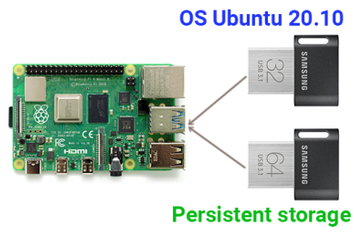
Nodes

I have decided to use Ubuntu 20.10, since this one will now boot from USB out of the box, and is not in Beta, like Raspberry Pi OS 64bit.



Tools / Downloads

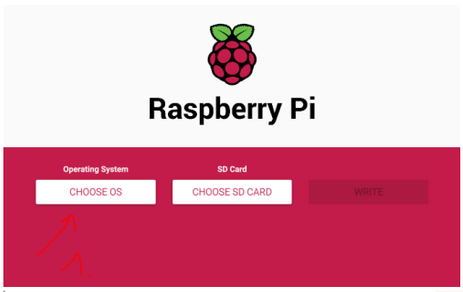
- Etcher (Super easy to "burn" the iso to USB or SD card) – https://www.balena.io/etcher/
- Ubuntu 20.10 64bit Server version – https://ubuntu.com/download/raspberry-pi
- Raspberry Pi Imager – https://www.raspberrypi.org/downloads/ (To make Rpi4 boot from USB, it requires a firmware update, and Ubuntu does not have tools to do this)
- SSH client of your choice, usually putty.

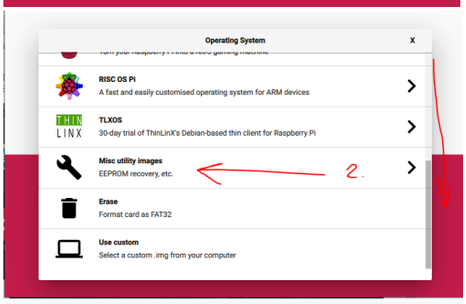
Hardware to have

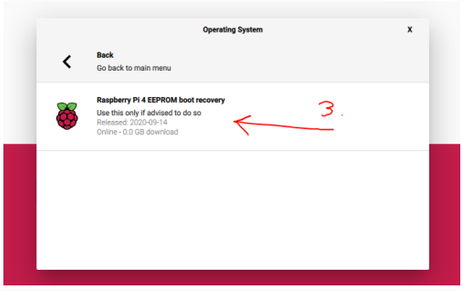
- Some kind of PC to set up the USB and SD card (windows ideally, but can be done with Linux or Mac just as well. We will focus on Windows).
- SD card reader
- USB keyboard / Micro HDMI cable / Monitor
- Rpi4 of course (just don't go overboard with so many 😍)
- USB-C cable and way to power the Rpi4

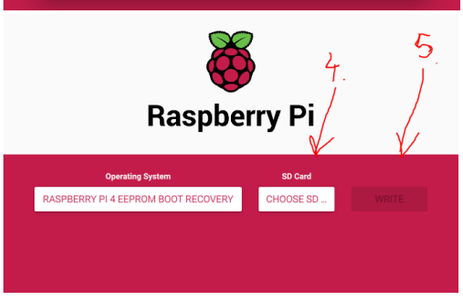
Update Raspberry Pi 4 firmware

Most likely, you will have to update the firmware on Raspberry Pi 4 to enable USB boot. This firmware is out of beta and marked stable, so we should be ok. Sadly, there is an additional step you need to take: get the Raspberry Pi Imager and have it write Raspberry Pi 4 EEPROM boot recovery to the SD card. This is a super small and fast way to update firmware and enable boot from USB.





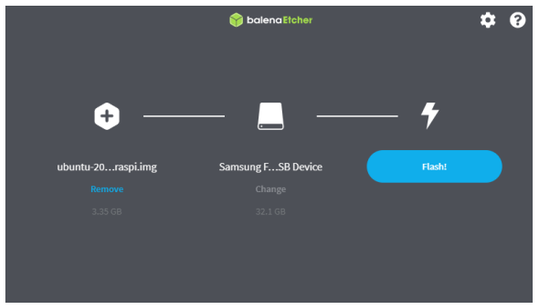




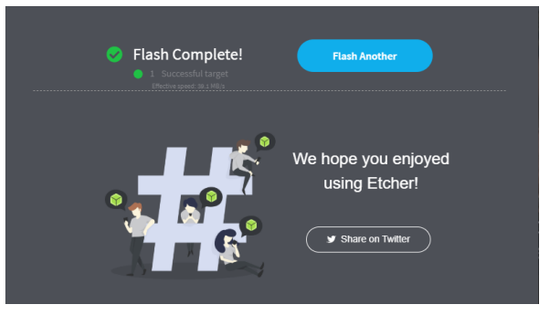
When done, put the SD card to Rpi4 and turn the power on. You don't need to connect anything else; just wait a minute or two until the green light next to power starts blinking periodically. That will mean it's done. The new firmware should be flashed. We can use the same SD card to update every node.

> **Hint**
>
> You have to do this on every Raspberry Pi node you have.

Depending on the number of Raspberry Pis, this will take some time, so just keep on it. There is no hurry, and between flashing you can prepare the Ubuntu 20.10 usbs. It goes without saying that you need to flash as many USB as you have nodes; in my case, it's 9x 32GB USB flash drives. Use etcher.



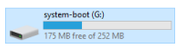
When done, switch to the next USB disk and use "Flash Another".



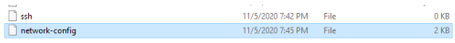
Headless Boot

There are a couple of things we can do before booting the Raspberry Pi 4 for which we don't have to use keyboard and monitor.

When you insert a USB disk with flashed Ubuntu 20.10 from steps above, you will get one partition that you can look up files in.



- Add an empty file called `ssh` - This will enable ssh when the Raspberry Pi 4 boots up.
- Edit network-config – Look into the links in the file for additional options. I will be adding my wifi "Kubernetes" into this, so the Rpi connects right away.



I'm using wifi for connection and all IPs are assigned by DHCP, but already pre-defined to specific IP based on MAC address. This step can be done when all the Rpis are up and running. Log into your router and assign permanent IPs in DHCP:

```
version: 2
ethernets:
  eth0:
    # Rename the built-in ethernet device to "eth0"
    match:
      driver: bcmgenet smsc95xx lan78xx
    set-name: eth0
    dhcp4: true
    optional: true
wifis:
  wlan0:
    dhcp4: true
    optional: true
    access-points:
      "Kubernetes":
        password: "some_password"
```

> **Note**
>
> You could set up static IPs instead; that's up to you.

For a fixed IP it might looks like this:

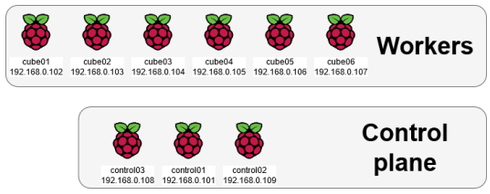
```
network:
    version: 2
    renderer: networkd
    ethernets:
        eth0:
            dhcp4: no
            dhcp4-overrides:
                use-dns: no
            gateway4: 192.168.0.1
            addresses:
              - 192.168.0.101/24
            match:
                driver: bcmgenet smsc95xx lan78xx
            optional: true
            set-name: eth0
```

Boot up

Plug the USB disk into the Raspberry Pi 4 and plug in the power. Now wait a little, watch on the router for a new IP to appear 😃 (If it doesn't, attach your monitor and keyboard, and look for what is wrong). Do not stress about the green light staying on all the time; this is because rPi is trying to read the SD card, which is not there. I will show you how to turn it off later.

Hopefully, you were able to ssh to the new IP and log in with username: ubuntu / password: ubuntu (you will be forced to change password, so make it same on all nodes for now)

For now, only connect the Rpis, make sure they all have unique IPs and are up and running. For reference this is my IP layout.

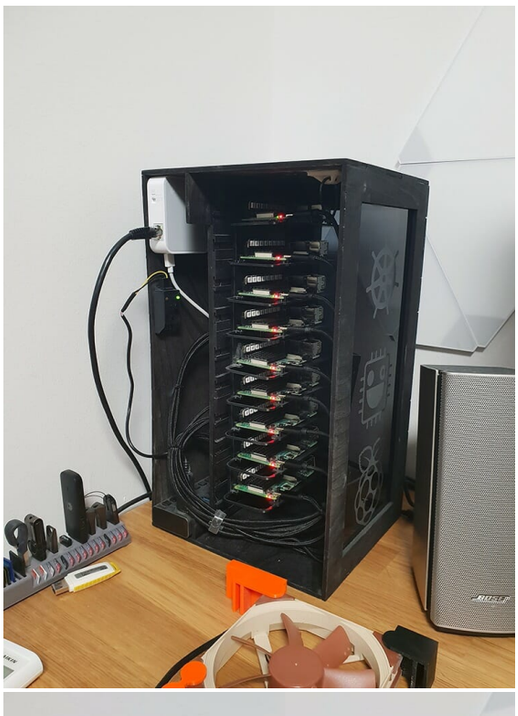


We are going to do some manual tasks on each node. and later we use Ansible a little to help us execute commands on all nodes at once (and yes, you can make one Ansible playbook that would do 99% of deployment, but that's for another tutorial 😃).

Cluster box

I went a bit overboard with Cluster Box...

This is my custom box to house the Raspberry Pi nodes. It's combination of laser cut plywood, plexiglass and 3D printed caddies which hold the nodes themselves. But hey, just get some standoffs and mount them in one column, it will work the same (or tape it to cardboard 😃).

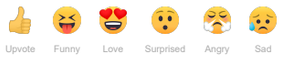


Liked it ? Buy me a drink :)

Last update: May 26, 2022

Comments

What do you think?
6 Responses



Sander Holvoet • 7 months ago
Amazing overview, kudos 👌

Do you think there are any drawbacks to deploying a RPi cluster using Raspberry Pi OS 64-bit, or would you still opt for Ubuntu instead? I'm currently considering using Raspberry Pi OS bullseye for my own cluster: https://downloads.raspberry...

Reply • Share ›

> **vladoportos** Mod ➔ Sander Holvoet • 7 months ago
> Hi,
> Untested for now, but at the time bullseye was not released. If it was I would probably opt for it. Important is that its 64bit, because storage modules does not support 32bit version...
> 1 Reply • Share ›

Abhi Jalan • a year ago
Any thoughts about setting up PXE / netboot for the Pi's?

Reply • Share ›

> **vladoportos** Mod ➔ Abhi Jalan • a year ago
> Hello Abhi,
> yes I thought of it and its a valid solution if you use PXE to boot and use network filesystem to run the OS on. Actually I have seen cluster with 1,060rPis that use that solution :) Thats what happens when Oracle guys get bored hahaha
>
> https://blogs.oracle.com/de...
>
> But it require one stronger PC with all the space and CPU to service that, I wanted to use just the rPi (although for the amount I have maybe just one rpi could handle it...hmm maybe I give it a try :D)
>
> The other solution I was thinking about is to build custom ISO with all the tools need and have it load to RAM... but that, well, eats too much ram from already small amount the rpis have. Also updating anything would require rebuild of the ISO and so on.. too much hassle.
> Reply • Share ›

Vincent • a year ago
Hi,
I wonder why did you choose to run the os from a usb drive instead of the sd card?
Thanks

Reply • Share ›

> **vladoportos** Mod ➔ Vincent • a year ago
> Mostly because of my experience with SD card, they keep dying on me :(maybe I'm just unlucky but have now at least 5 that are dead. So I decided to give USB keys a try, so far so good, none of the them kick the bucket :) Also they seems to be faster. Saying all that, this will work with SD cards just fine.
> Reply • Share ›
>
> > **Vincent** ➔ vladoportos • a year ago
> > Cool, thanks for the tips!
> > Reply • Share ›

cmonty14 • a year ago
Hi,
did you consider to use an OS that was modified for Raspi, e.g. https://dietpi.com/?

Regards
Thomas

Reply • Share ›

> **vladoportos** Mod ➔ cmonty14 • a year ago
> I did look for other OSes, but to be honest I did not find dietpi at the time. Looking at it I see that it also have 64bit image which is good but its in beta so that would exclude it for now (although it very well might work just fine, the 64bit is important since as far as I remember none of the cluster filesystems supported 32bit)
> Reply • Share ›
>
> > **cmonty14** ➔ vladoportos • a year ago
> > DietPi is based on official Raspbian image.
> > To my knowledge new LTS kernel 5.10.11 has been released by RPi Foundation for 32bit as well as 64bit officially.
> > More information here.
> >
> > The advantage of Dietpi compared to Ubuntu Server is clear: it is lightweight.
> > In my opinion Ubuntu Server is overloaded.
> > Reply • Share ›
> >
> > > **vladoportos** Mod ➔ cmonty14 • a year ago
> > > I don't argue, its pretty much preference of the user, just it needs to be 64bit. Seems like the LTS 64bit kernel was released Feb 5, I was writing this guide around December 2020 so it was not ready yet. I will add note and link for alternative OSes to the guide.
> > > Reply • Share ›