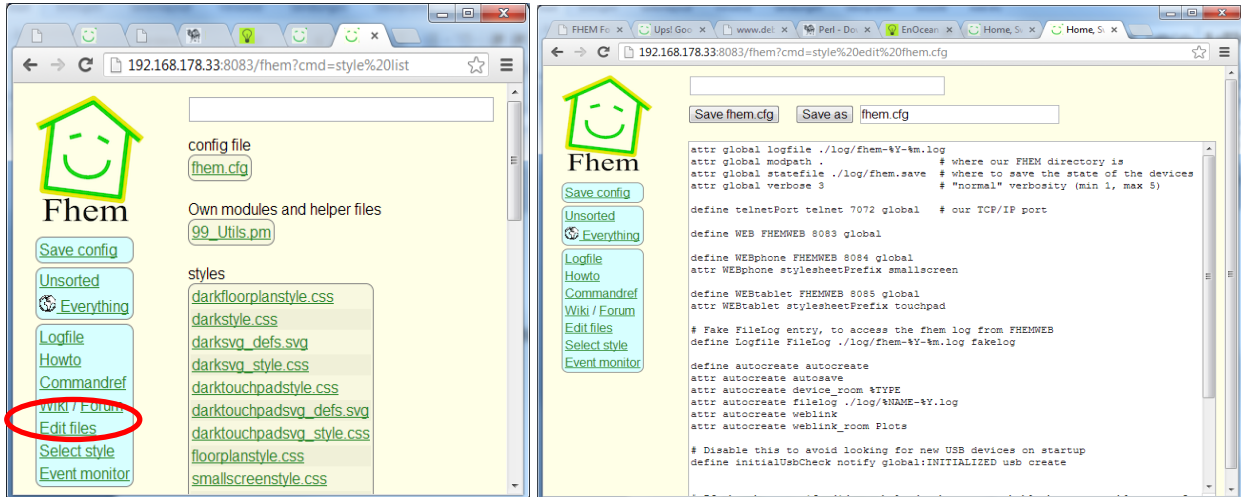
For German speaking users, there is an additional forum available at: <http://forum.fhem.de/>

2.9 Configuring FHEM Server

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

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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>

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

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

Or, for the HAT:

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

If it is not, the line above may be typed in at the bottom of the fhem.cfg file. Click the "Save fhem.cfg" button and then click "Save Config" on the left hand column, this then should show "EnOcean" as a selection on the left hand column. Clicking on "EnOcean" should show the messages being received.

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

```
define En0_switch_001396B9 EnOcean 001396B9
attr En0_switch_001396B9 room EnOcean
attr En0_switch_001396B9 subType switch
define FileLog_En0_switch_001396B9 FileLog ./log/En0_switch_001396B9-%Y.log
En0_switch_001396B9
attr FileLog_En0_switch_001396B9 logtype text
attr FileLog_En0_switch_001396B9 room EnOcean
```

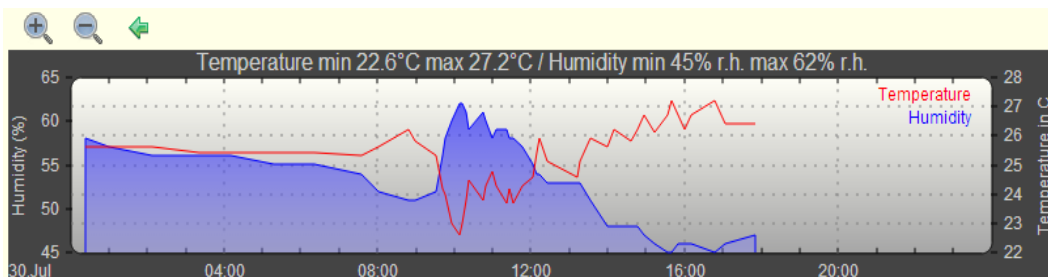
Raspberry Pi talks EnOcean – How to combine your Raspberry Pi board with the EnOcean Developer Kit

Press the learn button of the 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
```

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

```
#ID:0088F03E STM_330 temperatur & humidty sensor
define Sensor_0088F03E EnOcean 0088F03E
attr Sensor_0088F03E manufID 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_Sensor_0088F03E logtype text
attr FileLog_Sensor_0088F03E room EnOcean
```



Raspberry Pi talks EnOcean – How to combine your Raspberry Pi board with the EnOcean Developer Kit

3. Useful links

EnOcean:

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

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

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>