MoodleBox building reference*
Version 1.9.3

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Contents

1 Introduction

This article documents how to build a MoodleBox. It is intended for developers or system administrators to provide background information on how a MoodleBox is built.

This is not meant to be an end-user documentation. For end-user documentation, please consult MoodleBox website.

The actual building of MoodleBox is now done using Ansible. Using Ansible enables most of the build to be automated, as well as ensuring that it is reproducible. Though complete, the instructions in this document should not be understood as a method to obtain a MoodleBox that is totally equivalent to the officially published MoodleBox images.

What MoodleBox does

- Configurable wireless access point with SSID: *MoodleBox* and password: *moodlebox*.
- DHCP server for wireless clients.
- Moodle server (http://moodlebox.home/). This is a totally standard Moodle installation.
- MoodleBox Moodle administration plugin[1] providing a GUI to manage most aspects of the MoodleBox.
- Internet access: If MoodleBox is connected via ethernet or wireless LAN to an Internet-connected network, it acts as a router and gives its wireless clients access to the Internet.

Specific Moodle features

- Moodle version 3.11.x in its basic configuration, with no content (no courses). The only Moodle user account is an administrator account (username: *moodlebox*, password: *Moodlebox4$*). The server is configured to accept clients from the official Moodle app.[2] *cron* service is launched every minute.
- When a USB stick is inserted into the MoodleBox, its files are available to users in Moodle's *File system* repository.
- Ability to upload files via SFTP directly to the MoodleBox (username: *moodlebox*, password: *Moodlebox4$*); these files are then available to users in Moodle's *File system* repository.
- Adminer, a full-featured database management tool, is installed (http://moodlebox.home/adminer.php).

What MoodleBox doesn't do

- Email server: MoodleBox is intended to be used "in the field", independent of any network infrastructure; email server functionality is not relevant for this purpose.
- Coffee machine.

[1] https://github.com/moodlebox/moodle-tool_moodlebox.
[2] https://download.moodle.org/mobile/.

2 Preparation of the Raspberry Pi

Although MoodleBox works fine on other models, a Raspberry Pi Model 3B, 3B+ or 4B is recommended to **build** it.

Copy last version of Raspberry Pi OS Lite on a microSD card

Download last version of *Raspberry Pi OS Lite* from Raspberry Pi web site,[3] copy it on your (good quality!) microSD card. Complete description of the process is available on Raspberry Pi web site.[4]

Enable SSH access

For security reasons, SSH access isn't enabled by default.[5] To enable it, we copy a file with name `ssh` in the `boot` directory (root of `boot` partition of microSD card). The content of the file doesn't matter. The following commands will do.

```
$ cd <mounting point of "boot" partition>
$ > ssh
```

Eject the microSD card and insert it into the Raspberry Pi.

Connect the power supply of the Raspberry Pi. Plug the Raspberry Pi with an Ethernet cable into a network with a DHCP server and wait 20-30 seconds. Your Raspberry Pi is now reachable on the network using the address `raspberrypi.local`.[6]

Log in to the Raspberry Pi via SSH

From now on, all operations are done via the command line, using `ssh` (a regular terminal on macOS and Linux, or `Putty` on Windows).

Login to the Raspberry Pi. Username is *pi* with password *raspberry* (this password will be changed later, as will the user account).

```
$ ssh pi@raspberrypi.local
$ pi@raspberrypi.local's password:
```

[3] https://www.raspberrypi.com/software/operating-systems.
[4] https://www.raspberrypi.org/documentation/computers/getting-started.html.
[5] See https://www.raspberrypi.org/blog/a-security-update-for-raspbian-pixel/
[6] This network address is provided by the *zeroconf* standard protocol. Some older Android and Windows devices do not understand this protocol. With such devices, it is necessary to get access to the Raspberry Pi via its numerical IP address, which must be discovered manually.

Upgrade Raspberry Pi OS

Upgrade the Raspberry Pi's operating system, with these commands:

```
$ sudo apt-get update -y
$ sudo apt-get full-upgrade -y
```

This step can take several minutes, depending on your Internet connection speed.

Configure some Raspberry Pi important settings

Launch *raspi-config* utility:

```
$ sudo raspi-config
```

With *raspi-config*, configure following settings:

- Expand Filesystem.
- Change password for the `pi` user. As the disk image being produced is intended to be openly distributed, we choose MoodleBox default password *Moodlebox4$*.
- Install following *locales*:
  - `de_DE.UTF-8`
  - `en_AU.UTF-8`
  - `en_GB.UTF-8`
  - `es_ES.UTF-8`
  - `fr_FR.UTF-8`
  - `it_IT.UTF-8`

  and set `en_GB.UTF-8` as default *locale*.
- Set time zone and WLAN country. This will also unblock wireless use. MoodleBox default settings are respectively `Europe/Zurich` and `CH`.
- Set the hostname to *moodlebox*.

From now on, to connect to the Raspberry Pi (via SSH or SFTP), use address `moodlebox.local`, username *pi* and password *Moodlebox4$*.

Reboot and log in to the MoodleBox with these new credentials.

Change default username[7]

There's no problem to use default username *pi* for MoodleBox usage. However, for the convenience of the end-user, we change the default username to *moodlebox*.

We start by creating a temporary user account, *tempuser*, and set its password. As this account will be deleted later, the quality of the password is not important.

[7] This section is based on http://unixetc.co.uk/2016/01/07/how-to-rename-the-default-raspberry-pi-user/.

```
$ sudo useradd -m tempuser
$ sudo passwd tempuser
```

User account *tempuser* is added to *sudoers* user group, to allow it to perform the appropriate operations. The current session of user *pi* is then exited.

```
$ sudo usermod -a -G sudo tempuser
$ exit
```

Log now in to the MoodleBox with username *tempuser* and its previously set password.

```
$ ssh tempuser@moodlebox.local
$ tempuser@moodlebox.local's password:
```

We first save the files we're going to modify as a backup, in case a problem occurs.

```
$ cd /etc
$ sudo tar -czf /home/pi/authfiles.tgz passwd group shadow gshadow subuid
    subgid sudoers sudoers.d/010_pi-nopasswd systemd/system/autologin@.service
```

We change now the account name to *moodlebox* in the relevant files, then change its home directory name. A symbolic link to the old directory is created, in order to avoid some unlikely (but possible) side effects due to the account name change.

```
$ sudo sed -i 's/\bpi\b/moodlebox/g' passwd group shadow gshadow subuid subgid
    sudoers sudoers.d/010_pi-nopasswd systemd/system/autologin@.service
$ sudo mv /etc/sudoers.d/010_pi-nopasswd /etc/sudoers.d/010_moodlebox-nopasswd
$ sudo mv /home/pi /home/moodlebox
$ sudo ln -s /home/moodlebox /home/pi
$ exit
```

We can now log in to the MoodleBox with the new username *moodlebox* and password *Moodlebox4$* (which was not changed).

```
$ ssh moodlebox@moodlebox.local
$ moodlebox@moodlebox.local's password:
```

Temporary user account *tempuser* can be now deleted, as well as the backup file:

```
$ sudo userdel tempuser
$ sudo rm -rf /home/tempuser/
$ sudo rm authfiles.tgz
```

From now on, we will log in to the MoodleBox with username *moodlebox* and password *Moodlebox4$*.

Increase system available memory

To increase the system available memory, the memory reserved for the graphics chip is reduced to 16 MB. This is of no consequence, as our system does not have a graphical interface. We do this by adding the following line at the end of the file `/boot/config.txt`:

```
gpu_mem=16
```

Enable shutdown/startup hardware button

We enable shutdown/startup hardware button feature by further editing file `/boot/config.txt`. Insert following line after line beginning with `# Additional overlays` to get:

```
# Additional overlays and parameters are documented /boot/overlays/README
dtoverlay=gpio-shutdown
```

3 Wireless access point (AP) feature

Enable wireless interface for access point mode

We want to be able to use standard wireless interface `wlan0` to optionally connect to a wireless LAN, so we need another interface for our AP.

We use a *udev* rule for this purpose, creating a new file named `90-wireless.rules` in directory `/etc/udev/rules.d/`.

Here's the content of `/etc/udev/rules.d/90-wireless.rules` on the MoodleBox:

```
# File /etc/udev/rules.d/90-wireless.rules
# Add wireless interface for AP mode
ACTION=="add", SUBSYSTEM=="ieee80211", KERNEL=="phy0", \
  RUN+="/sbin/iw phy %k interface add uap0 type __ap"
```

Switch to alternative wireless chip firmware

Standard Raspberry Pi wireless firmware has several additional features that are not very useful for a MoodleBox. However, SRAM on the wireless chip is used both for data storage whilst in use, but also for additional features and bug fixes. Each time a feature is added or a bug fix made, the amount of SRAM available for runtime variables decreases, and so the number of clients in AP mode.

An alternative firmware is now available that has been tuned to maximise the number of clients in AP mode while still supporting STA mode. This is the firmware we choose to use in MoodleBox. Following commands switch the firmware to the alternative one.

```
$ cd /lib/firmware/brcm/
$ sudo ln -sf ../cypress/cyfmac43455-sdio-minimal.bin \
    brcmfmac43455-sdio.bin
```

Wireless connection as a client (optional)

If MoodleBox is intended to be used as a client (STA mode) as well as an access point, a valid configuration file named `wpa_supplicant.conf` should be provided to `wpa_supplicant` service, in directory `/etc/wpa_supplicant/`.

Following listing shows an example of such file:

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1
country=CH

network={
    scan_ssid=1
    ssid="<Name of your wireless LAN>"
    psk="<Password for your wireless LAN>"
    proto=RSN
    key_mgmt=WPA-PSK
    pairwise=CCMP
    auth_alg=OPEN
}
```

Don't forget to edit the file and put the SSID and password of your wireless network.

Install required packages for access point feature

Access point feature requires packages `hostapd` and `dnsmasq`. Let's install them.

```
$ sudo apt-get install -y hostapd dnsmasq
```

Static IP address configuration

MoodleBox gets dynamically via DHCP its IP address on the ethernet interface `eth0` or as a wireless client on the `wlan0` interface.

With its access point feature, it will also act as a DHCP provider on its wireless interface `uap0`. We force then a static IP address `10.0.0.1` on `wlan0` interface. Any other private IP address can alternatively be used.

To this end, we add at the very end of file `/etc/dhcpcd.conf` the lines

```
interface wlan0
# Uncomment following line to disable AP+STA mode
# nohook wpa_supplicant

interface uap0
static ip_address=10.0.0.1/24
nohook wpa_supplicant
```

Access point configuration

To configure the access point, we edit `hostapd.conf`. This is where the access point SSID and password are set, as well as other options, such as the broadcast channel and regulatory country. We define *MoodleBox* as SSID and *moodlebox* as password.

Here's the content of `/etc/hostapd/hostapd.conf` on the MoodleBox:

```
# Set country code
country_code=CH
# Name of the Wi-Fi interface
interface=uap0
# Use the nl80211 driver
driver=nl80211
# Wi-Fi network name (SSID)
ssid=MoodleBox
# Show or hide SSID
ignore_broadcast_ssid=0
# Use the 2.4GHz band
hw_mode=g
# The Wi-Fi channel
channel=11
# Enable 802.11n
ieee80211n=1
# Enable WMM
wmm_enabled=1
# Enable 40 MHz channels with short guard interval for 20 Mhz
ht_capab=[HT40][SHORT-GI-20][DSSS_CCK-40]
# Accept all MAC addresses
macaddr_acl=0
# Use WPA authentication
auth_algs=1
# Use WPA2
wpa=2
# Use a pre-shared key
wpa_key_mgmt=WPA-PSK
# The network passphrase
wpa_passphrase=moodlebox
# Use AES, instead of TKIP
rsn_pairwise=CCMP
```

```
# Enable hostapd_cli
ctrl_interface=/var/run/hostapd
ctrl_interface_group=0
```

We now need to define where `hostapd` gets its configuration. This is set in file `/etc/default/hostapd`, where we replace `#DAEMON_CONF=""` with `DAEMON_CONF="/etc/hostapd/hostapd.conf"` in this file.

Finally, we enable `hostapd` service:

```
$ sudo systemctl unmask hostapd
$ sudo systemctl enable hostapd
```

DHCP and DNS server configuration

DHCP and DNS server configuration on `uap0` interface are provided through `dnsmasq`.[8] We edit `/etc/dnsmasq.conf` to have this content:

```
interface=uap0            # Use interface uap0
listen-address=127.0.0.1 # Explicitly specify the address to listen on
listen-address=10.0.0.1  # Explicitly specify the address to listen on
bind-interfaces           # Make sure we aren't sending things elsewhere
server=9.9.9.9            # Forward DNS requests to external public DNS
server=149.112.112.112    # Forward DNS requests to external public DNS
domain-needed             # Don't forward short names
bogus-priv                # Don't forward addresses in the non-routed spaces
domain=home               # Set private domain name to 'home'
local=/home/              # Don't forward queries for private domain 'home'
address=/home/10.0.0.1    # Resolve subdomains '*.home'
expand-hosts              # Add private domain name to hostnames
dhcp-range=wifi,10.0.0.10,10.0.0.254,255.255.255.0,1h # Assign IP addresses
   with 1h lease, subnet name 'wifi'
dhcp-option=wifi,6,10.0.0.1 # Set DNS server for subnet wifi
txt-record=moodlebox.home,"MoodleBox by Nicolas Martignoni"
log-facility=/var/log/dnsmasq.log # Enable log
```

We edit now the file `/etc/hosts`, replacing last line, beginning with `127.0.1.1`, with this line:

```
10.0.0.1    moodlebox
```

This configuration enables any device to access the MoodleBox via its URL http://moodlebox.home/, even those which do not implement *zeroconf*[9] standard protocol.

Finally, we fix a race condition between `dhcpcd` and `dnsmasq` by editing `dnsmasq` service file `/lib/systemd/system/dnsmasq.service`. We add following lines just before `[Install]`:

[8] DNS configuration is based on https://www.linux.com/learn/dnsmasq-easy-lan-name-services.
[9] https://en.wikipedia.org/wiki/Zero-configuration_networking

```
RestartSec=5
Restart=on-failure
```

mDNS services publication

In order to make MoodleBox services visible on the network, we create the file `/etc/avahi/services/moodlebox.service`, with following content.

```
<?xml version="1.0" standalone='no'?>
<!DOCTYPE service-group SYSTEM "avahi-service.dtd">
<service-group>
  <name replace-wildcards="yes">%h</name>
  <service>
    <type>_device-info._tcp</type>
    <port>0</port>
    <txt-record>model=MoodleBox</txt-record>
  </service>
  <service>
    <type>_ssh._tcp</type>
    <port>22</port>
  </service>
  <service>
    <type>_sftp-ssh._tcp</type>
    <port>22</port>
  </service>
  <service>
    <type>_http._tcp</type>
    <port>80</port>
  </service>
</service-group>
```

Routing configuration

We configure routing so that wireless clients can browse the Internet when MoodleBox is connected via ethernet or wireless to an Internet router.

We edit the file `/etc/sysctl.conf`, uncommenting or adding line

```
net.ipv4.ip_forward=1
```

Installation of package `iptables-persistent` enables routing rules to survive MoodleBox reboot or shutdown.

```
$ sudo apt-get install -y iptables-persistent
```

We can now define the routing rules:

```
$ sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
$ sudo iptables -t nat -A POSTROUTING -o wlan0 -j MASQUERADE
$ sudo iptables -A FORWARD -i eth0 -o uap0 \
    -m state --state RELATED,ESTABLISHED -j ACCEPT
$ sudo iptables -A FORWARD -i wlan0 -o uap0 \
    -m state --state RELATED,ESTABLISHED -j ACCEPT
$ sudo iptables -A FORWARD -i uap0 -o eth0 -j ACCEPT
$ sudo iptables -A FORWARD -i uap0 -o wlan0 -j ACCEPT
```

And we reboot.

```
$ sudo reboot
```

Captive portal

We can now install the captive portal, based on free software Nodogsplash.[10] Nodogsplash needs first to be compiled for the Raspberry Pi platform. Its compilation is not covered in this guide. Refer to Nodogsplash documentation for any support about its compilation.

Let's install the Nodogsplash package we got after compilation:

```
$ sudo dpkg –i nodogsplash_5.0.0-1_armhf.deb
```

Nodogsplash configuration file `/etc/nodogsplash/nodogsplash.conf` should read

```
# Nodogsplash Configuration File
GatewayInterface uap0
FirewallRuleSet authenticated-users {
    FirewallRule allow all
}
FirewallRuleSet preauthenticated-users {
}
FirewallRuleSet users-to-router {
    FirewallRule allow udp port 53
    FirewallRule allow tcp port 53
    FirewallRule allow udp port 67
    FirewallRule allow tcp port 22
    FirewallRule allow tcp port 80
    FirewallRule allow tcp port 443
}
GatewayName MoodleBox
GatewayAddress 10.0.0.1
RedirectURL http://moodlebox.home/
GatewayPort 2050
```

[10] https://nodogsplashdocs.readthedocs.io/.

```
MaxClients 50
SessionTimeout 360
```

We can now edit Nodogsplash splash page at our convenience. The files to edit are located in directory `/etc/nodogsplash/htdocs/`.

In the official MoodleBox image, Nodogsplash captive portal is not enabled. If we want to disable it too, we type following commands in our shell:

```
$ sudo systemctl stop nodogsplash.service
$ sudo systemctl disable nodogsplash.service
```

4 Installation of the web server and the database (LEMP stack)

The LEMP software stack is a group of software that can be used to serve dynamic web pages and web applications. The term LEMP is an acronym that represents a Linux operating system with an Nginx (pronounced "engine-x", hence the E in the acronym) web server. The backend data stored in a MariaDB database and the dynamic processing is handled by PHP.

Installation of Nginx and PHP

We install first Nginx and all needed PHP packages, notably those required by Moodle.

```
$ sudo apt-get install -y nginx php7.4-fpm php7.4-cli php7.4-common \
    php7.4-json php7.4-mbstring php7.4-opcache php7.4-readline \
    php7.4-xmlrpc php7.4-curl php7.4-gd php7.4-intl php7.4-soap \
    php7.4-mysql php7.4-xml php7.4-zip php7.4 php-apcu
```

SSL certificate and key

We can now copy the SSL certificate `moodlebox.pem` and its key `moodlebox.key` to the directory `/etc/nginx/`.

SSL certificate generation is not covered in this guide. Refer to adequate documentation on SSL certificate generation, e.g. on https://stackoverflow.com/a/10176685.

Web server configuration: Nginx and PHP

Nginx web server configuration is set in file `/etc/nginx/sites-available/default`, which content should be like below.

```
# Default server configuration
#
server {
    listen 80 default_server;
    listen [::]:80 default_server;

    listen 443 ssl;
    listen [::]:443 ssl;
    ssl_certificate /etc/nginx/ssl/moodlebox.pem;
    ssl_certificate_key /etc/nginx/ssl/moodlebox.key;

    root /var/www/moodle;

    index index.php index.html index.htm index.nginx-debian.html;

    server_name moodlebox;

    location / {
        try_files $uri $uri/ =404;
    }

    location ~ [^/]\.php(/|$) {
        include fastcgi_params;
        fastcgi_split_path_info ^(.+\.php)(/.+)$;
        fastcgi_read_timeout    300;
        fastcgi_pass    unix:/var/run/php/php7.4-fpm.sock;
        fastcgi_index   index.php;
        fastcgi_param   PATH_INFO   $fastcgi_path_info;
        fastcgi_param   SCRIPT_FILENAME $document_root$fastcgi_script_name;
        fastcgi_param   PHP_VALUE "max_execution_time=300\n
           upload_max_filesize=50M\n post_max_size=50M\n max_input_vars=5000";
        client_max_body_size    50M;
    }

}
```

Last `fastcgi_param` line, with line `client_max_body_size`, increases to 50 MB the max upload file size, as well as script maximum execution time to 300 s. It also sets `max_input_vars` to 5000.

We then relaunch the web server:

```
$ sudo systemctl restart nginx php7.4-fpm
```

The ownership, group and access rights of Nginx and PHP should now be tweaked so that the default user *moodlebox* can easily edit the files, while allowing Moodle updates and plugin installation via the web interface.

To do this, we edit the two files `/lib/systemd/system/nginx.service` and `/lib/systemd/system/php7.4-fpm.service`, adding after line `[Service]` the line `UMask=0002`, to get some-

thing like

```
...
[Service]
UMask=0002
Type=...
...
```

We then edit the file `/etc/php/7.4/fpm/pool.d/www.conf` to set the correct group ownership for PHP, replacing line `group = www-data` with `group = moodlebox`, so we have now

```
...
user = www-data
group = moodlebox
...
```

If needed, variables in `/etc/php/7.4/fpm/pool.d/www.conf` can be tweaked, e.g. for performance gains.

MariaDB installation and configuration

We install now MariaDB package. PHP MariaDB support was already installed with PHP (see section 4).

```
$ sudo apt-get install -y mariadb-server
```

During the installation, we define the password of the main user *moodlebox* of the database. For this installation, we set the password to *Moodlebox4$*.

In order to allow flexible access to the databases, a new database user is created in MariaDB.

```
$ sudo mysql
    > CREATE USER 'moodlebox'@'localhost' IDENTIFIED BY 'Moodlebox4$';
    > GRANT ALL PRIVILEGES ON *.* TO 'moodlebox'@'localhost';
    > FLUSH PRIVILEGES;
    > QUIT;
```

If needed, variables in `/etc/mysql/mariadb.conf.d/50-server.cnf` can be tweaked, e.g. for performance gains.

5 Installation and configuration of Moodle

Moodle database creation

We first create the database which Moodle will use.

```
$ sudo mysql
    > CREATE DATABASE moodle;
    > QUIT;
```

Moodle download

We can now download Moodle; we do this with Git in order to facilitate future updates. We first install Git.

```
$ sudo apt-get install -y git
```

We get now Moodle source in the appropriate location, specifying the current stable branch of Moodle. A shallow clone is used to later save space on the MoodleBox image.

```
$ sudo git clone --depth=1 -b MOODLE_311_STABLE \
    git://git.moodle.org/moodle.git /var/www/moodle
```

Creation of Moodle data directories

Moodle data and several other directories are now created.

```
$ sudo mkdir -p /var/www/moodledata/repository /var/www/moodledata/temp \
    /var/www/moodledata/backup /var/cache/moodle \
    /var/cache/moodle-cache-backup
```

Adequate permissions and ownership are set on these directories, including SGID permission on Moodle data directory. We also set the correct permissions to Moodle source directory:

```
$ sudo chown -R www-data:moodlebox /var/www/moodle /var/www/moodledata/ \
    /var/cache/moodle /var/cache/moodle-cache-backup
$ sudo chmod -R ug+w,o-w /var/www/moodle /var/www/moodledata/ \
    /var/cache/moodle /var/cache/moodle-cache-backup
$ sudo chmod -R g+s /var/www/moodledata/
```

We can now launch Moodle installation, either by loading URL http://moodlebox.home/ in a browser and follow the instructions on screen, or by using Moodle command line interface.[11] For MoodleBox, the administrator account is defined with *moodlebox* as username and the password *Moodlebox4$*.

The installation takes at least 10 minutes. Be patient!

[11] See https://docs.moodle.org/311/en/Installing_Moodle#Command_line_installer.

Tweaking the Moodle configuration

Moodle course backup directory

As we use for Moodle course backup a different directory than the data directory, we set the following line in Moodle configuration file `/var/www/moodle/config.php`:

```
$CFG->backuptempdir = '/var/www/moodledata/backup';
```

X-Sendfile setup

We set *X-Sendfile* in `/var/www/moodle/config.php` to allow files in the Moodle data directory to be uploaded faster through the web server:

```
$CFG->xsendfile = 'X-Accel-Redirect';
$CFG->xsendfilealiases = array ('/dataroot/' => $CFG->dataroot);
```

For *X-Sendfile* to be active, we must add following lines to Nginx configuration file `/etc/nginx/sites-available/default`, inside `server` block:

```
location /dataroot/ {
    internal;
    alias /var/www/moodledata/;
}
```

Custom filetype definition

Defining a custom file type in Moodle facilitates the web certificate from MoodleBox home page. The definition is coded in `/var/www/moodle/config.php` too:

```
$CFG->customfiletypes = array(
  (object)array(
    'extension' => 'crt',
    'icon' => 'sourcecode',
    'type' => 'application/x-x509-ca-cert',
    'customdescription' => 'X.509 CA certificate'
  )
);
```

Hiding content that doesn't make sense for MoodleBox

We hide Moodle campaign and Moodle services and support sections from notifications page. These content don't make sense for MoodleBox, which is offline most of the time.

```
$CFG->showcampaigncontent = false;
$CFG->showservicesandsupportcontent = false;
```

Final content of the file `/var/www/moodle/config.php` is then:

```
<?php  // Moodle configuration file

unset($CFG);
global $CFG;
$CFG = new stdClass();

$CFG->dbtype    = 'mariadb';
$CFG->dblibrary = 'native';
$CFG->dbhost    = 'localhost';
$CFG->dbname    = 'moodle';
$CFG->dbuser    = 'moodlebox';
$CFG->dbpass    = 'Moodlebox4$';
$CFG->prefix    = 'mdl_';
$CFG->dboptions = array (
  'dbpersist' => 0,
  'dbport' => '',
  'dbsocket' => '',
  'dbcollation' => 'utf8mb4_general_ci',
);

$CFG->wwwroot   = 'http://moodlebox.home';
$CFG->dataroot  = '/var/www/moodledata';
$CFG->admin     = 'admin';

$CFG->backuptempdir = '/var/www/moodledata/backup';
$CFG->xsendfile = 'X-Accel-Redirect';
$CFG->xsendfilealiases = array('/dataroot/' => $CFG->dataroot);
$CFG->customfiletypes = array(
  (object)array(
    'extension' => 'crt',
    'icon' => 'sourcecode',
    'type' => 'application/x-x509-ca-cert',
    'customdescription' => 'X.509 CA certificate'
  )
);
$CFG->showcampaigncontent = false;
$CFG->showservicesandsupportcontent = false;

$CFG->directorypermissions = 02777;

require_once(__DIR__ . '/lib/setup.php');

// There is no php closing tag in this file,
// it is intentional because it prevents trailing whitespace problems!
```

Cron configuration

Moodle cron should be launched every minute. Moreover, since MoodleBox is offline most of the time and doesn't have a mail server, no mail should be sent by cron process. We edit cron configuration with the shell command

```
$ sudo crontab -e
```

and add following lines to the crontab

```
MAILTO=""
* * * * * nice -n10 /usr/bin/php /var/www/moodle/admin/cli/cron.php
```

6 MoodleBox plugin

MoodleBox plugin[12] enables monitoring of the MoodleBox as well as managing several of its settings, such as password change, date and time setting, wireless access settings, etc.

This plugin works only on Raspberry Pi hardware, and needs some prerequisites to work

Installation of the MoodleBox plugin in Moodle

As usually, we install the plugin in Moodle by visiting *Site administration* > *Plugins* > *Repositories* > *Install plugins*. Click on the *Install plugins from the Moodle plugins directory* button and select *MoodleBox* administration plugin (*Admin tools*).

It's also possible to install it via Git.

```
$ cd /var/www/moodle/admin/tool/
$ sudo git clone https://github.com/moodlebox/moodle-tool_moodlebox.git
   moodlebox
```

In this case, we need to complete the installation of the plugin by visiting the page http://moodlebox.home/admin.

Finalisation of the installation of the MoodleBox plugin

To finalise the installation of the MoodleBox plugin, we need to create of a few files and set their permissions. We'll also set the correct owner, group and permissions for all the plugin files.

```
$ cd /var/www/moodle/admin/tool/moodlebox
$ sudo touch .reboot-server .shutdown-server .set-server-datetime \
    .newpassword .wifisettings .resize-partition
```

[12] MoodleBox plugin source code is available at https://github.com/moodlebox/moodle-tool_moodlebox.

```
$ sudo chown -R www-data:moodlebox /var/www/moodle/admin/tool/moodlebox
$ sudo chmod -R ug+w,o-w /var/www/moodle/admin/tool/moodlebox
$ sudo chmod -R 774 /var/www/moodle/admin/tool/moodlebox/bin
```

We install `direvent` and configure some jobs so that the MoodleBox plugin works correctly.

```
$ sudo apt-get install -y direvent
```

Here's the configuration file of `direvent`:

```
watcher {
  path /var/www/moodle/admin/tool/moodlebox/;
  file .reboot-server;
  event CLOSE_WRITE;
  command "/sbin/shutdown -r now";
}

watcher {
  path /var/www/moodle/admin/tool/moodlebox/;
  file .shutdown-server;
  event CLOSE_WRITE;
  command "/sbin/shutdown -h now";
}

watcher {
  path /var/www/moodle/admin/tool/moodlebox/;
  file .set-server-datetime;
  event CLOSE_WRITE;
  command "/bin/bash /var/www/moodle/admin/tool/moodlebox/.set-server-datetime
      ";
}

watcher {
  path /var/www/moodle/admin/tool/moodlebox/;
  file .newpassword;
  event CLOSE_WRITE;
  command "/bin/bash /var/www/moodle/admin/tool/moodlebox/bin/changepassword.
      sh";
}

watcher {
  path /var/www/moodle/admin/tool/moodlebox/;
  file .wifisettings;
  event CLOSE_WRITE;
  command "/usr/bin/python3 /var/www/moodle/admin/tool/moodlebox/bin/
      changewifisettings.py";
}

watcher {
  path /var/www/moodle/admin/tool/moodlebox/;
```

```
  file .resize-partition;
  event CLOSE_WRITE;
  command "/bin/bash /var/www/moodle/admin/tool/moodlebox/bin/resizepartition.
      sh";
}
```

Lastly, we copy these lines at the end of `/etc/sudoers.d/020_www-data-nopasswd` (or create it if it's not there):

```
www-data ALL=(ALL) NOPASSWD:/sbin/parted /dev/mmcblk0 unit MB print free
www-data ALL=(ALL) NOPASSWD:/usr/bin/vcgencmd
```

And we don't forget to reboot now!

7 Moodle repositories for USB sticks and SFTP uploads

Let's now configure the Moodle *File system* repositories, which will make it easier for MoodleBox's users to manage the files they want to provide with Moodle.

USB sticks

We set up automatic mounting of USB sticks (regardless of their format), as well as access to all files on inserted USB sticks via the *File system* repository.[13]

This is done by installing the `usbmount` package, then creating a directory in the Moodle data directory, and finally creating a link from the USB stick mount point to this directory.

The `usbmount` package should be built from its source code before to be installed.[14] We also install standard packages to support exFAT and NTFS formatted devices. Support for other formats is built-in.

```
$ sudo apt-get install -y ntfs-3g exfat-fuse
$ sudo dpkg -i usbmount_0.0.24_all.deb
$ sudo mkdir -p /var/www/moodledata/repository
$ sudo chown -R www-data:moodlebox /var/www/moodledata/
$ sudo ln -s /media/usb /var/www/moodledata/repository
```

You then have to configure Moodle appropriately:[15] having logged in to Moodle as an administrator, visit *Site administration* > *Plugins* > *Repositories* > *Manage repositories*.

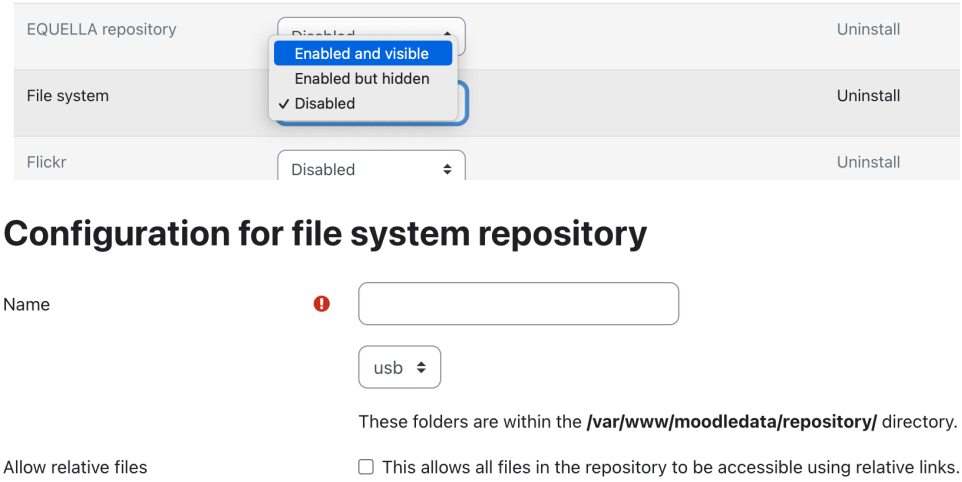
Select *Enabled and visible* in the row *File system* to enable this repository.

Click on *Save*. Then, on the same row, click on *Settings*, then on *Create a repository instance*. Finally select *usb* from the drop-down menu, and enter *USB Drive* in the mandatory *Name* field.

[13] If more than one USB stick is inserted into the MoodleBox, only the files on the first inserted stick are accessible via the File system repository.

[14] See https://github.com/rbrito/usbmount. Follow the instructions in the README file.

[15] See https://docs.moodle.org/en/File_system_repository.



SFTP upload

We create a directory in which the files will be dropped in order to be accessible from Moodle, as well as a link to the Moodle data directory. Appropriate permissions are set.

```
$ mkdir -p /home/moodlebox/files
$ sudo chown -R moodlebox:www-data files/
$ sudo chmod g+s files/
$ sudo ln -s /home/moodlebox/files /var/www/moodledata/repository
```

The repository is then configured in a similar way to the *USB Drive* repository above, by specifying the directory *files* and enter *SFTP Documents* as the repository name.

To use this feature, MoodleBox's admin will log in to the MoodleBox using a SFTP software[16], with the user name *moodlebox* and the password *Moodlebox4$*. He can then upload files in the `files` directory.

8 Additional Moodle configurations

Enabling access to the MoodleBox via the Moodle mobile app

After logging in to Moodle with the administrator account, we visit *Site Administration* > *Advanced features*. We check the box *Enable web services for mobile devices* and save the changes.

For MoodleBox, which is not intended to be published on the Internet, the warning[17] about the SSL certificate can be safely ignored.

[16] For instance: FileZilla, Cyberduck, WinSCP.

[17] Text of the warning: *It is recommended to enable HTTPS with a valid certificate. The Moodle app will always try to use a secured connection first.*

Utilities to use PDF files in Moodle

We install Ghostscript and Poppler to enable Moodle to manage PDF annotations and PDF to PNG conversions.

```
$ sudo apt-get install -y ghostscript poppler-utils
```

9 Installation of *Adminer*

Adminer is a full-featured database management tool written in PHP. It consists of a single file ready to be deployed to the server. We install it by downloading it to the adequate location, and set its appropriate permissions.

```
$ cd /var/www/moodle/
$ sudo wget -c https://www.adminer.org/latest.php -O adminer.php
$ sudo chown moodlebox:www-data adminer.php
$ sudo chmod -R 664 adminer.php
```

To manage the database with *Adminer*, the interface should be accessed at http://moodlebox.home/adminer.php. To log in, use usual credentials: by default, username *moodlebox* and password *Moodlebox4$*.

10 Optimisation

To make the MoodleBox more comfortable to use, it is necessary to take care of its optimisation. We configure Moodle's cache, as well as its management of file uploads and downloads.

RAM disks for some Moodle directories[18]

Some files in Moodle data directory are needed very frequently. To enable faster access to them, we deliver them directly from the server's RAM, faster than the SD-card.

We create a directory as a mount point for the RAM disk, with adequate permissions. This directory will contain the cache files that we will define below.

```
$ sudo mkdir /var/cache/moodle
$ sudo chown www-data:moodlebox /var/cache/moodle/
$ sudo chmod ug+w,o-w /var/cache/moodle/
```

RAM disks are also used for the temporary and sessions directories in Moodle. These two directories are located Moodle data directory *moodledata*.

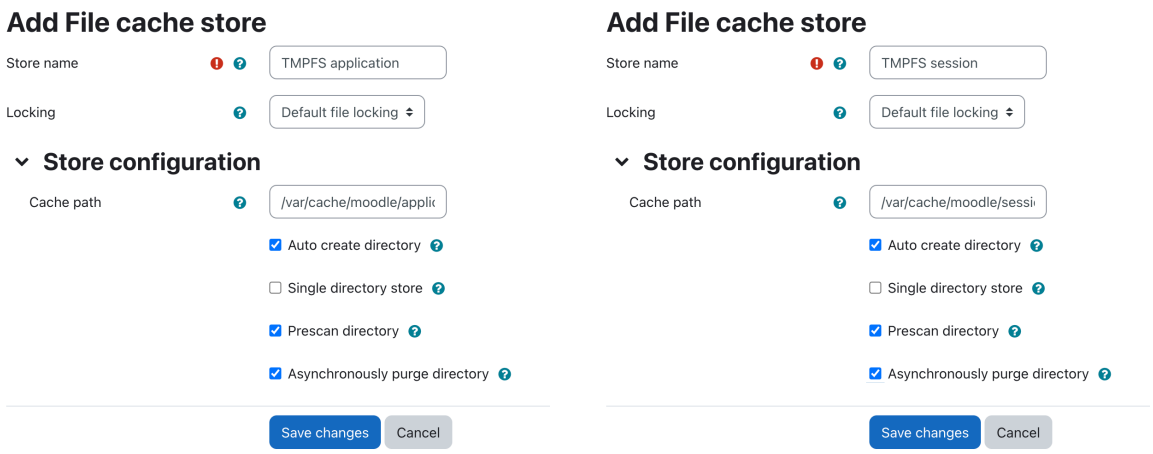
We define the RAM disks in the Raspberry's mount table. To do this, we add the following lines to the file `/etc/fstab`:

[18] Inspired by https://www.leading-interactive.de/e-learning/moodle-performance-tuning-mit-tmpfs/.

```
tmpfs /var/cache/moodle tmpfs size=64M,mode=775,uid=www-data,gid=www-data 0 0
tmpfs /var/www/moodledata/temp tmpfs size=64M,mode=775,uid=www-data,gid=www-
    data 0 0
tmpfs /var/www/moodledata/sessions tmpfs size=16M,mode=775,uid=www-data,gid=
    www-data 0 0
```

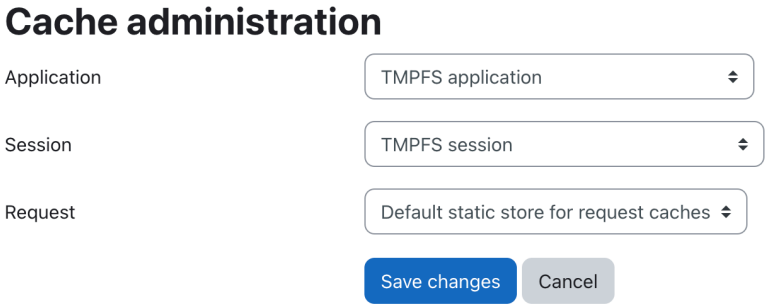
After a reboot of the MoodleBox, the cache can be configured in Moodle.

Log in to Moodle with the administrator account, then visit *Site Administration* > *Plugins* > *Caching* > *Configuration*. We create two new cache stores, by clicking on *Add Instance* in the *Installed cache stores* section (at the top of the page).



1. Store name: *TMPFS application*, Cache path: */var/cache/moodle/application*, check the boxes *Auto create directory*, *Prescan directory* and *Asynchronously purge directory*;
2. Store name: *TMPFS session*, Cache path: */var/cache/moodle/session*, check the boxes *Auto create directory*, *Prescan directory* and *Asynchronously purge directory*.

Finally, we map these new cache instances with their destination, by clicking on *Edit mappings* in the *Stores used when no mapping is present* section, at the very bottom of the page.



Le cache en disque RAM a un défaut: les données qu'il contient disparaissent à chaque redémarrage de la MoodleBox. Moodle doit donc à chaque fois reconstruire le cache. Si l'on veut conserver le cache entre les redémarrages, on copie à intervalle régulier le contenu du disque RAM sur la carte microSD, et, lors de chaque démarrage, on effectue l'opération inverse.

On crée le dossier de sauvegarde, puis on définit le cron

```
$ sudo mkdir /var/cache/moodle-cache-backup/
$ sudo crontab -e
```

On ajoute à la table des crons les deux lignes suivantes pour effectuer la sauvegarde du cache toutes les 20 minutes et pour restaurer le cache au démarrage:

```
*/20 * * * * rsync -a --delete /var/cache/moodle/ /var/cache/moodle-cache-
    backup/
@reboot cp -Rpf /var/cache/moodle-cache-backup/* /var/cache/moodle/
```

Optimisation de MariaDB

On modifie les valeurs de quelques variables de MariaDB dans le fichier `/etc/mysql/mariadb.conf.d/50-server.cnf`. Pour ce faire, on ouvre le fichier en question et on y modifie les lignes adéquates, à savoir:

```
table_cache             = 512
table_definition_cache  = 512
max_connections         = 100
query_cache_size        = 16M
query_cache_type        = 0
```

11 Redimensionnement automatique de la partition

Afin d'éviter à l'utilisateur de devoir redimensionner manuellement la partition de travail, on configure le redimensionnement automatique au premier démarrage. La méthode est identique à celle utilisée lors de la construction de l'image-disque de *Raspbian Stretch Lite*.[19]

On copie le fichier `resize2fs_once` ci-dessous dans le dossier `/etc/init.d/`, et on lui donne les permissions adéquates pour être lancé au redémarrage.

```
#!/bin/sh
### BEGIN INIT INFO
# Provides:          resize2fs_once
# Required-Start:
# Required-Stop:
# Default-Start: 3
# Default-Stop:
# Short-Description: Resize the root filesystem to fill partition
# Description:
### END INIT INFO
. /lib/lsb/init-functions
case "$1" in
```

[19] https://github.com/RPi-Distro/pi-gen.

```
  start)
    log_daemon_msg "Starting resize2fs_once"
    ROOT_DEV=`grep -Eo 'root=[[:graph:]]+' /proc/cmdline | cut -d '=' -f 2-`
        &&
    resize2fs $ROOT_DEV &&
    update-rc.d resize2fs_once remove &&
    rm /etc/init.d/resize2fs_once &&
    log_end_msg $?
    ;;
  *)
    echo "Usage: $0 start" >&2
    exit 3
    ;;
esac
```

Finalement, avant la dernière extinction précédant le clonage et le redimensionnement de l'image disque, on termine en lançant la commande

```
$ sudo systemctl enable resize2fs_once
```

puis on ajoute à la fin de la ligne du fichier `/boot/cmdline.txt` les instructions ci-dessous, immédiatement après le texte `rootwait` (sans oublier un espace).

```
quiet init=/usr/lib/raspi-config/init_resize.sh
```

Il est indispensable de ne pas redémarrer la MoodleBox, sans quoi l'opération décrite dans cette section devra être intégralement recommencée.

12 Nettoyage de la distribution

Les commandes ci-dessous permettent de nettoyer la MoodleBox et de diminuer l'espace disque qui lui est nécessaire, avant de la cloner et de la distribuer.

```
$ sudo rm -r /var/www/moodledata/cache/*
$ sudo rm -r /var/www/moodledata/localcache/*
$ sudo rm -r /var/www/moodledata/temp/*
$ sudo rm -r /var/www/moodledata/trashdir/*
$ sudo rm -r /var/www/moodledata/sessions/*
$ sudo rm -r /var/cache/moodle/*
$ sudo rm -r /var/cache/moodle-cache-backup/*
$ sudo mysql moodle -e "truncate table moodle.mdl_logstore_standard_log"
$ sudo mysql moodle -e "truncate table moodle.mdl_config_log"
$ sudo mysql moodle -e "truncate table moodle.mdl_upgrade_log"
$ sudo apt-get clean
$ sudo rm -r /var/lib/apt/lists/*
$ sudo rm -r /var/cache/debconf/*
$ sudo rm -r /tmp/*
```

```
$ sudo rm -r /var/tmp/*
$ rm ~/.mysql_history
$ sudo bash -c 'for logs in `find /var/log -type f`; do > $logs; done'
$ cat /dev/null > ~/.bash_history && history -c && sudo shutdown -h now
```

Si tout s'est bien passé, la totalité a une taille d'environ 1.6 Go. L'image-disque, une fois tronquée, a une taille d'environ 1.9 Go. Compressée, elle tient dans environ 550 Mo.

13 Acknowledgements

MoodleBox utilise certaines idées de la première version de Christian Westphal,[20] qui mérite pour cela une gratitude particulière.

[20] Christian Westphal, Académie de Strasbourg, voir https://moodle.org/user/view.php?id=1378197&course=20.