Setup Raspberry Pi in headless mode

Headless Mode means system runs without any primary input and output such as keyboard or monitor. The system won't use any desktop environment and therefore GUI applications cannot run. The headless mode is set from the installation step, and all settings are configured via files or terminals. Raspberry Pi OS has a lite version which is actually a headless mode OS.

#pi #headless

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Table of Content

1. Download Lite OS Image

Official images for recommended operating systems are available to download from the Raspberry Pi website download page.

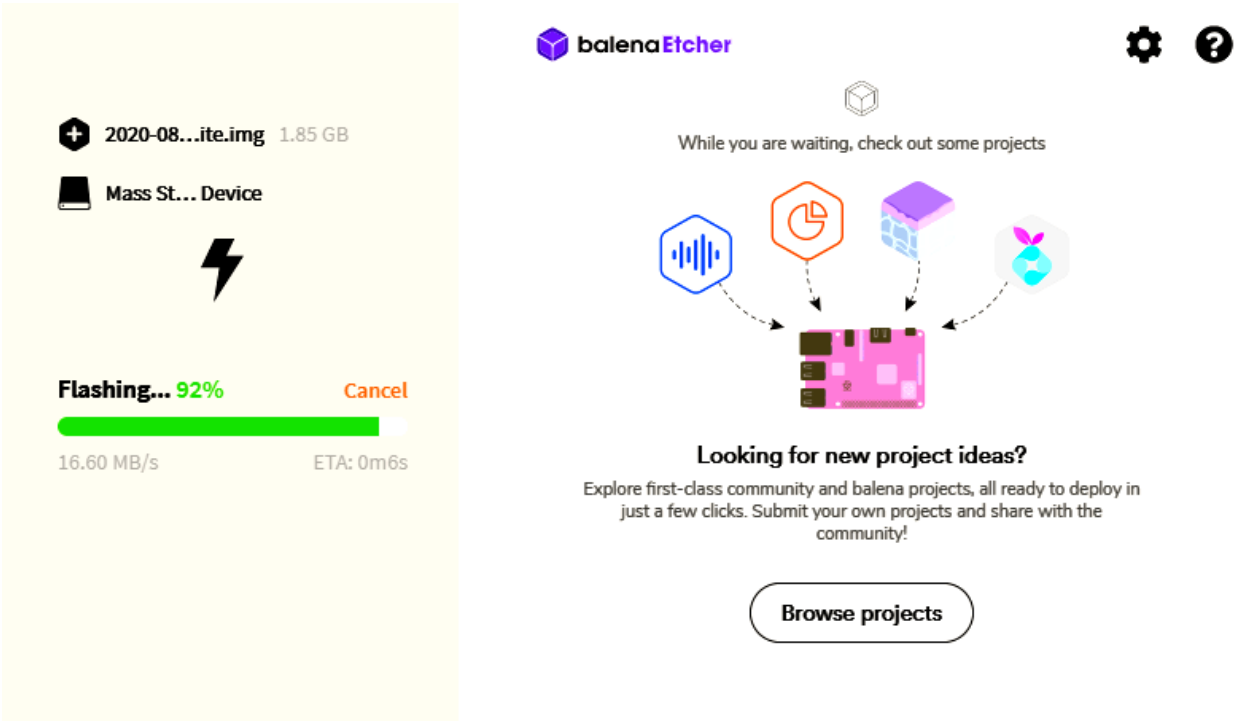
Headless Mode is available in the *Raspberry Pi OS Lite* version, please download the OS zip file in preparation. The release notes of Lite OS is listed here.

2. Burn Image to SDCard

> Raspberry Pi Imager is the official Image Writer from Raspberry Pi.

The application balenaEtcher is a very good image writer that will write the OS image to an SDCard. Download and install it, then run it. Just follow the guided steps:

- **Select image** - browse to the zip file downloaded above
- **Select drive** - it may find the SDCard drive automatically
- Click **Flash**



Etcher is writing the OS image

After copying the image to the target SDCard, File Explorer may have trouble seeing the content of that SDCard. A simple fix is to pull the SDCard out then plug it back. It should appear with a partition named *boot*.

3. Enable SSH

For security reasons, Secure Socket Shell (`ssh`) is no longer enabled by default. To enable it, place a blank text file called *ssh* /* no file extension */ in the root of the *boot* partition on the SDCard.

4. Add WiFi Network

To add a wireless network which Pi will automatically connect to, create a text file called `wpa_supplicant.conf` and place that file in the root of the *boot* partition on SDCard too.

In below config file, the `ssid` field is the WiFi Access Point name, and the `psk` field is the password of that WiFi.

wpa_supplicant.conf

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

network={
    ssid="NETWORK-NAME"
    psk="NETWORK-PASSWORD"
}
```

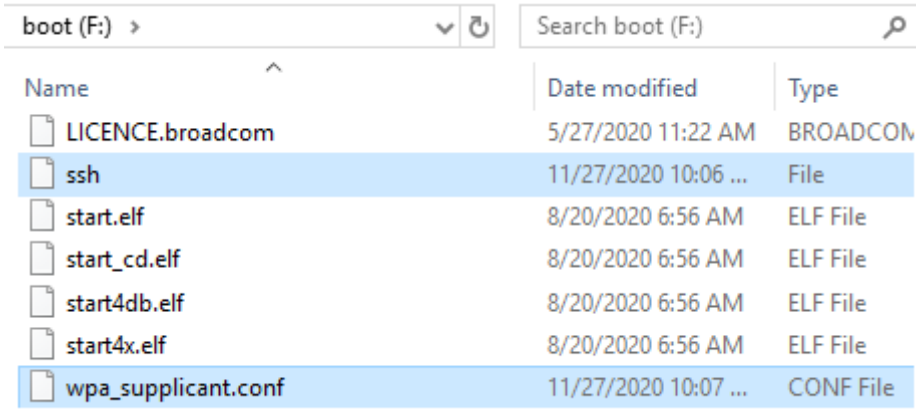
See ISO 3166-1 country codes to fill into `country` field.

If the target network is a hidden one, an extra option in the `wpa_supplicant.conf` file, `scan_ssid=1` , may help connection.

Adding multiple wireless network configurations is allowed, with some extra fields to set the name and the priority (higher number gets connected first):

```
network={
    ssid="HomeOneSSID"
    psk="passwordOne"
    priority=1
    id_str="homeOne"
}

network={
    ssid="HomeTwoSSID"
    psk="passwordTwo"
    priority=2
    id_str="homeTwo"
}
```



*Added `ssh` and `wpa_supplicant.conf` in the **boot** partition*

Direct USB connection (Pi Zero / Zero W Only)

See the below section to skip setting a WiFi network, as it will setup a virtual network over the USB connection.

5. Direct USB connection (Pi Zero / Zero W Only)

On Pi Zero / Zero W only, it's able to turn on USB OTG mode and the Pi will act as an USB slave with different modes: Serial, Ethernet, Mass storage device, etc. The research was published here and here.

This step will setup Pi in USB OTG Ethernet mode, so that when plugging Pi into computer by the Peripheral USB port /* labelled USB, not PWR */, there is virtual network will be created and Pi can be accessed over that network, and no need of an external WiFi network is required. This method also helps to power Pi over the USB port.

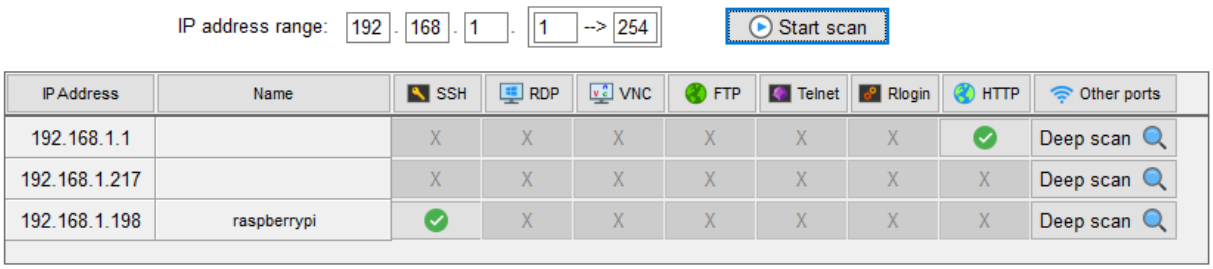
1. Add `dtoverlay=dwc2` on a new line in the `config.txt` file.
2. Open up the `cmdline.txt` file. Insert `modules-load=dwc2,g_ether` after `rootwait` with *only one space* between the text `rootwait` and the new text!!!

6. Login to Pi

Power Pi up and wait for the power led gets stable. Use any Network Scanner to detect the IP of the Pi. A plugin on MobaXterm can be used too.

For the official Raspberry Pi OS, the default user name is `pi`, with password `raspberry`, on the host `raspberrypi`.

Bonjour is a service from Apple to discovery devices in a network using hostname. Install it and then Pi can be connected using its default hostname `raspberrypi.local`.



Scan for Pi's IP

Review Network Settings

This command should list the network connection in the first line for *wlan0*:

```
iwconfig
```

This command should show info for *wlan0*:

```
ifconfig
```

This command should list the *wlan0* network with details:

```
iwlist wlan0 scan
```

Connect to another Wifi network

Open the `wpa-supplicant` configuration file in nano:

```
sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
```

Go to the bottom of the file and add the following:

```
network={
    ssid="NETWORK-NAME"
    psk="NETWORK-PASSWORD"
}
```

Reconfigure the interface with:

```
wpa_cli -i wlan0 reconfigure
```

Verify whether it has successfully connected using `ifconfig wlan0`

7. Update system (optional)

To get the latest version of Pi OS and its packages, please update the system by entering below commands:

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

8. Expand Filesystem (optional)

To use all of available space on the SDCard, expand the filesystem by running:

```
sudo raspi-config
```

Select **Advanced Options → Expand Filesystem**

Then reboot the system.

9. Serial Console

By default, the primary UART is assigned to the Linux console, and the secondary UART is connected to Bluetooth Module (on modle having Bluetooth feature - Pi Zero W, Pi 3, and Pi 4). Use `raspi-config` to disable the Linux serial console, then enable UART as an pheripheral.

10. Others (optional)

Please read the Notes - Save power post.