Enhanced Privacy Box with Raspberry Pi: Revamped and Containerized

Privacy for you Internet access plus a monitor for your devices, a Wi-Fi/LAN intruder detector and a VPN Server for remote access with a Raspberry Pi.
Bonus track: password manager

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20240210

Changelog

Data	Changes
03/01/23	Added Netdata as a monitoring solution recommended instead RPi-monitor
10/02/24	Updated for Debian 12 (Bookworm), including instructions for container installation. Corrected some misconfigurations.

Note about the changes:

I’m excited to announce the latest update to my comprehensive guide, "Building a Privacy Box with a Raspberry Pi," now titled "Enhanced Privacy Box with Raspberry Pi: Revamped and Containerized". This revised edition addresses and corrects previously inaccuracies, expands on explanations to ensure clarity, and introduces an innovative approach to privacy technology by incorporating containerization. By leveraging containers instead of traditional applications, users gain flexibility, efficiency, and enhanced security for their Internet access, device monitoring, Wi-Fi/LAN intrusion detection, and VPN server functionalities. Whether you're a novice or an experienced Raspberry Pi enthusiast, this guide is your go-to resource for constructing a robust privacy box tailored to the modern digital landscape.

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Introduction

Background

In these uncertain and peculiar times that seem to be stretching on indefinitely, it's crucial that **we safeguard our privacy**. The adage "if you're not paying for it, then you are the product"[1,2] holds true.

We weren't educated in school on the use of Information and Communication Technologies (ICT). Most of us aren't digital natives, and even those who are find that technology evolves faster than our ability to adapt to it. Those fortunate enough to have an affinity for technology and to be early adopters may find it 'somewhat less difficult' to navigate ICT, almost like an intuition. However, this doesn't mean we're safe from the dangers of exposing our lives on the Internet. Various companies are constantly on the lookout to collect our data to create the most accurate profile possible, detailing our tastes, preferences, and habits. They know us much better than we know ourselves, and that's not a cliché, **it's reality.**

This data is collected by companies known as Data Brokers[3] using various techniques. The data is used to create profiles of us for different purposes, such as marketing and advertising, risk mitigation, and people-search services[4,5]. While personalized advertisements might sound appealing to some, it's important to be aware of the side effects, such as differential pricing and other more severe consequences. Companies, armed with extensive information about us, can calculate prices for the services or products we want to acquire or the advertisements we see with high accuracy. For instance, the price for health insurance won't be the same if the company has information about us acquired from Data Brokers. The same applies to the advertisements we see on our devices. Here's an example from Signal: https://signal.org/blog/the-instagram-ads-you-will-never-see/ .

It's common to hear someone say, "I don't care about privacy concerns. I have nothing to hide." A quick response you could give, with a smile on your face, is, "If you have nothing to hide, then you can give me your email password." Of course, they won't, which proves that EVERYONE has some information to protect.

What is a Privacy Box

The Privacy Box, as I call it, is a device designed to enhance your Internet privacy. It comes equipped with various tools that are pre-installed and configured. One of these tools is the Pi-hole application, which blocks advertisements across your entire network for all types of devices, eliminating the need to install software on each individual device.

Another tool is Unbound, a local validating, recursive, and caching DNS resolver. This means that your Internet Service Providers (ISP) won't be able to see what you're searching for, as the Domain Name Resolution will be local and even faster, within your Raspberry Pi.

In addition to these tools, WireGuard, a VPN Server, is also included. This allows for a secure, remote connection to your network, ensuring continued privacy when you're outside your local network.

All these functionalities are installed inside a Raspberry Pi device, allowing it to run 24x7 at a low cost.

Figure 1: Raspberry Pi 3 Model B

The main features of the Privacy Box include:

- **Blocking unwanted content** on all connected devices without the need for client-side software (Pi-hole)
- Providing **network-wide protection** (Pi-hole)
- **Improving network performance** (Pi-hole)
- A **secure open-source recursive DNS server** for local resolution (Unbound)
- A **network intrusion detector** (Pi.Alert)
- **Device monitoring** (RPI-Monitor)
- **Secure and remote access** through a VPN (WireGuard)

As an added bonus, I've included a tutorial on setting up a Raspberry Pi to host a password manager and how to access it from the Internet. I've chosen Vaultwarden, which is based on the well-known solution, Bitwarden. Due to technical reasons, it's easier to run this server on another Raspberry Pi. You could try to set it up on the same device where you have Pi-hole, but I wouldn't recommend it.

If you lack the technological knowledge to follow this guide and build this Privacy Box yourself, ask a friend with more tech knowledge (perhaps a geek) to help you set it up. We techies love to help others. My intention has been to create a very simple tutorial, with step-by-step instructions, explaining the reason for each step so that we can understand what we're doing.

Before we begin, I would like to express my gratitude to Mr.Smashy (@THESMASHY)), who authored a guide[6] that served as the original source of inspiration for this one. His contributions to this field are greatly appreciated. Now, let's get started! 😊

Note: Commands are identified using a different text style and are framed within a grey box like this:

```
$ls -l
```

The command will start with either a $ or # symbol. This indicates whether the command is executed without administrator privileges ($ symbol) or with administrator privileges (# symbol). To elevate privileges (from $ to #), we must run the `sudo -s` command or start the command with `sudo`. In both cases, you will need the administrator password. Here are some examples:

```
$sudo -s
#
```

Running the `ls` command with elevated privileges:

```
$sudo ls
```

Objective

The aim is to provide instructions for installing a set of utilities within a Raspberry Pi to create a Privacy Box that ensures our privacy while browsing the Internet. This includes how to install the WireGuard VPN, which allows us to connect remotely to our network. We will also demonstrate how to set up Vaultwarden, an alternative implementation of the Bitwarden password manager. This tool will be installed on a separate Raspberry Pi device.

Requirements

Here is the list of requirements:

- Raspberry Pi 3 Model B (or higher)
- A computer to write the image and connect to the Raspberry Pi for configuration
- SD Card, USB memory stick, or SSD HD (capacity: 16 GB or higher)
- Internet connection
- Basic knowledge of computers or a tech-savvy friend
- Basic knowledge of the Linux editor nano
- Power supply
- Curiosity
- Time

Note 1: Regarding the computer, I have used my laptop with GNU/Linux (EndevourOS flavor) to write the image and connect to the Raspberry Pi, so the commands you will see belong to the GNU/Linux operating system. The remaining instructions are independent of the operating system you use. If you are a Windows or Mac user, you will find several alternatives easily on the Internet to write the image to the SD Card or USB stick and connect to the Raspberry Pi.

Note 2: Whether to choose an SD Card, USB memory stick, or SSD HD? People say the lifetime of an SD Card is shorter than a USB memory stick or SSD HD, so many people boot from an SD Card and use a USB memory stick or an SSD hard drive to run the operating system. From Raspberry Pi 3 and up, the operating system can be booted and run directly from the USB. In this manual, I have added some tools to decrease the write cycles to the disk using RAM memory. Which one to choose? I would recommend using an SSD HD.

Important: MAKE REGULAR BACKUPS to ensure you have a plan B for any incident related to the device.

Setup of the Privacy Box

This section will explain how to set up Pi-hole and Unbound, along with other optional and recommended tools.

Why I chose Debian instead of Raspbian or RaspberryPi OS

There are several reasons why I chose a Debian image instead of Raspbian or RaspberryPi OS. The main reason is freedom. Debian is a full GNU/Linux flavor, with no commercial or proprietary software.

A second reason is the incident related to the internal repository files modification without notification that Raspbian did in February 2021[7,8,9]. A Microsoft repository pointing to a Microsoft server was added secretly without any notification. The reason was to provide Visual Studio Code for some scenarios. This modification without consent crossed the boundaries of my trust and made me decide to move to a full open-source distribution like Debian. If they changed this without notification, what could they do next time?

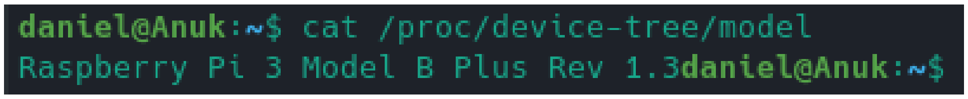
Identifying the device

To identify your Raspberry Pi model, you can use a command that queries the device directly. This is particularly useful if you're unsure about the model even after visually inspecting it.

You can run the following command in the terminal:

```
$cat /proc/device-tree/model
```

This command will return the Raspberry Pi Model. It's a straightforward and reliable way to confirm the specific model of your Raspberry Pi.

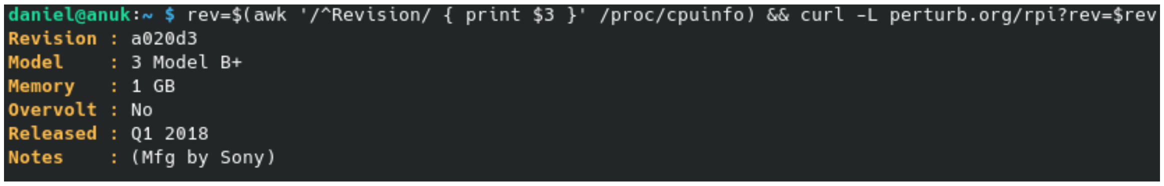


```
daniel@Anuk:~$ cat /proc/device-tree/model
Raspberry Pi 3 Model B Plus Rev 1.3daniel@Anuk:~$
```

If you have installed Raspbian as your operating system, you can use the following command to check your Raspberry Pi model. This command will return information about your device:

```
$rev=$(awk '/^Revision/ { print $3 }' /proc/cpuinfo) && curl -L
perturb.org/rpi?rev=$rev
```

This command first retrieves the revision number of your Raspberry Pi from the CPU info, and then uses `curl` to send a request to `perturb.org` with the revision number as a parameter. The website will return the model information based on the revision number.

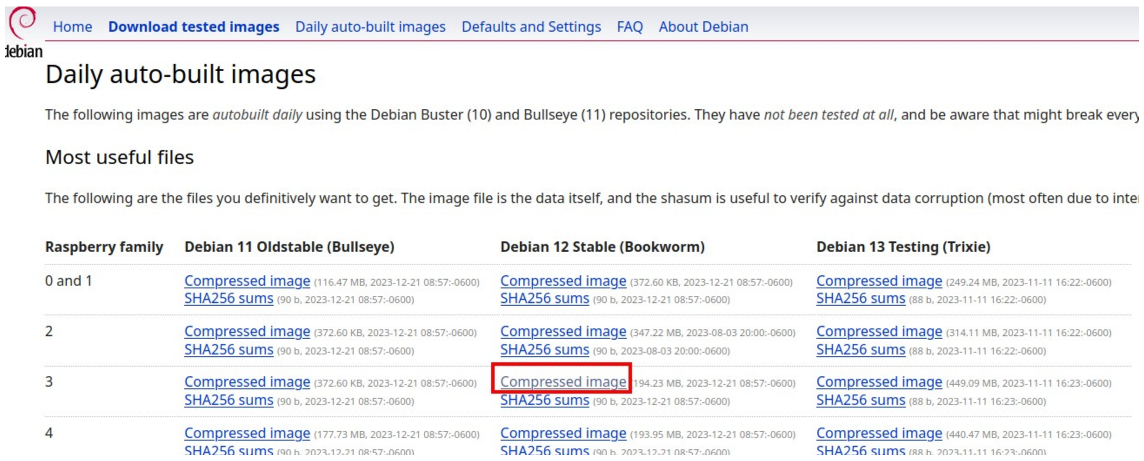


```
daniel@anuk:~ $ rev=$(awk '/^Revision/ { print $3 }' /proc/cpuinfo) && curl -L perturb.org/rpi?rev=$rev
Revision : a020d3
Model    : 3 Model B+
Memory   : 1 GB
Overvolt : No
Released : Q1 2018
Notes    : (Mfg by Sony)
```

Download and Flash an Image

You can download the Debian image for Raspberry Pi from https://raspi.debian.net/. For a production environment, I recommend using a tested image from the daily build available here: https://raspi.debian.net/daily-images/

Choose the xz-compressed image that corresponds to your hardware.



Daily auto-built images

The following images are *autobuilt daily* using the Debian Buster (10) and Bullseye (11) repositories. They have *not been tested at all*, and be aware that might break every

Most useful files

The following are the files you definitively want to get. The image file is the data itself, and the shasum is useful to verify against data corruption (most often due to inte

Raspberry family	Debian 11 Oldstable (Bullseye)	Debian 12 Stable (Bookworm)	Debian 13 Testing (Trixie)
0 and 1	Compressed image (116.47 MB, 2023-12-21 08:57:-0600) SHA256 sums (90 b, 2023-12-21 08:57:-0600)	Compressed image (372.60 KB, 2023-12-21 08:57:-0600) SHA256 sums (90 b, 2023-12-21 08:57:-0600)	Compressed image (249.24 MB, 2023-11-11 16:22:-0600) SHA256 sums (88 b, 2023-11-11 16:22:-0600)
2	Compressed image (372.60 KB, 2023-12-21 08:57:-0600) SHA256 sums (90 b, 2023-12-21 08:57:-0600)	Compressed image (347.22 MB, 2023-08-03 20:00:-0600) SHA256 sums (90 b, 2023-08-03 20:00:-0600)	Compressed image (314.11 MB, 2023-11-11 16:22:-0600) SHA256 sums (88 b, 2023-11-11 16:22:-0600)
3	Compressed image (372.60 KB, 2023-12-21 08:57:-0600) SHA256 sums (90 b, 2023-12-21 08:57:-0600)	Compressed image 194.23 MB, 2023-12-21 08:57:-0600) SHA256 sums (90 b, 2023-12-21 08:57:-0600)	Compressed image (449.09 MB, 2023-11-11 16:23:-0600) SHA256 sums (88 b, 2023-11-11 16:23:-0600)
4	Compressed image (177.73 MB, 2023-12-21 08:57:-0600) SHA256 sums (90 b, 2023-12-21 08:57:-0600)	Compressed image (193.95 MB, 2023-12-21 08:57:-0600) SHA256 sums (90 b, 2023-12-21 08:57:-0600)	Compressed image (440.47 MB, 2023-11-11 16:23:-0600) SHA256 sums (88 b, 2023-11-11 16:23:-0600)

Once you've downloaded the file, locate it and open a console session in that folder. You can decompress the downloaded image using the following `unxz` command:

```
$unxz raspi_3_bookworm.img.xz
```

This will result in an img file. In my case, it's `raspi_3_bookworm.img`.

Next, plug an SD card or USB into your laptop and flash the image to the device with the following command (replace sdb with the identifier for your SD Card or USB):

```
$sudo dd bs=4M if=raspi_3_bookworm.img of=/dev/sdb conv=fdatasync
status=progress
```

If you choose to boot and run the operating system from the USB, you'll need to configure the device to boot from USB. You can find the settings for booting from USB on the Raspberry Pi website.

Please note that if you have a Raspberry Pi 2 version 1.1 or lower, you can only boot from SD, but then you can switch to the USB.

Configuring remote access with SSH

The secure way to connect to your Raspberry Pi is through an SSH connection. This can be done in two ways:

1. **Using a login and password:** This method allows anyone who knows the username and password to connect to the device from any location.
2. **Using an SSH key:** This method is more secure. Your public key is stored on the remote machine and a private key is stored on your machine. Both SSH keys are required to establish a secure connection.

I recommend setting up the second method.

Enable SSH on Raspberry Pi in Headless Mode Without Keys

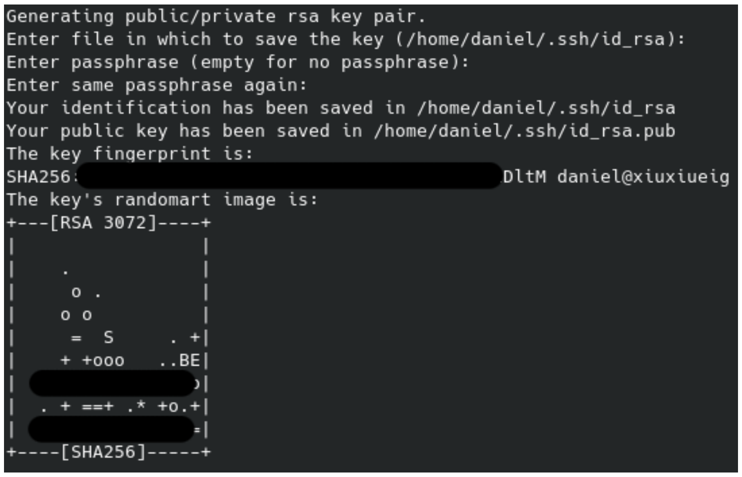
First, we need to enable the SSH connection, which is disabled by default for security reasons. Here are the steps:

1. Turn off the device and remove the card or USB.
2. Insert the microSD card into the card reader or plug the USB into the computer.
3. Create an empty file inside the boot partition called `SSH`.

Pre-configuration and Enabling SSH Remote Connection Using SSH Key

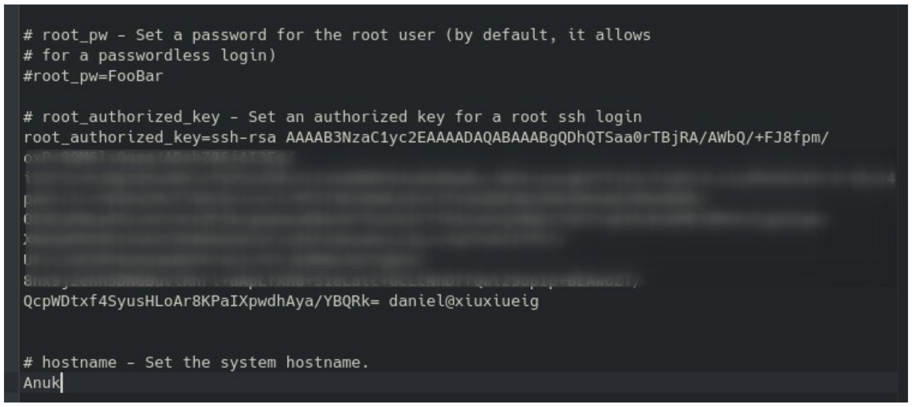
We are going to generate SSH keys on our computer and copy the public key into `sysconf.txt` (raspifirm partition). Use the following command to generate the keys:

```
$ssh-keygen -t rsa
```



```
Generating public/private rsa key pair.
Enter file in which to save the key (/home/daniel/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/daniel/.ssh/id_rsa
Your public key has been saved in /home/daniel/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:[redacted]DltM daniel@xiuxiueig
The key's randomart image is:
+---[RSA 3072]----+
|                 |
|    .            |
|     o .         |
|    o o          |
|     =  S     . +|
|    + +ooo   ..BE|
|[redacted]|
|  . + ==+ .* +o.+|
|[redacted]=|
+----[SHA256]-----+
```

Next, edit sysconf.txt, uncomment the root_authorized_key entry, and paste the public key generated in the previous step (located in the id_rsa.pub file). You can also modify the hostname of the Raspberry Pi (I have chosen ‘Anuk’).



```
# root_pw - Set a password for the root user (by default, it allows
# for a passwordless login)
#root_pw=FooBar

# root_authorized_key - Set an authorized key for a root ssh login
root_authorized_key=ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABgQDhQTSaa0rTBjRA/AWbQ/+FJ8fpm/
[redacted]
QcpWDtxf4SyusHLoAr8KPaIXpwdhAya/YBQRk= daniel@xiuxiueig


# hostname - Set the system hostname.
Anuk
```

Configuring a static IP address

To set a static IP address, navigate to the `RASPIROOT` partition and modify the `eth0` file located at the following path: `/etc/network/interfaces.d/eth0`. Set the IP address of your choice and the IP of the corresponding router gateway. In my case, these are `192.168.1.10` and `192.168.1.1`, respectively. The file should look like:

```
auto eth0
iface eth0 inet static
        address 192.168.1.10
        netmask 255.255.255.0
        gateway 192.168.1.1
```

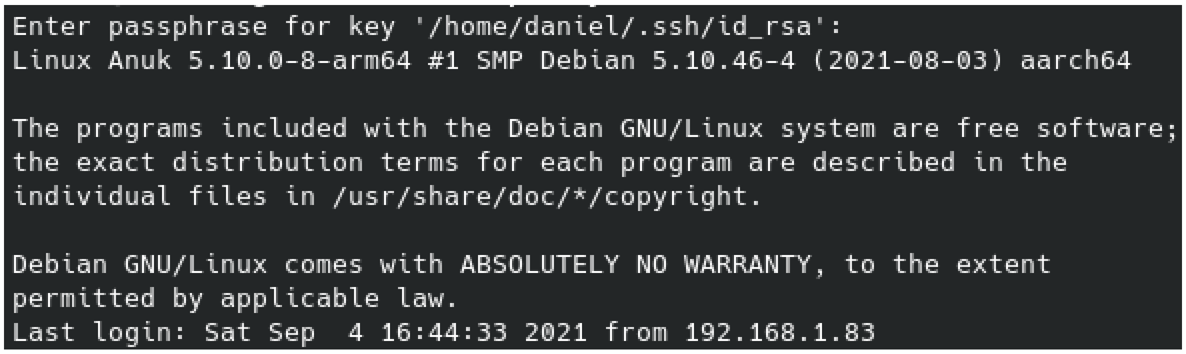
Configuring DNS

We will set the DNS to Cloudflare (either `1.1.1.1` or `1.0.0.1`). Create the file `/etc/resolv.conf` with the chosen DNS:

```
nameserver 1.0.0.1
```

After setting up the DNS, put the SD Card or USB stick back into the Raspberry Pi and boot it. Now, you can try to connect to the Raspberry Pi from your computer using the username `root` and the IP address you set.

```
$ssh root@192.168.1.10
```



```
Enter passphrase for key '/home/daniel/.ssh/id_rsa':
Linux Anuk 5.10.0-8-arm64 #1 SMP Debian 5.10.46-4 (2021-08-03) aarch64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sat Sep  4 16:44:33 2021 from 192.168.1.83
```

Additional configurations

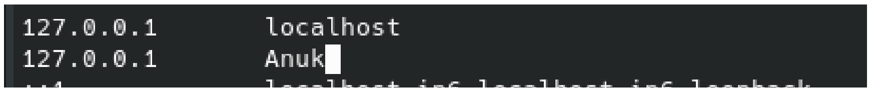
Setting the Hostname

Set the hostname by editing the file `/etc/hostname`:

```
#nano /etc/hostname
```

Add a hostname entry to the hosts file (in my case, 'Anuk'):

```
#nano /etc/hosts
```



```
127.0.0.1       localhost
127.0.0.1       Anuk
```

If you're using Raspbian, you can set the hostname through the `raspi-config` application.

Updating the System

Update the system to get the latest updates:

```
#apt update && apt-get upgrade -y
```

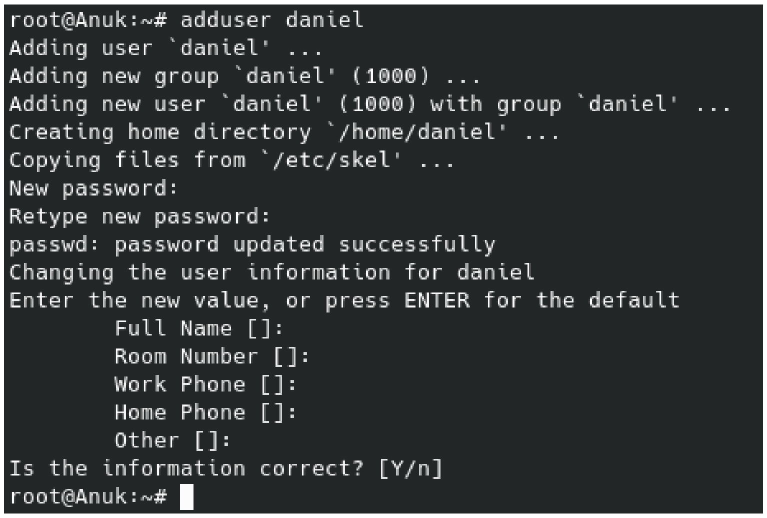
Install some additional software that we will need:

```
#apt install sudo dnsutils gnupg wget curl git
```

Adding a Non-Root User

Add a non-root user and set a password for it:

```
#adduser daniel
```



```
root@Anuk:~# adduser daniel
Adding user `daniel' ...
Adding new group `daniel' (1000) ...
Adding new user `daniel' (1000) with group `daniel' ...
Creating home directory `/home/daniel' ...
Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for daniel
Enter the new value, or press ENTER for the default
        Full Name []:
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n]
root@Anuk:~#
```

Add the user to the `sudo` and `video` groups:

```
#adduser daniel video
#adduser daniel sudo
```

Note: If you're using Raspbian OS, the default user is 'pi'. I recommend creating another user and removing the default one once you've created the new one with the following commands:

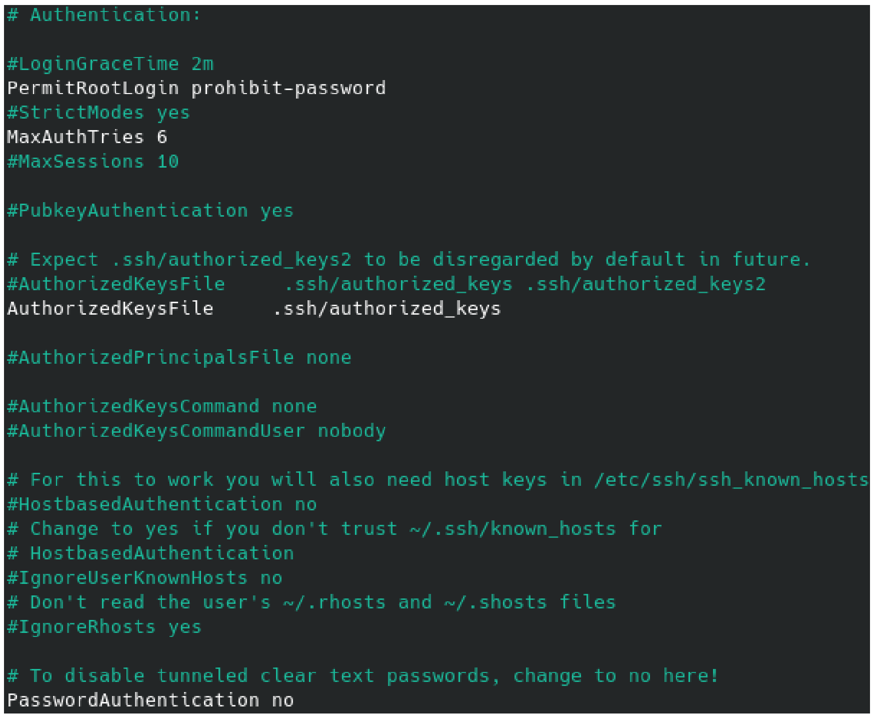
```
$sudo pkill -u pi
$sudo deluser --remove-home pi
```

Lock Down the SSH Service

Edit the SSH config file. We recommend using the SSH keys generated previously and disabling password access:

```
$sudo nano /etc/ssh/sshd_config
```

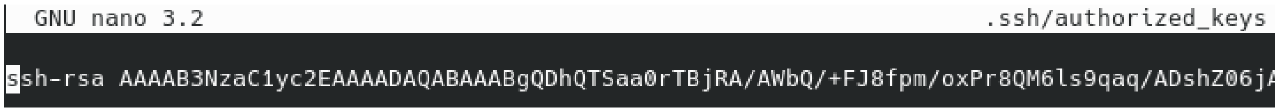
Uncomment the lines in white



```
# Authentication:

#LoginGraceTime 2m
PermitRootLogin prohibit-password
#StrictModes yes
MaxAuthTries 6
#MaxSessions 10

#PubkeyAuthentication yes

# Expect .ssh/authorized_keys2 to be disregarded by default in future.
#AuthorizedKeysFile     .ssh/authorized_keys .ssh/authorized_keys2
AuthorizedKeysFile     .ssh/authorized_keys

#AuthorizedPrincipalsFile none

#AuthorizedKeysCommand none
#AuthorizedKeysCommandUser nobody

# For this to work you will also need host keys in /etc/ssh/ssh_known_hosts
#HostbasedAuthentication no
# Change to yes if you don't trust ~/.ssh/known_hosts for
# HostbasedAuthentication
#IgnoreUserKnownHosts no
# Don't read the user's ~/.rhosts and ~/.shosts files
#IgnoreRhosts yes

# To disable tunneled clear text passwords, change to no here!
PasswordAuthentication no
```

and copy-paste the public key we generated previously:

```
$mkdir -p ~/.ssh
$nano ~/.ssh/authorized_keys
```



```
  GNU nano 3.2                                                   .ssh/authorized_keys

ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABgQDhQTSaa0rTBjRA/AWbQ/+FJ8fpm/oxPr8QM6ls9qaq/ADshZ06j
```

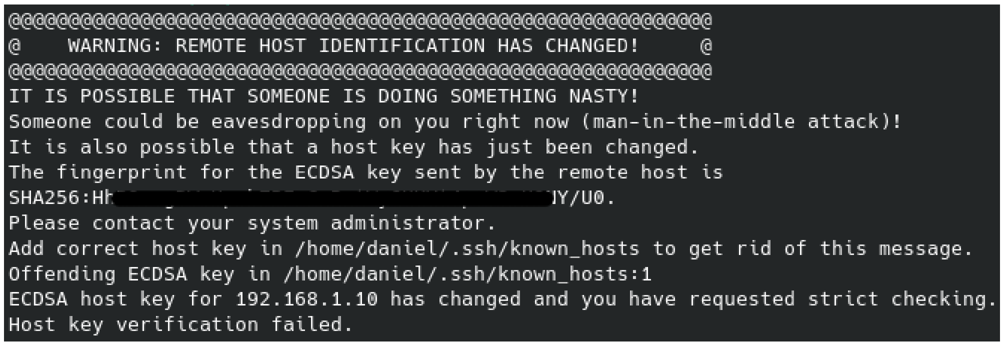
Save changes and exit the editor. Restart SSH:

```
$sudo service ssh restart
```

Restart the service. We’re going to be disconnected in case we were connected through SSH:

```
$sudo service networking restart
```

If you’ve previously assigned this IP address, you’ll get a message.



```
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@    WARNING: REMOTE HOST IDENTIFICATION HAS CHANGED!     @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
IT IS POSSIBLE THAT SOMEONE IS DOING SOMETHING NASTY!
Someone could be eavesdropping on you right now (man-in-the-middle attack)!
It is also possible that a host key has just been changed.
The fingerprint for the ECDSA key sent by the remote host is
SHA256:H[redacted]Y/U0.
Please contact your system administrator.
Add correct host key in /home/daniel/.ssh/known_hosts to get rid of this message.
Offending ECDSA key in /home/daniel/.ssh/known_hosts:1
ECDSA host key for 192.168.1.10 has changed and you have requested strict checking.
Host key verification failed.
```

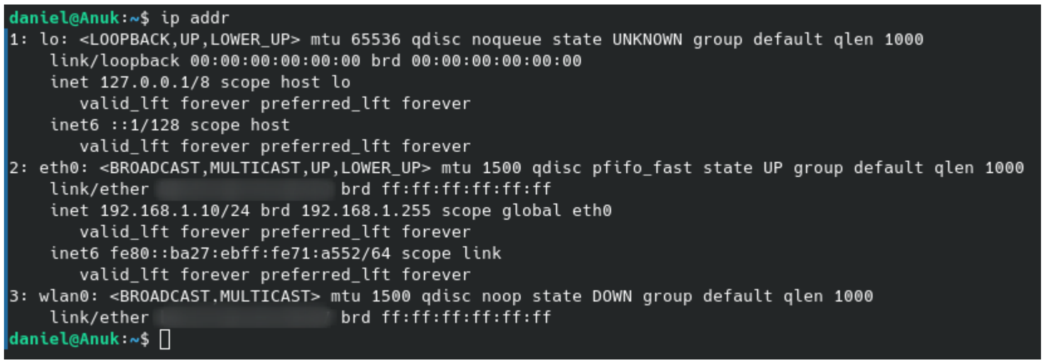
Just delete the entry in your known hosts database:

```
$nano ~/.ssh/known_hosts
```

Logout as root and login as the new user (in my case, 'daniel'):

```
$ssh daniel@192.168.1.10
```

Check the IP configuration (static IP and DNS configuration).



```
daniel@Anuk:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether [redacted] brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.10/24 brd 192.168.1.255 scope global eth0
       valid_lft forever preferred_lft forever
    inet6 fe80::ba27:ebff:fe71:a552/64 scope link
       valid_lft forever preferred_lft forever
3: wlan0: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group default qlen 1000
    link/ether [redacted] brd ff:ff:ff:ff:ff:ff
daniel@Anuk:~$
```

Setting the Time Zone

Set our time zone. We can check all the time zones listed with the command:

```
$timedatectl list-timezones
```

Choose the one that fits you best. In my case, I chose 'Europe/Madrid':

```
$sudo timedatectl set-timezone Europe/Madrid
```

Once set, you can retrieve the status with the following command:

```
$timedatectl status
```

We're going to set the time automatically, using the NTP protocol which helps us to change and synchronize the date and time periodically:

```
$sudo nano /etc/systemd/timesyncd.conf
```

Set NTP to ‘time.cloudflare.com’ and uncomment the `FallbackNTP` and `PollIntervalMaxSec` lines.

Installing Unattended Upgrades Package (Recommended)

To have unattended upgrades, we need to install an additional package:

```
$sudo apt install unattended-upgrades
```

The configuration of unattended upgrades is set inside this file:

```
$sudo nano /etc/apt/apt.conf.d/50unattended-upgrades
```

You may want to update some settings. I recommend uncommenting and changing ‘Unattended-Upgrade::Remove-Unused-Dependencies’ to ‘true’. Exit and save the file.

Basically, we commented out the type of upgrade we want to apply. The second last line allows the system to email us the status. We must install `mailutils` or `mailx` first in Raspbian for the email notification to be effective. The last line allows the system to reboot automatically. Please also make sure that `update-notifier-common` has been installed.

There are more options that we can set such as reboot time and log file in the configuration file. Uncomment any option when necessary.

Create a periodic upgrade file with the following command:

```
$sudo nano /etc/apt/apt.conf.d/02periodic
```

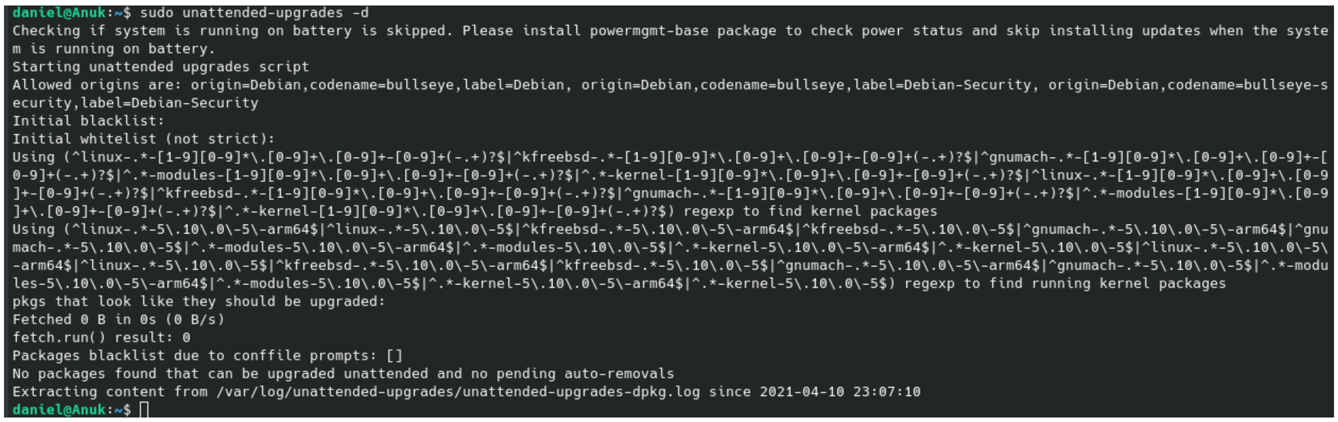
And add the following content:

```
// Control parameters for cron jobs by /etc/cron.daily/apt-compat //


// Enable the update/upgrade script (0=disable)
APT::Periodic::Enable "1";

// Do "apt-get update" automatically every n-days (0=disable)
APT::Periodic::Update-Package-Lists "1";

// Do "apt-get upgrade --download-only" every n-days (0=disable)
APT::Periodic::Download-Upgradeable-Packages "1";
```

```
// Run the "unattended-upgrade" security upgrade script
// every n-days (0=disabled)
// Requires the package "unattended-upgrades" and will write
// a log in /var/log/unattended-upgrades
APT::Periodic::Unattended-Upgrade "1";

// Do "apt-get autoclean" every n-days (0=disable)
APT::Periodic::AutocleanInterval "7";

// Send report mail to root
//     0:  no report             (or null string)
//     1:  progress report       (actually any string)
//     2:  + command outputs     (remove -qq, remove 2>/dev/null, add -d)
//     3:  + trace on
APT::Periodic::Verbose "2";
```

Check your unattended upgrades by running this command to debug your configuration:

```
$sudo unattended-upgrades -d
```



```
daniel@Anuk:~$ sudo unattended-upgrades -d
Checking if system is running on battery is skipped. Please install powermgmt-base package to check power status and skip installing updates when the syste
m is running on battery.
Starting unattended upgrades script
Allowed origins are: origin=Debian,codename=bullseye,label=Debian, origin=Debian,codename=bullseye,label=Debian-Security, origin=Debian,codename=bullseye-s
ecurity,label=Debian-Security
Initial blacklist:
Initial whitelist (not strict):
Using (^linux-.*-[1-9][0-9]*\.[0-9]+\.[0-9]+-[0-9]+(-.+)?$|^kfreebsd-.*-[1-9][0-9]*\.[0-9]+\.[0-9]+-[0-9]+(-.+)?$|^gnumach-.*-[1-9][0-9]*\.[0-9]+\.[0-9]+-[
0-9]+(-.+)?$|^.*-modules-[1-9][0-9]*\.[0-9]+\.[0-9]+-[0-9]+(-.+)?$|^.*-kernel-[1-9][0-9]*\.[0-9]+\.[0-9]+-[0-9]+(-.+)?$|^linux-.*-[1-9][0-9]*\.[0-9]+\.[0-9
]+-[0-9]+(-.+)?$|^kfreebsd-.*-[1-9][0-9]*\.[0-9]+\.[0-9]+-[0-9]+(-.+)?$|^gnumach-.*-[1-9][0-9]*\.[0-9]+\.[0-9]+-[0-9]+(-.+)?$|^.*-modules-[1-9][0-9]*\.[0-9
]+\.[0-9]+-[0-9]+(-.+)?$|^.*-kernel-[1-9][0-9]*\.[0-9]+\.[0-9]+-[0-9]+(-.+)?$) regexp to find kernel packages
Using (^linux-.*-5\.10\.0\-5\-arm64$|^linux-.*-5\.10\.0\-5$|^kfreebsd-.*-5\.10\.0\-5\-arm64$|^kfreebsd-.*-5\.10\.0\-5$|^gnumach-.*-5\.10\.0\-5\-arm64$|^gnu
mach-.*-5\.10\.0\-5$|^.*-modules-5\.10\.0\-5\-arm64$|^.*-modules-5\.10\.0\-5$|^.*-kernel-5\.10\.0\-5\-arm64$|^.*-kernel-5\.10\.0\-5$|^linux-.*-5\.10\.0\-5\
-arm64$|^linux-.*-5\.10\.0\-5$|^kfreebsd-.*-5\.10\.0\-5\-arm64$|^kfreebsd-.*-5\.10\.0\-5$|^gnumach-.*-5\.10\.0\-5\-arm64$|^gnumach-.*-5\.10\.0\-5$|^.*-modu
les-5\.10\.0\-5\-arm64$|^.*-modules-5\.10\.0\-5$|^.*-kernel-5\.10\.0\-5\-arm64$|^.*-kernel-5\.10\.0\-5$) regexp to find running kernel packages
pkgs that look like they should be upgraded:
Fetched 0 B in 0s (0 B/s)
fetch.run() result: 0
Packages blacklist due to conffile prompts: []
No packages found that can be upgraded unattended and no pending auto-removals
Extracting content from /var/log/unattended-upgrades/unattended-upgrades-dpkg.log since 2021-04-10 23:07:10
daniel@Anuk:~$ 
```

Installing Fail2Ban (Optional)

Fail2Ban is an intrusion prevention software designed to protect against brute-force attacks. First, we need to install the package:

```
$sudo apt install fail2ban -y
```

Fail2Ban will block an attacker’s IP if they fail to log in after 5 attempts for 10 minutes.

Note: Fail2Ban installed from the repository will only provide security on the IPv4 protocol. If you want Fail2Ban to support IPv6, please refer to the relevant guide.

The configuration of Fail2Ban is set in the following file: `/etc/fail2ban/jail.conf`. If you make any config changes, restart the service via:

```
$sudo service fail2ban restart
```

In order to recover access, use:

```
$ssh -o PreferredAuthentications=password -o PubkeyAuthentication=no
user@your.vps.ip
```

Installing a Firewall (Optional)

It is recommended to install a firewall to block unsolicited connections. Uncomplicated Firewall (ufw) is a program for managing a netfilter firewall designed to be easy to use. It uses a command-line interface consisting of a small number of simple commands and uses iptables for configuration. To install ufw, just run this command:

```
$sudo apt install ufw
```

Configuring the Firewall

Create your access list to the ports you need:

```
$sudo ufw allow 80
$sudo ufw allow 443
$sudo ufw allow 53
$sudo ufw allow 8888
$sudo ufw allow 22/tcp
```

You can be even more restrictive with extended parameters on the rules, like SSH for example. You can only allow access on port 22 from your computer's IP address:

```
$sudo ufw allow from 192.168.1.120 to any port 22/tcp
```

Enabling the Firewall

```
$sudo ufw enable
```

To show rules once the firewall is enabled, run the following command:

```
$sudo ufw enable
```

To show rules once the firewall is enabled, run the following command:

```
$sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
80                         ALLOW       Anywhere
443                        ALLOW       Anywhere
53                         ALLOW       Anywhere
8888                       ALLOW       Anywhere
22                         ALLOW       Anywhere
5335                       ALLOW       Anywhere
51900/udp                  ALLOW       Anywhere
80 (v6)                    ALLOW       Anywhere (v6)
443 (v6)                   ALLOW       Anywhere (v6)
53 (v6)                    ALLOW       Anywhere (v6)
8888 (v6)                  ALLOW       Anywhere (v6)
22 (v6)                    ALLOW       Anywhere (v6)
5335 (v6)                  ALLOW       Anywhere (v6)
```

Installing Log2Ram to Expand SSD Life (Recommended)

SSD Disks, SD Cards, and USB sticks have an SSD inside, which has a lifespan determined mainly by the write cycles (times we write something to the disk). To reduce the times we write to the SSD memory, we can redirect the writing of the system logs to RAM memory using Log2Ram. To do this, we have to install the Log2Ram application.

First, we need to force a log reduction before starting to use Log2Ram:

```
$sudo journalctl --vacuum-size=16M
```

Let’s add the repository where we are going to install the application and its key. Please check the Debian flavor you are using (bookworm in my case):

```
$echo "deb http://packages.azlux.fr/debian/ bookworm main" | sudo tee
/etc/apt/sources.list.d/azlux.list
wget -qO - https://azlux.fr/repo.gpg.key | sudo apt-key add -
```

Let’s update the system database and install the application:

```
$sudo apt-get update
$sudo apt install log2ram -y
```

Once installed, we need a reboot:

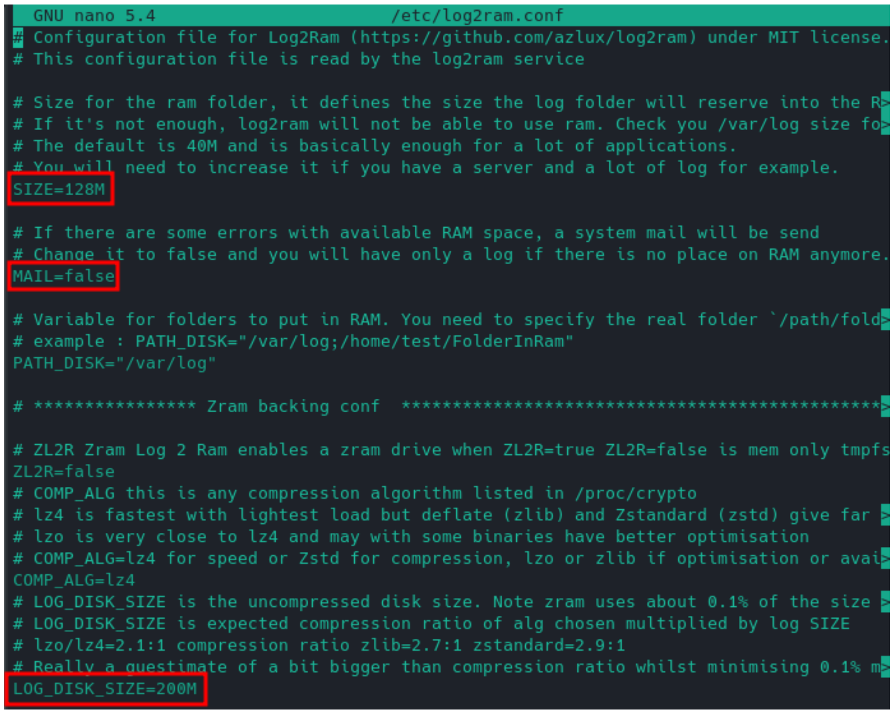
```
$sudo reboot
```

Configuring Log2Ram

We need to configure Log2Ram to increase the size:

```
$sudo nano /etc/log2ram.conf
```

Increase the `SIZE` parameter to `128MB`, disable the mail notification, and increase the `LOG_DISK_SIZE` to `200M`. Exit and save.



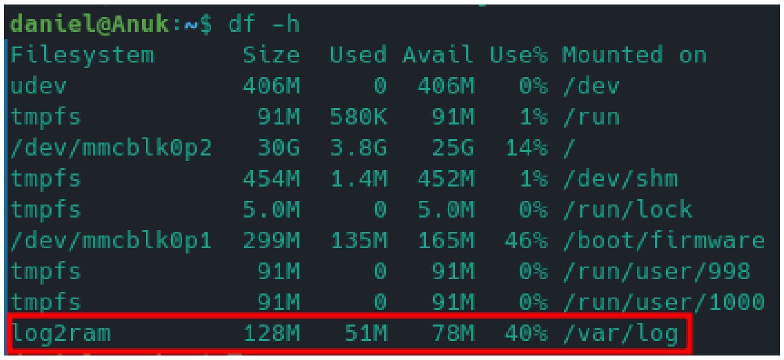
```
  GNU nano 5.4                          /etc/log2ram.conf
# Configuration file for Log2Ram (https://github.com/azlux/log2ram) under MIT license.
# This configuration file is read by the log2ram service

# Size for the ram folder, it defines the size the log folder will reserve into the R>
# If it's not enough, log2ram will not be able to use ram. Check you /var/log size fo>
# The default is 40M and is basically enough for a lot of applications.
# You will need to increase it if you have a server and a lot of log for example.
SIZE=128M

# If there are some errors with available RAM space, a system mail will be send
# Change it to false and you will have only a log if there is no place on RAM anymore.
MAIL=false

# Variable for folders to put in RAM. You need to specify the real folder `/path/fold>
# example : PATH_DISK="/var/log;/home/test/FolderInRam"
PATH_DISK="/var/log"

# **************** Zram backing conf  ***********************************************>

# ZL2R Zram Log 2 Ram enables a zram drive when ZL2R=true ZL2R=false is mem only tmpfs
ZL2R=false
# COMP_ALG this is any compression algorithm listed in /proc/crypto
# lz4 is fastest with lightest load but deflate (zlib) and Zstandard (zstd) give far >
# lzo is very close to lz4 and may with some binaries have better optimisation
# COMP_ALG=lz4 for speed or Zstd for compression, lzo or zlib if optimisation or avai>
COMP_ALG=lz4
# LOG_DISK_SIZE is the uncompressed disk size. Note zram uses about 0.1% of the size >
# LOG_DISK_SIZE is expected compression ratio of alg chosen multiplied by log SIZE
# lzo/lz4=2.1:1 compression ratio zlib=2.7:1 zstandard=2.9:1
# Really a guestimate of a bit bigger than compression ratio whilst minimising 0.1% m>
LOG_DISK_SIZE=200M
```

Restart Log2Ram:

```
$sudo service log2ram restart
```

And check that Log2Ram is running:

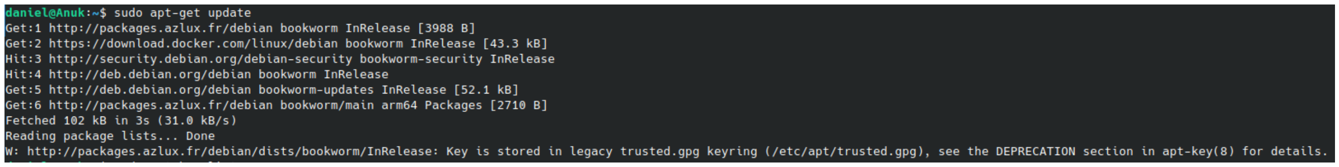
```
$df -h
```



```
daniel@Anuk:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            406M     0  406M   0% /dev
tmpfs            91M  580K   91M   1% /run
/dev/mmcblk0p2   30G  3.8G   25G  14% /
tmpfs           454M  1.4M  452M   1% /dev/shm
tmpfs           5.0M     0  5.0M   0% /run/lock
/dev/mmcblk0p1  299M  135M  165M  46% /boot/firmware
tmpfs            91M     0   91M   0% /run/user/998
tmpfs            91M     0   91M   0% /run/user/1000
log2ram         128M   51M   78M  40% /var/log
```

How to solve apt-key deprecation warning

In case you get the following deprecation warning when adding the Log2Ram repository:

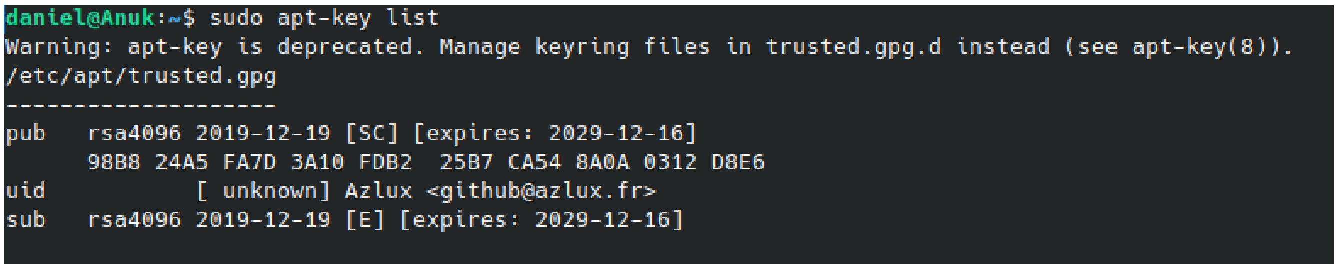


```
daniel@Anuk:~$ sudo apt-get update
Get:1 http://packages.azlux.fr/debian bookworm InRelease [3988 B]
Get:2 https://download.docker.com/linux/debian bookworm InRelease [43.3 kB]
Hit:3 http://security.debian.org/debian-security bookworm-security InRelease
Hit:4 http://deb.debian.org/debian bookworm InRelease
Get:5 http://deb.debian.org/debian bookworm-updates InRelease [52.1 kB]
Get:6 http://packages.azlux.fr/debian bookworm/main arm64 Packages [2710 B]
Fetched 102 kB in 3s (31.0 kB/s)
Reading package lists... Done
W: http://packages.azlux.fr/debian/dists/bookworm/InRelease: Key is stored in legacy trusted.gpg keyring (/etc/apt/trusted.gpg), see the DEPRECATION section in apt-key(8) for details.
```

```
W: http://packages.azlux.fr/debian/dists/bookworm/InRelease: Key is stored
in legacy trusted.gpg keyring (/etc/apt/trusted.gpg), see the DEPRECATION
section in apt-key(8) for details
```

You can fix it by following these steps:

1.Retrieve the list of the repositories. You need the last 8 digits of the public key of the repository you want to trust. In our case, it's the first entry (`0312D8E6`).

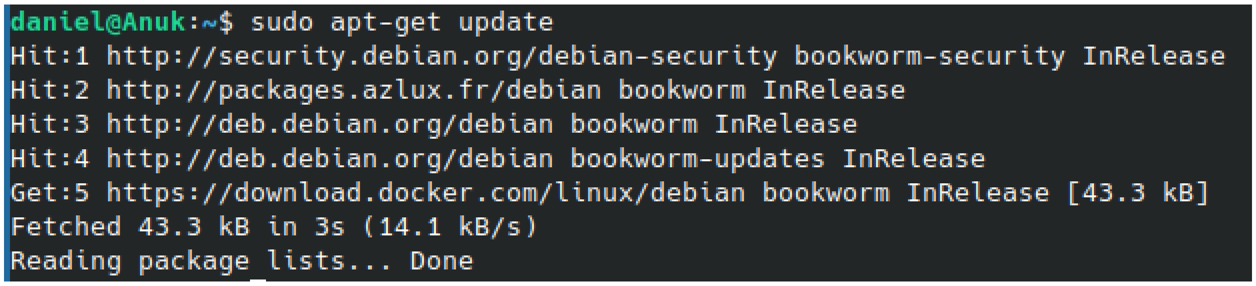


```
daniel@Anuk:~$ sudo apt-key list
Warning: apt-key is deprecated. Manage keyring files in trusted.gpg.d instead (see apt-key(8)).
/etc/apt/trusted.gpg
--------------------
pub   rsa4096 2019-12-19 [SC] [expires: 2029-12-16]
      98B8 24A5 FA7D 3A10 FDB2  25B7 CA54 8A0A 0312 D8E6
uid           [ unknown] Azlux <github@azlux.fr>
sub   rsa4096 2019-12-19 [E] [expires: 2029-12-16]
```

2.Create a new file adding the key:

```
sudo apt-key export 0312D8E6 | sudo gpg --dearmour -o
/etc/apt/trusted.gpg.d/log2ram.gpg
```

Now, you should no longer see the warning message.



```
daniel@Anuk:~$ sudo apt-get update
Hit:1 http://security.debian.org/debian-security bookworm-security InRelease
Hit:2 http://packages.azlux.fr/debian bookworm InRelease
Hit:3 http://deb.debian.org/debian bookworm InRelease
Hit:4 http://deb.debian.org/debian bookworm-updates InRelease
Get:5 https://download.docker.com/linux/debian bookworm InRelease [43.3 kB]
Fetched 43.3 kB in 3s (14.1 kB/s)
Reading package lists... Done
```

Installing and configuring Pi-hole

Now that the system is configured and secured, we can install Pi-hole. It can be installed as a native application (bare metal) or using Docker containers. I previously chose bare metal, but recently I moved to the container world. Here are some advantages and disadvantages of running Pi-hole in a container rather than as a native application:

Advantages

- **Portability:** You can easily move your Pi-hole configuration to another device or system by using docker volumes or backups (you can have a second pi-hole instance in another raspberry pi or running in a NAS).
- **Isolation:** You can run Pi-hole in a separate environment from your host system, which can improve security and prevent conflicts with other applications.
- **Flexibility:** You can customize your Pi-hole installation by using different docker images. You can also use docker-compose to manage multiple containers and services.

Disadvantages

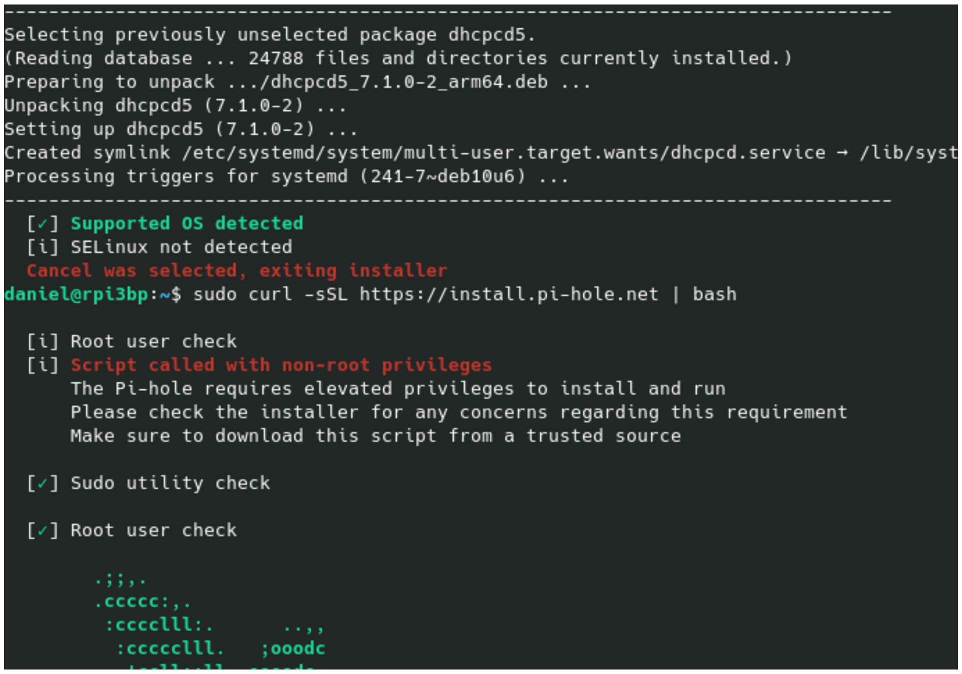
- **Overhead:** You have to install and run docker on your host system, which can consume some resources and add some complexity.
- **Compatibility:** You may encounter some issues with Pi-hole features that rely on the host network, such as DHCP or DNSSEC. You may also need to adjust some settings or ports to make Pi-hole work properly with docker.
- **Updates:** You have to manually update your Pi-hole container when a new version is released, or use a script or a cron job to do it automatically. You also have to keep track of the changes in the docker image and the Pi-hole configuration.

Here there are instructions for both ways:

Bare metal installation

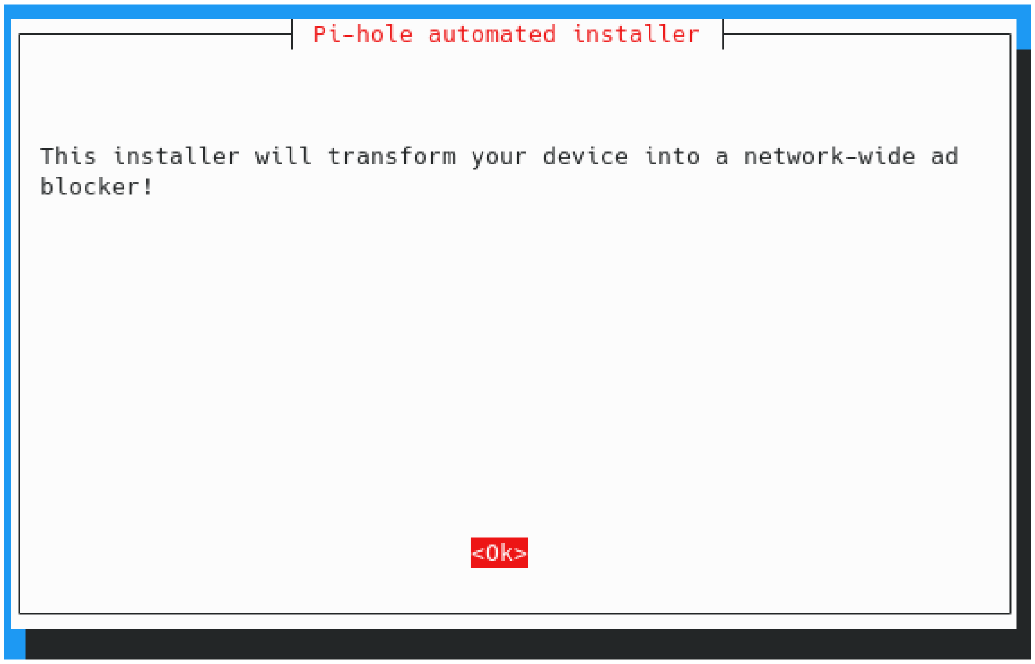
The installation process is very simple. Just download this script from the Pi-hole site and execute it to start the installation with the following command:

```
$sudo curl -sSL https://install.pi-hole.net | bash
```



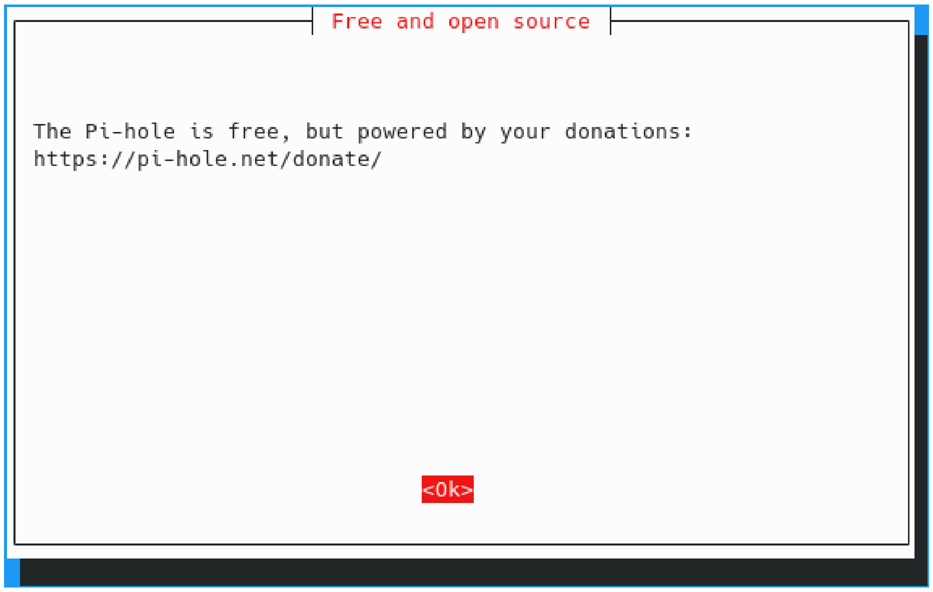
```
--------------------------------------------------------------------------------
Selecting previously unselected package dhcpcd5.
(Reading database ... 24788 files and directories currently installed.)
Preparing to unpack .../dhcpcd5_7.1.0-2_arm64.deb ...
Unpacking dhcpcd5 (7.1.0-2) ...
Setting up dhcpcd5 (7.1.0-2) ...
Created symlink /etc/systemd/system/multi-user.target.wants/dhcpcd.service → /lib/syst
Processing triggers for systemd (241-7~deb10u6) ...
--------------------------------------------------------------------------------
  [✓] Supported OS detected
  [i] SELinux not detected
  Cancel was selected, exiting installer
daniel@rpi3bp:~$ sudo curl -sSL https://install.pi-hole.net | bash

  [i] Root user check
  [i] Script called with non-root privileges
      The Pi-hole requires elevated privileges to install and run
      Please check the installer for any concerns regarding this requirement
      Make sure to download this script from a trusted source

  [✓] Sudo utility check

  [✓] Root user check

        .;;,.
        .ccccc:,.
         :cccclll:.      ..,,
          :ccccclll.   ;ooodc
```

After some checks, you'll be greeted with the install screen

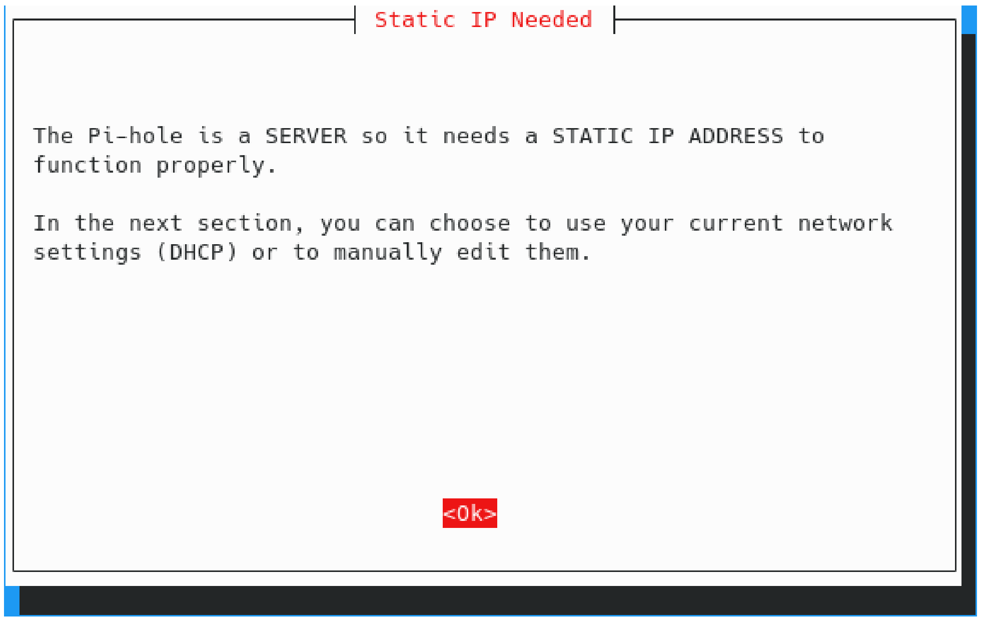


```
Pi-hole automated installer

This installer will transform your device into a network-wide ad
blocker!

<Ok>
```

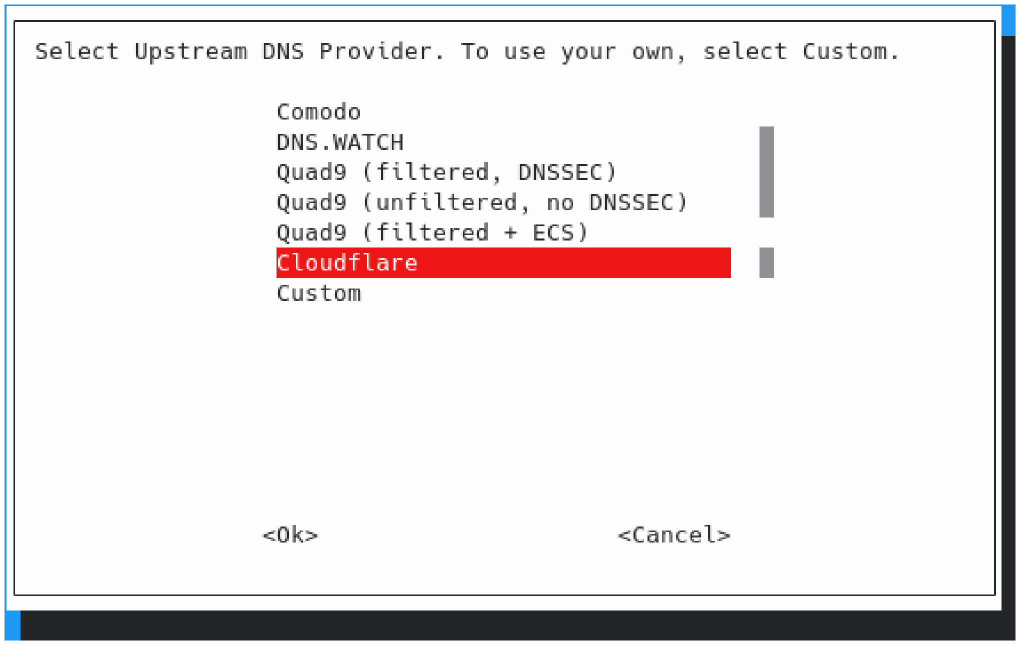
Remember to give a donation to the project if you find it useful. (I did it)



```
The Pi-hole is free, but powered by your donations:
https://pi-hole.net/donate/
```

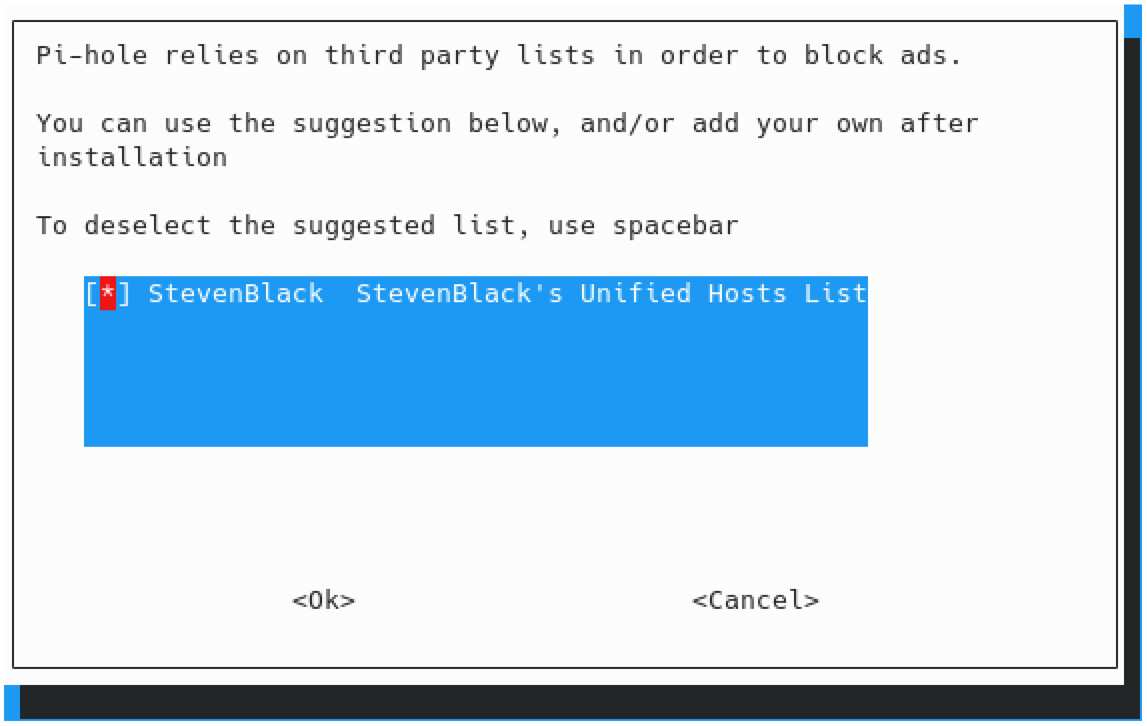


```
The Pi-hole is a SERVER so it needs a STATIC IP ADDRESS to
function properly.

In the next section, you can choose to use your current network
settings (DHCP) or to manually edit them.
```



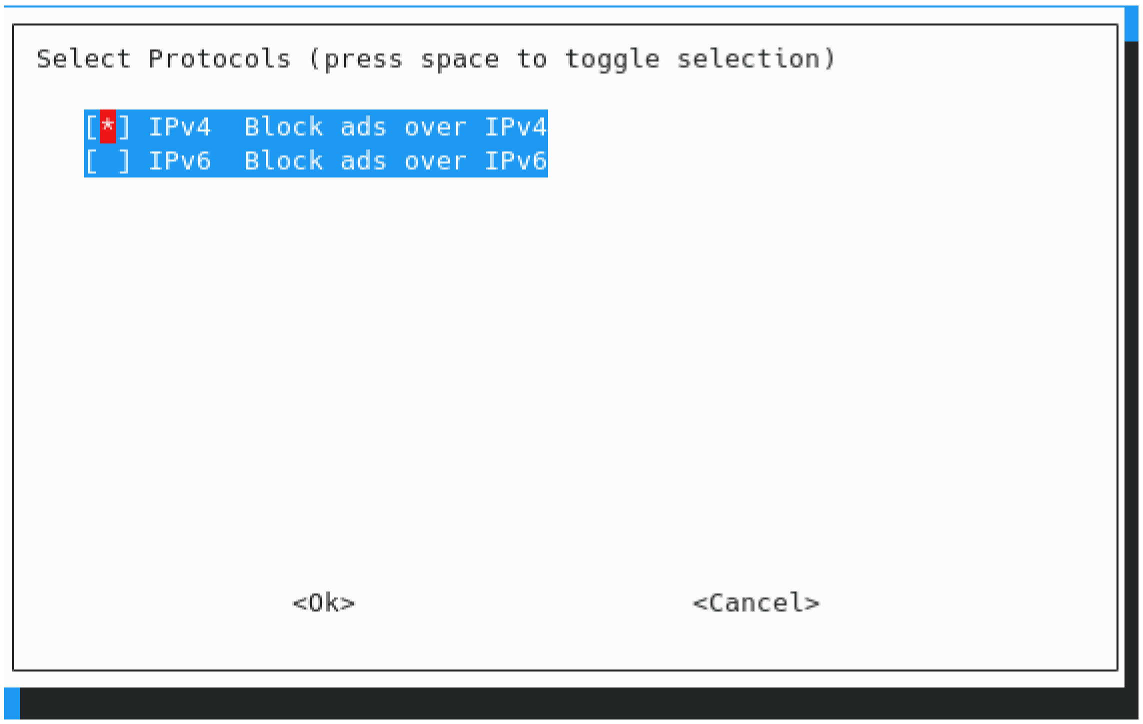
```
Select Upstream DNS Provider. To use your own, select Custom.

                 Comodo
                 DNS.WATCH
                 Quad9 (filtered, DNSSEC)
                 Quad9 (unfiltered, no DNSSEC)
                 Quad9 (filtered + ECS)
                 Cloudflare
                 Custom

              <Ok>                     <Cancel>
```

I recommend selecting all the third-party lists listed. We can add additional sources later.



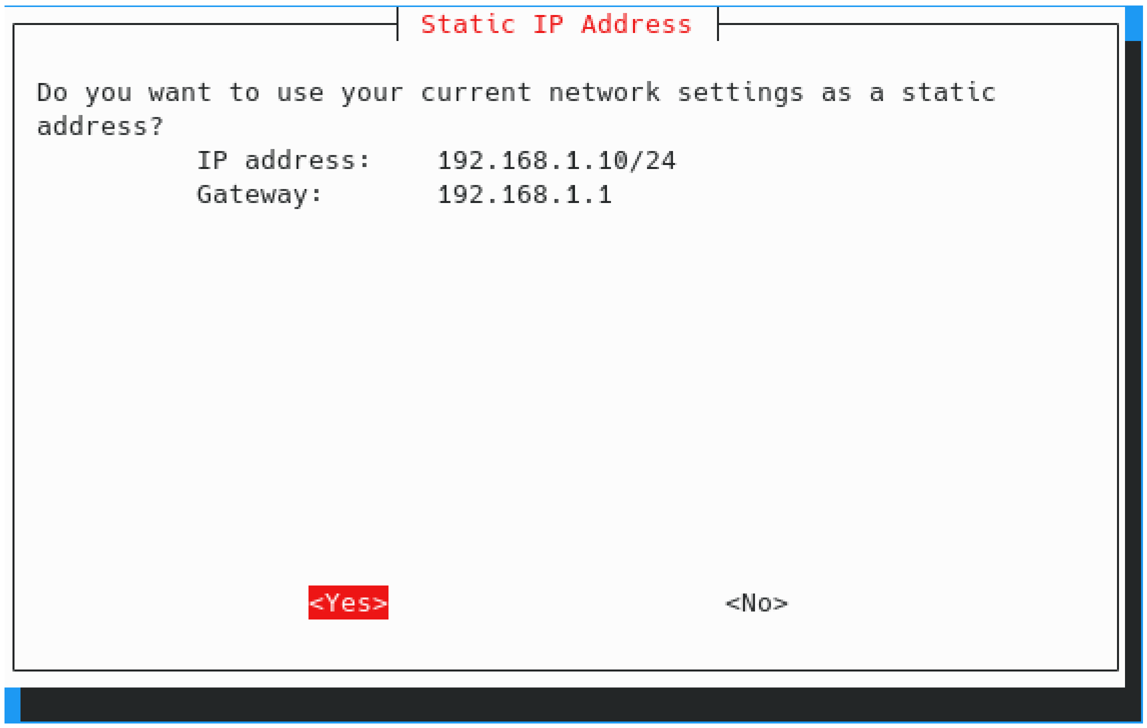
```
Pi-hole relies on third party lists in order to block ads.

You can use the suggestion below, and/or add your own after
installation

To deselect the suggested list, use spacebar

   [*] StevenBlack  StevenBlack's Unified Hosts List

              <Ok>                     <Cancel>
```

Choose the protocols you have in your network.



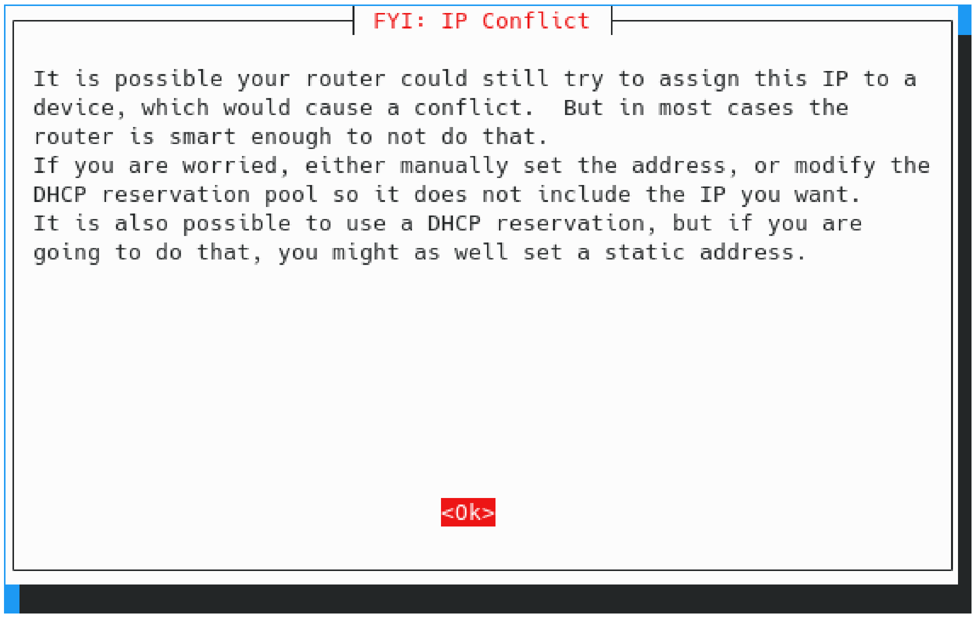
```
Select Protocols (press space to toggle selection)

  [*] IPv4  Block ads over IPv4
  [ ] IPv6  Block ads over IPv6
```

Confirm the static IP chosen previously



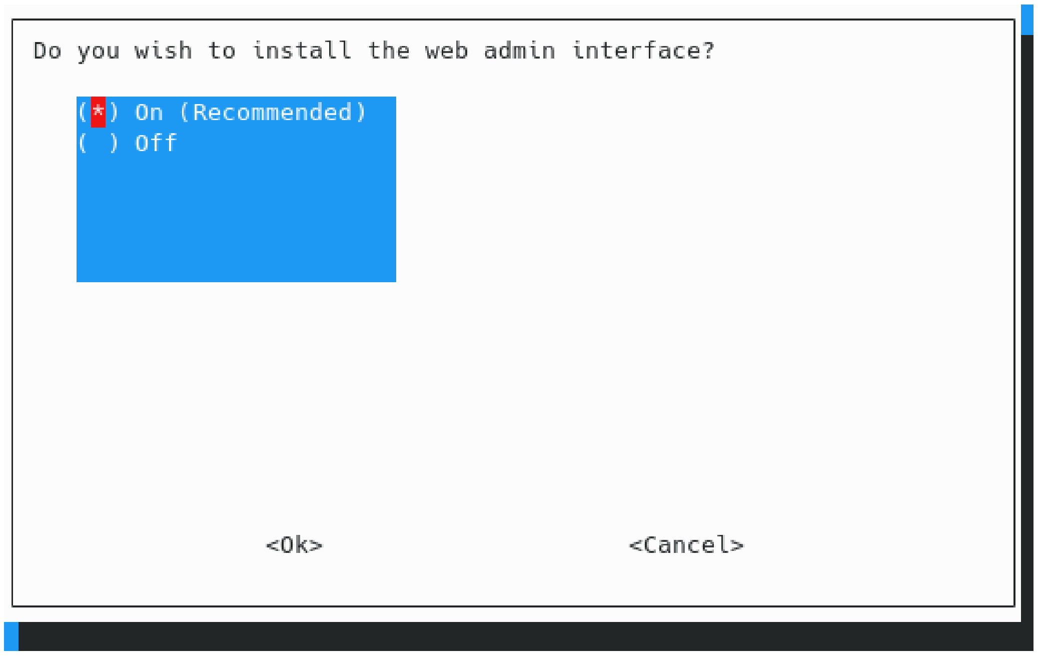
```
Static IP Address

Do you want to use your current network settings as a static
address?
          IP address:    192.168.1.10/24
          Gateway:       192.168.1.1
```

ensure you have an IP reservation for your Raspberry Pi.



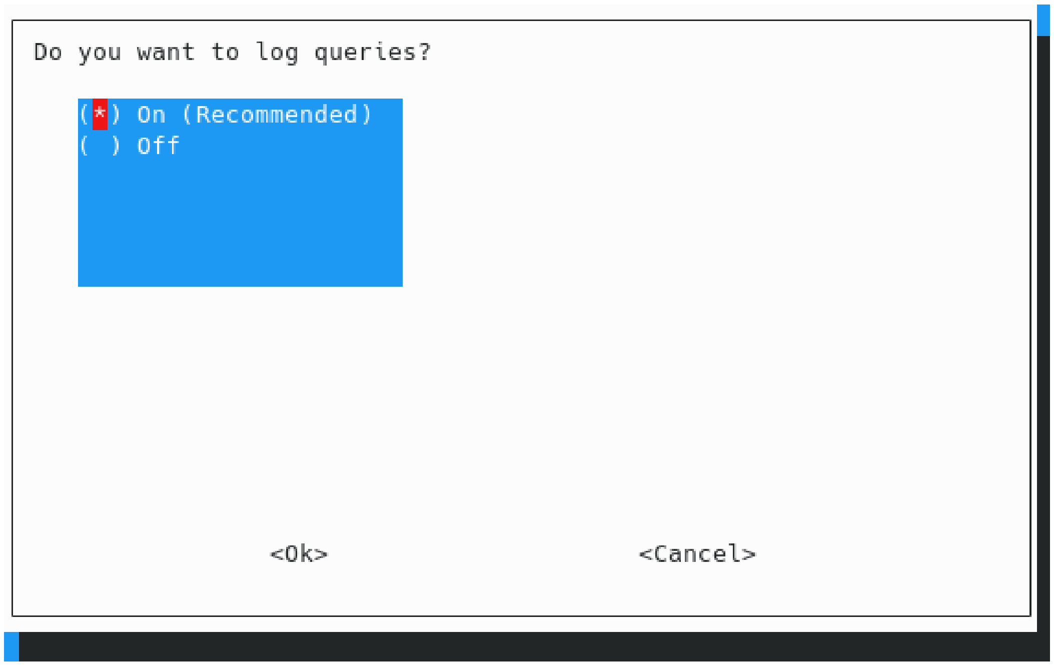
```
FYI: IP Conflict

It is possible your router could still try to assign this IP to a
device, which would cause a conflict.  But in most cases the
router is smart enough to not do that.
If you are worried, either manually set the address, or modify the
DHCP reservation pool so it does not include the IP you want.
It is also possible to use a DHCP reservation, but if you are
going to do that, you might as well set a static address.

<Ok>
```

I will recommend to install the web interface

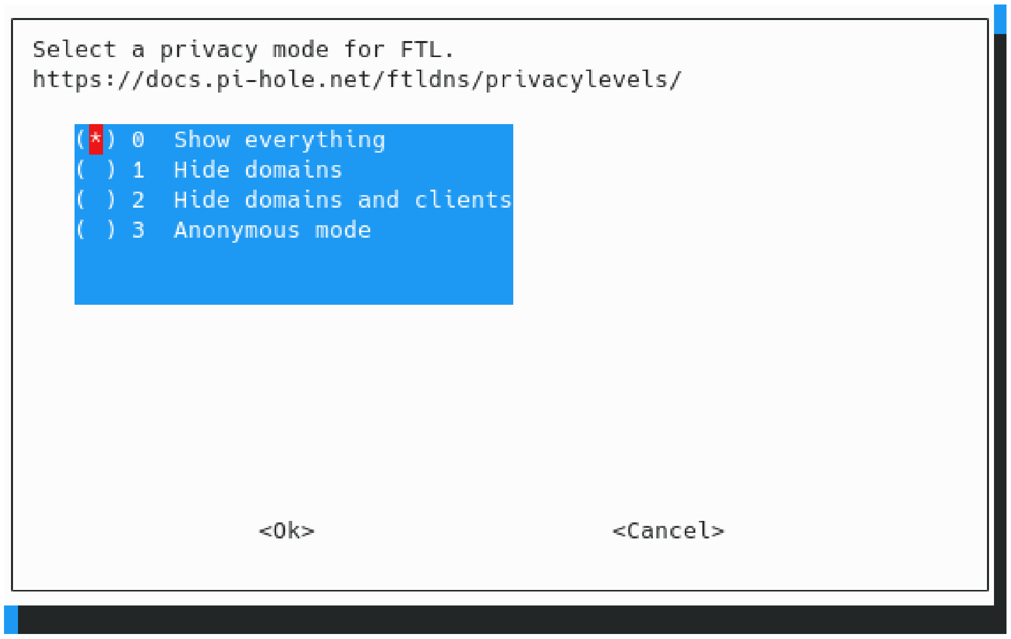


```
Do you wish to install the web admin interface?

   (*) On (Recommended)
   ( ) Off

            <Ok>                     <Cancel>
```

Let the log enable

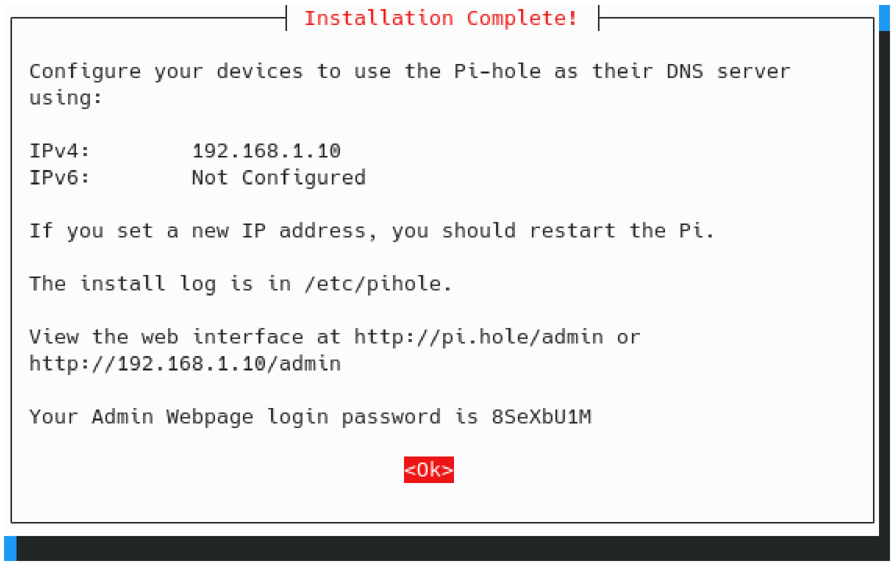


```
Do you want to log queries?

   (*) On (Recommended)
   ( ) Off

                 <Ok>                     <Cancel>
```



```
Select a privacy mode for FTL.
https://docs.pi-hole.net/ftldns/privacylevels/

    (*) 0  Show everything
    ( ) 1  Hide domains
    ( ) 2  Hide domains and clients
    ( ) 3  Anonymous mode

                 <Ok>                     <Cancel>
```

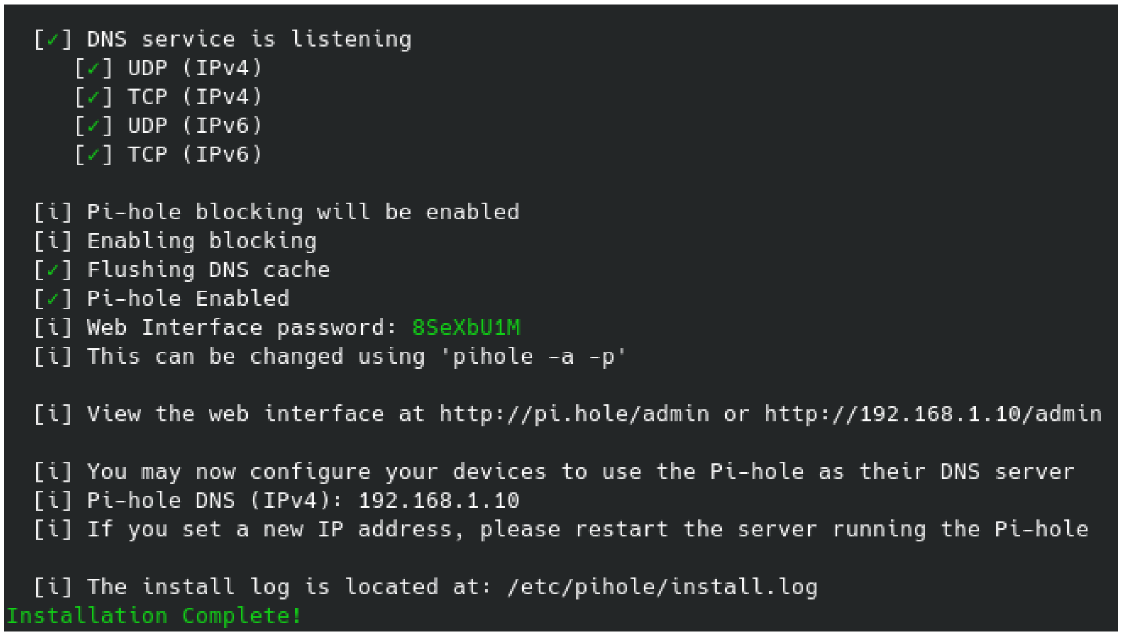
When the installation is complete, you will get a final screen with some important info.



```
Installation Complete!

Configure your devices to use the Pi-hole as their DNS server
using:

IPv4:        192.168.1.10
IPv6:        Not Configured

If you set a new IP address, you should restart the Pi.

The install log is in /etc/pihole.

View the web interface at http://pi.hole/admin or
http://192.168.1.10/admin

Your Admin Webpage login password is 8SeXbU1M

                         <Ok>
```

Save this information to access to the Pi-hole server:

Save this information to access the Pi-hole server. Save the admin webpage password in your password manager for now; it should be changed later. This same info is displayed once you return to the shell. Note the command to change the web admin password (*pihole -a -p*)



```
  [✓] DNS service is listening
     [✓] UDP (IPv4)
     [✓] TCP (IPv4)
     [✓] UDP (IPv6)
     [✓] TCP (IPv6)

  [i] Pi-hole blocking will be enabled
  [i] Enabling blocking
  [✓] Flushing DNS cache
  [✓] Pi-hole Enabled
  [i] Web Interface password: 8SeXbU1M
  [i] This can be changed using 'pihole -a -p'

  [i] View the web interface at http://pi.hole/admin or http://192.168.1.10/admin

  [i] You may now configure your devices to use the Pi-hole as their DNS server
  [i] Pi-hole DNS (IPv4): 192.168.1.10
  [i] If you set a new IP address, please restart the server running the Pi-hole

  [i] The install log is located at: /etc/pihole/install.log
Installation Complete!
```

Containers installation

First, we need to install the Docker engine. To manage containers easily, I will also install Portainer.

Installing using the apt repository

Before you install Docker Engine for the first time on a new host machine, you need to set up the Docker apt repository. Afterward, you can install and update Docker from the repository.

Set up Docker's apt repository. First, we have to add Docker's official GPG key:

```
$sudo apt-get update
$sudo apt-get install ca-certificates curl gnupg
$sudo install -m 0755 -d /etc/apt/keyrings
$curl -fsSL https://download.docker.com/linux/debian/gpg | sudo gpg --
dearmor -o /etc/apt/keyrings/docker.gpg
$sudo chmod a+r /etc/apt/keyrings/docker.gpg
```

`Next, add the repository to our apt sources:`

```
$echo \
  "deb [arch=$(dpkg --print-architecture)
signed-by=/etc/apt/keyrings/docker.gpg]
https://download.docker.com/linux/debian \
  $(. /etc/os-release && echo "$VERSION_CODENAME") stable" | \
  sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
$sudo apt-get update
```

Installing the Docker packages

We are ready to install the docker packages

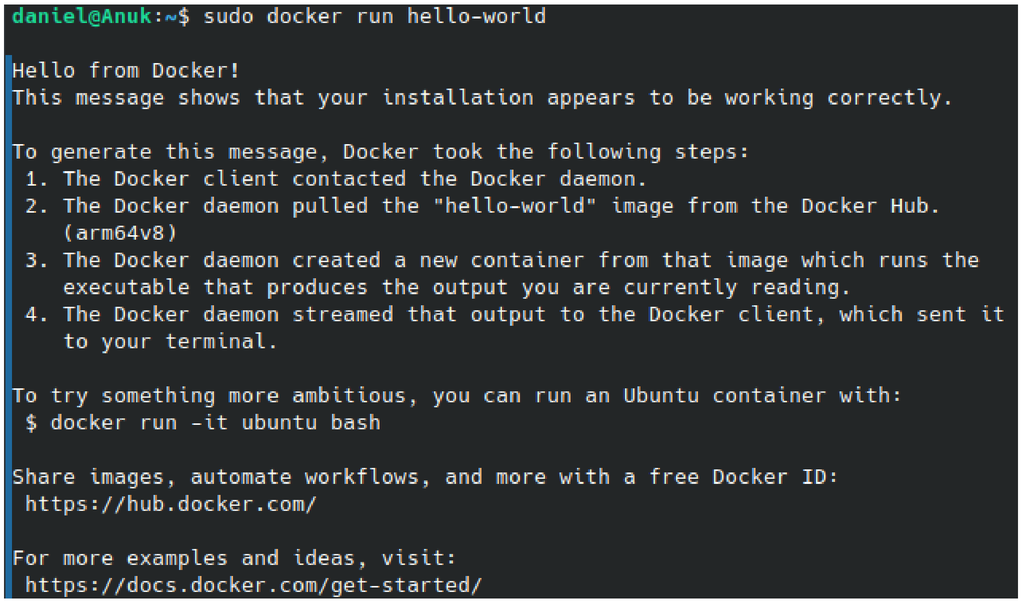
1. To install the latest version, run:

   ```
   $sudo apt-get install docker-ce docker-ce-cli containerd.io docker-
   buildx-plugin docker-compose-plugin
   ```

2. Verify that the installation is successful by running the `hello-world` image:

   ```
   $sudo docker run hello-world
   ```

   This command downloads a test image and runs it in a container. When the container runs, it prints a confirmation message and exits.



```
daniel@Anuk:~$ sudo docker run hello-world

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (arm64v8)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/

For more examples and ideas, visit:
 https://docs.docker.com/get-started/
```

You have now successfully installed and started Docker Engine.

Installing the portainer images

To install portainer, we have to run this command:

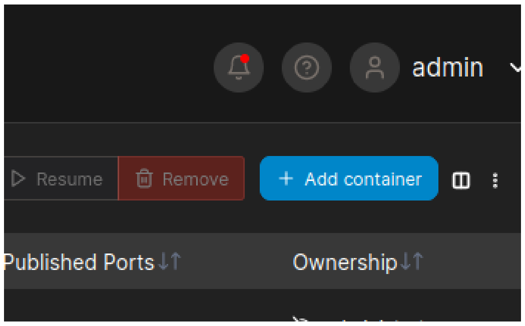
```
$sudo docker run -d -p 9000:9000 --name=portainer --restart=always -v
/var/run/docker.sock:/var/run/docker.sock -v portainer_data:/data
portainer/portainer-ce:latest
```

Pointing to browser to our IP address at port 9000 (http://192.168.1.10:9000/#!/home in my case), portainer will be ask to set an admin password

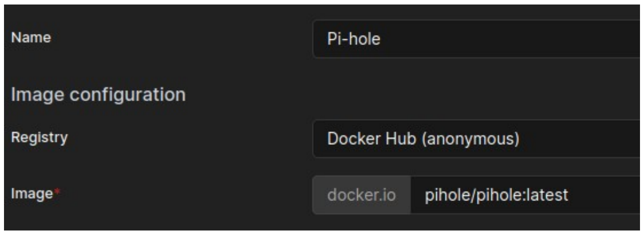
Installing pi-hole container

To install pi-hole using portainer, just follow this steps

1. Add a new container from Containers menu

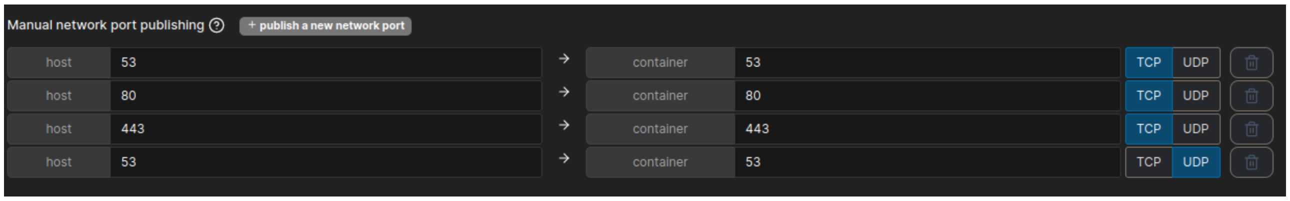


2. Name your container and use the image “pihole/pihole:latest”.



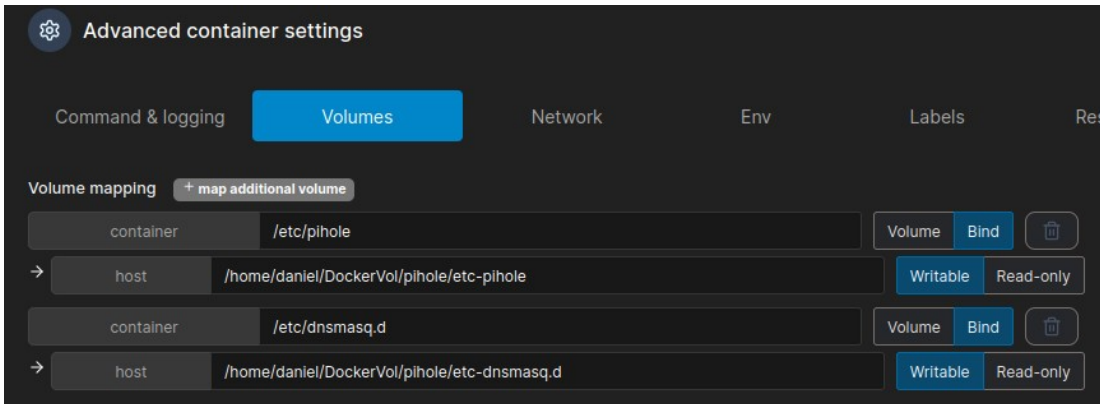
Name	Pi-hole
Image configuration	
Registry	Docker Hub (anonymous)
Image*	docker.io pihole/pihole:latest

3. Publishing ports is only needed if we set the network to bridge. If we set the network to host, there is no need to publish ports, as the container has full access to all network interfaces of the host. If we set the network to bridge, we configure it to publish 5 network ports (53 TCP and UDP, 80 and 443 TCP). If we want to use Pi-hole as a DHCP Server, we should also publish port 67 UDP.



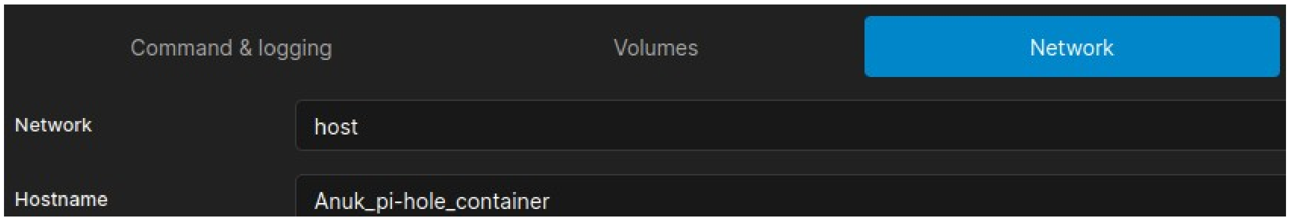
host		container		protocol
host	53	container	53	TCP
host	80	container	80	TCP
host	443	container	443	TCP
host	53	container	53	UDP

4. We need to create two volumes to map on our host. Ensure you have created this path on your host (raspberry pi). I have created the folder DockerVol
   - /etc/dnsmasq.d to /home/daniel/DockerVol/pihole/etc-dnsmasq.d
   - /etc/pihole to /home/daniel/DockerVol/pihole/etc-pihole



container	/etc/pihole	Bind	
host	/home/daniel/DockerVol/pihole/etc-pihole	Writable	
container	/etc/dnsmasq.d	Bind	
host	/home/daniel/DockerVol/pihole/etc-dnsmasq.d	Writable	

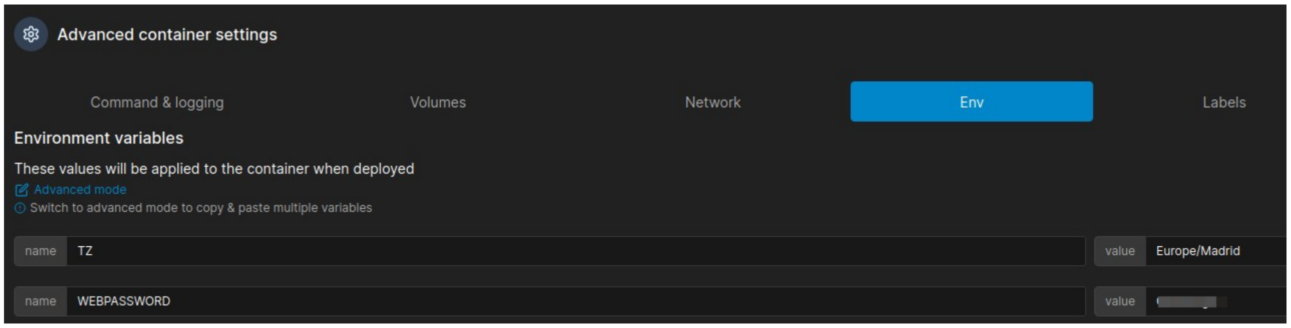
5. To facilitate the use of unbound, network should be host and we can set the hostname



Network: host

Hostname: Anuk_pi-hole_container

6. Inside environment variables we set the timezone and webpassword



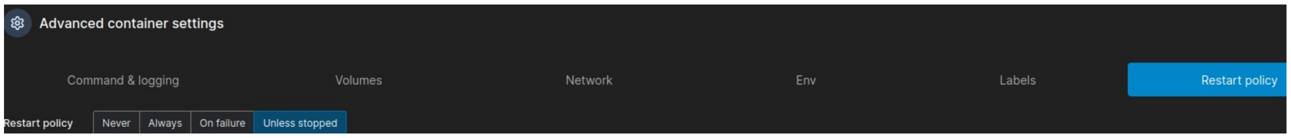
Environment variables

These values will be applied to the container when deployed

Switch to advanced mode to copy & paste multiple variables

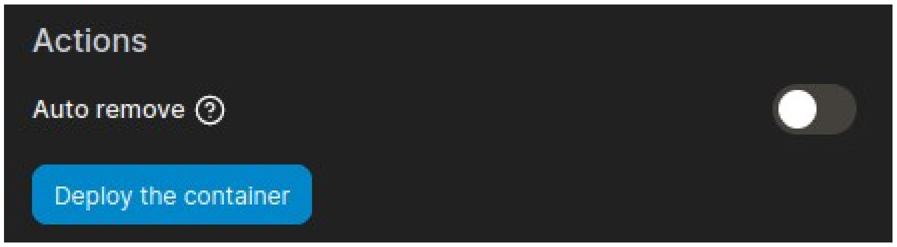
name	value
TZ	Europe/Madrid
WEBPASSWORD	[redacted]

7. Set the restart policy to 'unless stopped'.

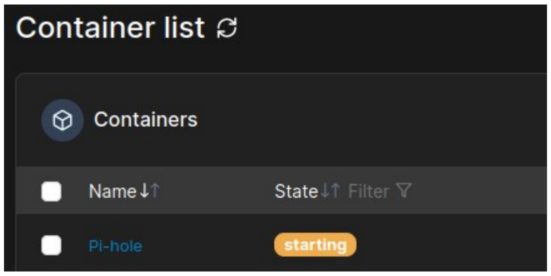


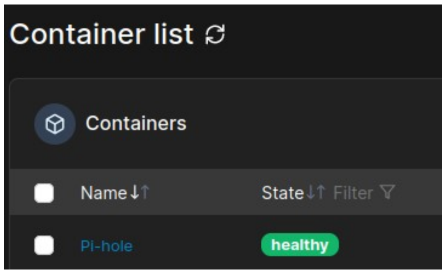
Restart policy: Never Always On failure [✓ Unless stopped]

8. Deploy the container

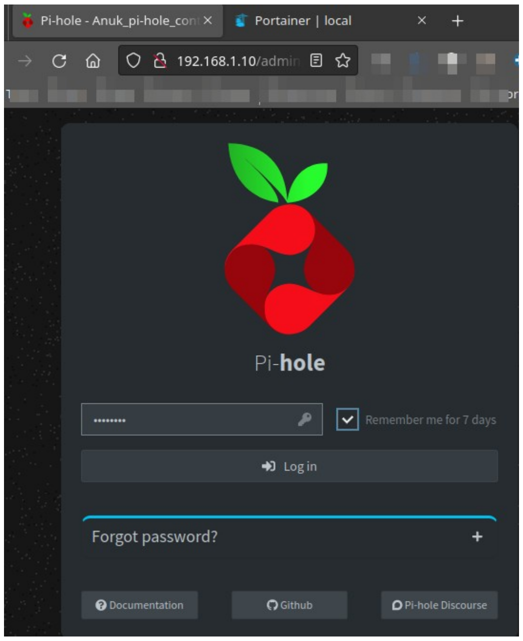


Portainer start to download the container and deploy it.





Once it finish, we can point our browser to the IP and login inside pi-hole



Note about network configuration

When you set the network configuration of a Docker container to host, the container uses the Docker host's network stack directly. In this mode, the container has full access to all network interfaces of the host, and the ports opened by the container are directly accessible on the host's IP address.

Therefore, when using host network mode, there's no need to publish ports using the -p or --publish flag. This is because the container's ports are already directly exposed to the host, and hence, to the outside world.

However, please note that the host mode gives the container full access to local system services and is therefore considered insecure. It's recommended to use it judiciously and understand the security implications.

Adjusting Pi-hole settings

To modify the privacy settings of the Pi-hole application, the following file needs to be edited:

```
$sudo nano /etc/pihole/pihole-FTL.conf
```

If you're using containers, the file is located at:

```
$sudo nano ~/DockerVol/etc-pihole/pihole-FTL.conf
```

Configure the privacy level and the duration for storing queries in the database according to your preferences. In my setup, I've selected a privacy level of 0 and set the database to store queries for 30 days.

Here's how you can set these parameters:

```
# Which privacy level is used?. More info:
https://docs.pi-hole.net/ftldns/privacylevels/

PRIVACYLEVEL=0

# How long should queries be stored in the database? Setting this to 0
disables the database. Default 365

MAXDBDAYS=30
```

Updating Pi-hole Regularly

Pi-hole frequently receives updates for its components, including Pi-hole core, FTL, and the Web Interface. The update process varies depending on whether Pi-hole is running as a standalone application or inside a container.

Updating the standalone application manually

To update Pi-hole as a standalone application, execute the following command:

```
$pihole -up
```

Updating via Portainer

1. Navigate to 'Containers', then stop the container you wish to update.
2. Select the container, and look for the 'Recreate' button. This will preserve the data mapped to a volume while recreating the container.
3. Choose 'Pull latest image', then 'Recreate'.
4. After recreation, start the container. It should now be running with the latest version.

5. The container is now updated to the newest release!

Please be patient as the update process may take some time. Consider removing old container images to save space.

Automating the Update Process

Important: The Pi-hole team advises against automating Pi-hole updates. It's crucial to read release notes as some updates may require additional changes beyond simply updating the image.

Updating standalone Pi-hole via Cron

To automatically update Pi-hole every Sunday, use a cron job. However, be cautious with automated updates; if a major change occurs that you're not ready for, disable the cron job by running `sudo crontab -e` and commenting out the update line (add a '#' at the beginning of the line).

To set up the cron job:

```
$sudo crontab -e
```

Add the following line to update every Sunday at 2:30 AM:

```
30 2 * * SUN pihole -up
```

Updating Container Using Watchtower

Warning (From Pi-hole GitHub Site): Many users employ Watchtower for updating Pi-hole containers. However, it's advised not to automatically update your Pi-hole container, especially unattended. While updates are generally safe, unexpected issues can occur.

To manually update:

1. Read the release notes thoroughly.
2. Pull the new image.
3. Stop and remove the current Pi-hole container. Ensure any important data (logs, customizations) is volume-mapped, or it will be lost.
4. Recreate the container with the new image.

Remember, Pi-hole is a critical part of your network. Avoid unattended updates that could cause issues during off-hours.

Setup Unbound

Boosting Pi-hole security

With Pi-hole operational, it's currently set for minimal blocking and defaults to forwarding lookups to Google DNS. While you can switch to another upstream DNS provider, it essentially boils down to whom you trust with your DNS queries. But what if you prefer not to rely on external providers like Cloudflare DNS? That's where Unbound comes into play. By installing Unbound, you enable your system to independently resolve DNS queries using root servers, utilizing a recursive approach.

Why Unbound? Unbound allows you to resolve DNS names directly through root servers in a recursive manner. For a detailed explanation, visit Pi-hole's Unbound Guide. The primary advantage here is enhanced security; you don't have to depend on an upstream provider for DNS traffic. The trade-off is the initial lookup performance, which can be slower as it involves traversing multiple servers. However, both Pi-hole and Unbound support caching configurations, which significantly improve performance for subsequent lookups.

Installing Unbound

To install Unbound, run:

```
$sudo apt install unbound -y
```

Setting Up Root Hints Manually

If you're not installing Unbound from a repository and have downloaded the list of primary root servers manually, use this command. Note: This step is only necessary if you're not using the default `dns-root-data` package, which Unbound can locate automatically.

```
$wget https://www.internic.net/domain/named.root -qO- | sudo tee
/var/lib/unbound/root.hints
```

Configuring Unbound for Pi-hole

Create a new configuration file for Unbound:

```
$sudo nano /etc/unbound/unbound.conf.d/pi-hole.conf
```

In this file, paste the following configuration. This differs from the one in Pi-hole's documentation, as it includes caching settings to enhance performance.

```
server:
    # If no logfile is specified, syslog is used
    # logfile: "/var/log/unbound/unbound.log"
    verbosity: 0

interface: 127.0.0.1
    port: 5335
    do-ip4: yes
    do-udp: yes
    do-tcp: yes

# May be set to yes if you have IPv6 connectivity
    do-ip6: no

# You want to leave this to no unless you have *native* IPv6. With 6to4 and
    # Terredo tunnels your web browser should favor IPv4 for the same
reasons
    prefer-ip6: no

# Use this only when you downloaded the list of primary root servers!
    # If you use the default dns-root-data package, unbound will find it
automatically
    #root-hints: "/var/lib/unbound/root.hints"

# Trust glue only if it is within the server's authority
    harden-glue: yes

# Require DNSSEC data for trust-anchored zones, if such data is absent, the
zone becomes BOGUS
    harden-dnssec-stripped: yes

# Don't use Capitalization randomization as it known to cause DNSSEC issues
sometimes
    # see https://discourse.pi-hole.net/t/unbound-stubby-or-dnscrypt-
proxy/9378 for further details
```

```
    use-caps-for-id: no


# Reduce EDNS reassembly buffer size.
    # Suggested by the unbound man page to reduce fragmentation reassembly
problems
    edns-buffer-size: 1472


# Perform prefetching of close to expired message cache entries
    # This only applies to domains that have been frequently queried
    # This refreshes expiring cache entries if they have been accessed with
    # less than 10% of their TTL remaining
    prefetch: yes


    # This attempts to reduce latency by serving the outdated record before
    # updating it instead of the other way around. Alternative is to
increase
    # cache-min-ttl to e.g. 3600.
    cache-min-ttl: 0
    serve-expired: yes
    # I had best success leaving this next entry unset.
    # serve-expired-ttl: 3600 # 0 or not set means unlimited (I think)


    # Use about 2x more for rrset cache, total memory use is about 2-2.5x
    # total cache size. Current setting is way overkill for a small
network.
    # Judging from my used cache size you can get away with 8/16 and still
    # have lots of room, but I've got the ram and I'm not using it on
anything else.
    # Default is 4m/4m
    msg-cache-size: 128m
    rrset-cache-size: 256m


# One thread should be sufficient, can be increased on beefy machines. In
reality for most users running on small networks or on a single machine, it
should be unnecessary to seek performance enhancement by increasing num-
threads above 1.
    num-threads: 1
```

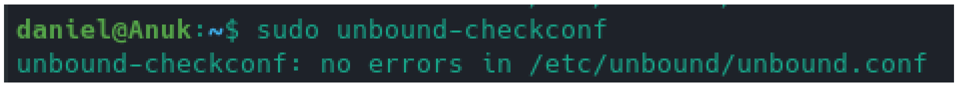
```
# Ensure kernel buffer is large enough to not lose messages in traffic
spikes
    so-rcvbuf: 1m

# Ensure privacy of local IP ranges
    private-address: 192.168.0.0/16
    private-address: 169.254.0.0/16
    private-address: 172.16.0.0/12
    private-address: 10.0.0.0/8
    private-address: fd00::/8
    private-address: fe80::/10

# To get unbound stats (sudo unbound-control stats_noreset)
remote-control:
    control-enable: yes
```

Verifying the Unbound Configuration

To ensure that your Unbound configuration is correctly set up and free of errors, you can use the `unbound-checkconf` tool. This tool scans the Unbound configuration file for any syntax errors or misconfigurations. Run the following command in your terminal:

```
$sudo unbound-checkconf
```

This command will provide feedback on your Unbound configuration. If there are no issues, it typically returns a message indicating that the configuration is okay. If it finds any problems, it will display the relevant error messages, which you can use to troubleshoot and correct your configuration.



```
daniel@Anuk:~$ sudo unbound-checkconf
unbound-checkconf: no errors in /etc/unbound/unbound.conf
```

Final step: restarting unbound

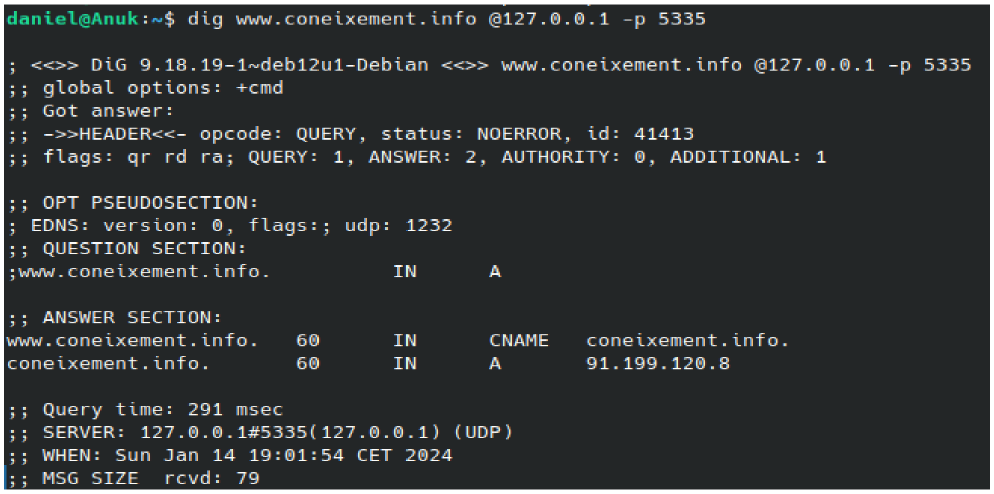
After configuring Unbound, it's essential to restart the service for the changes to take effect. Execute the following command:

```
$sudo service unbound restart
```

Testing unbound

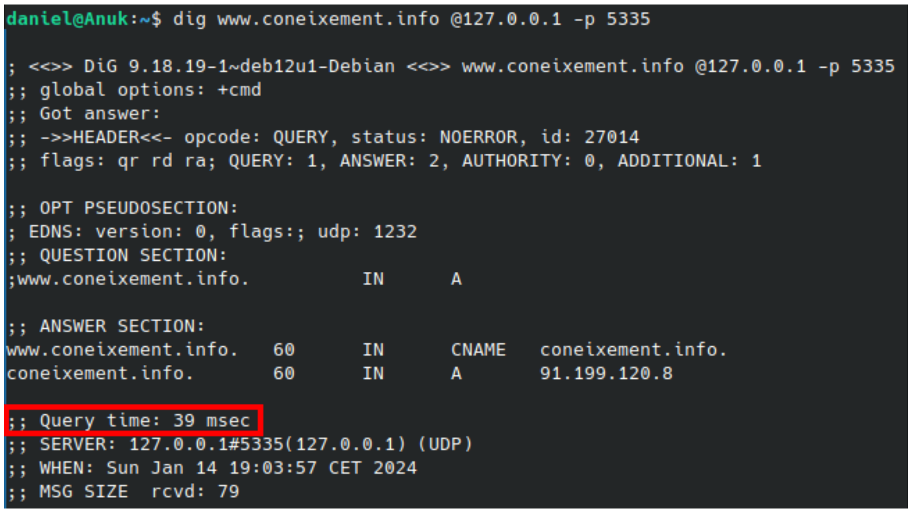
To verify that Unbound is functioning correctly and to measure its response time, use the `dig` command. For example, to query the domain `coneixement.info`, use:

```
$dig www.coneixement.info @127.0.0.1 -p 5335
```



```
daniel@Anuk:~$ dig www.coneixement.info @127.0.0.1 -p 5335

; <<>> DiG 9.18.19-1~deb12u1-Debian <<>> www.coneixement.info @127.0.0.1 -p 5335
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 41413
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;www.coneixement.info.          IN      A

;; ANSWER SECTION:
www.coneixement.info.   60      IN      CNAME   coneixement.info.
coneixement.info.       60      IN      A       91.199.120.8

;; Query time: 291 msec
;; SERVER: 127.0.0.1#5335(127.0.0.1) (UDP)
;; WHEN: Sun Jan 14 19:01:54 CET 2024
;; MSG SIZE  rcvd: 79
```

This command tests the response time of Unbound. You'll likely notice a significant reduction in response time on subsequent tests, thanks to caching.



```
daniel@Anuk:~$ dig www.coneixement.info @127.0.0.1 -p 5335

; <<>> DiG 9.18.19-1~deb12u1-Debian <<>> www.coneixement.info @127.0.0.1 -p 5335
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 27014
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;www.coneixement.info.          IN      A

;; ANSWER SECTION:
www.coneixement.info.   60      IN      CNAME   coneixement.info.
coneixement.info.       60      IN      A       91.199.120.8

;; Query time: 39 msec
;; SERVER: 127.0.0.1#5335(127.0.0.1) (UDP)
;; WHEN: Sun Jan 14 19:03:57 CET 2024
;; MSG SIZE  rcvd: 79
```

Keeping Unbound Updated

Setting up a cron job to keep Unbound's root hints file updated is a good practice. To do this. Open the crontab editor:

```
$sudo crontab -e
```

At the end of the file, add the following line:

```
01 02 03 */4 * wget -N -q -O /var/lib/unbound/root.hints
https://www.internic.net/domain/named.root
```

Save and exit the editor.

The cron job is scheduled to run at 02:01 AM on the 3rd day of every 4th month. This frequency is usually sufficient for updating the root hints file. The `-N` option ensures the file is only downloaded if it's newer than the existing one, `-q` keeps the operation quiet, and `-O` specifies the path where the file should be stored.

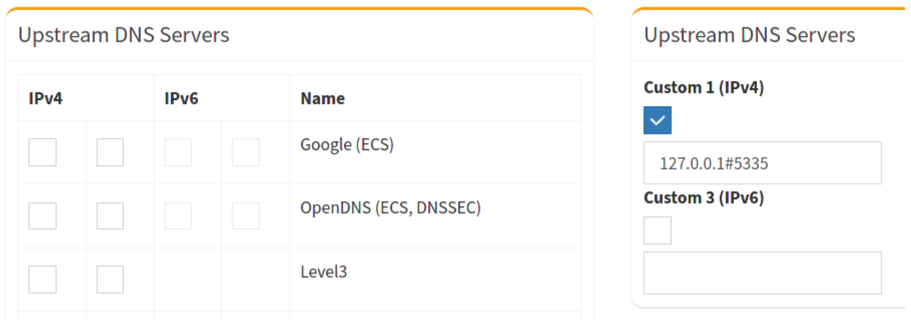
This setup ensures your Unbound service remains up-to-date without cluttering your logs with unnecessary output.

Configuring Pi-hole to Use Unbound

Access Pi-hole Admin Interface, open your web browser and visit the Pi-hole admin page at http://pi.hole/admin. Log in using the password you set during the Pi-hole installation. Adjust DNS Settings. once logged in, navigate to the 'Settings' section and click on the 'DNS' tab. In the DNS settings, uncheck any pre-selected DNS servers.

- Check the box next to 'Custom 1 (IPv4)'.
- Enter `127.0.0.1#5335` in the corresponding field. This directs Pi-hole to use Unbound, running on the same device, on port 5335.

Save Your Changes. Click the 'Save' button at the bottom of the page to apply your new DNS settings.



Upstream DNS Servers

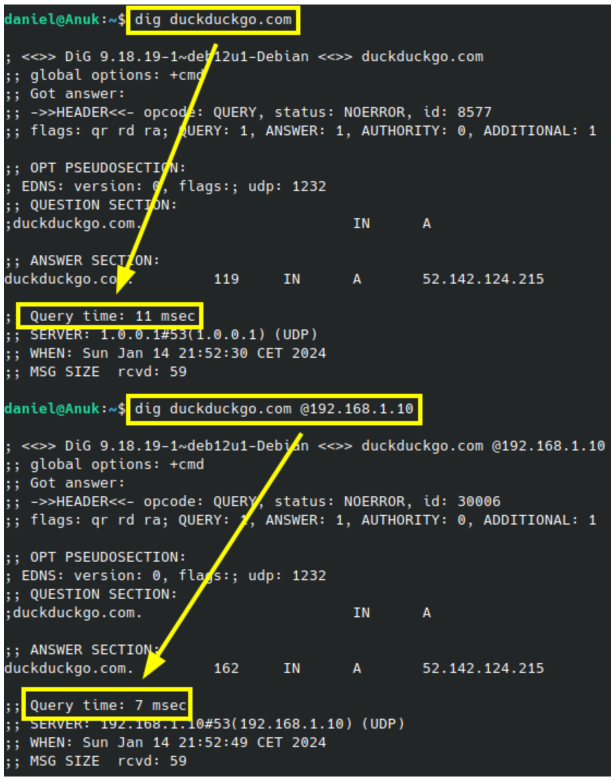
IPv4		IPv6		Name
☐	☐	☐	☐	Google (ECS)
☐	☐	☐	☐	OpenDNS (ECS, DNSSEC)
☐	☐			Level3

Upstream DNS Servers

Custom 1 (IPv4) ✓ 127.0.0.1#5335

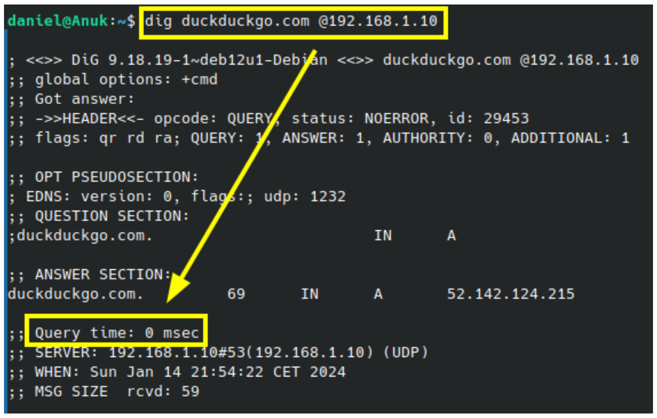
Custom 3 (IPv6) ☐

Note on Performance: Initially, you might notice slower performance during the first few queries. This is normal as both Pi-hole and Unbound are building their cache.



```
daniel@Anuk:~$ dig duckduckgo.com

; <<>> DiG 9.18.19-1~deb12u1-Debian <<>> duckduckgo.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 8577
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;duckduckgo.com.                        IN      A

;; ANSWER SECTION:
duckduckgo.com.         119     IN      A       52.142.124.215

;; Query time: 11 msec
;; SERVER: 1.0.0.1#53(1.0.0.1) (UDP)
;; WHEN: Sun Jan 14 21:52:30 CET 2024
;; MSG SIZE  rcvd: 59

daniel@Anuk:~$ dig duckduckgo.com @192.168.1.10

; <<>> DiG 9.18.19-1~deb12u1-Debian <<>> duckduckgo.com @192.168.1.10
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 30006
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;duckduckgo.com.                        IN      A

;; ANSWER SECTION:
duckduckgo.com.         162     IN      A       52.142.124.215

;; Query time: 7 msec
;; SERVER: 192.168.1.10#53(192.168.1.10) (UDP)
;; WHEN: Sun Jan 14 21:52:49 CET 2024
;; MSG SIZE  rcvd: 59
```

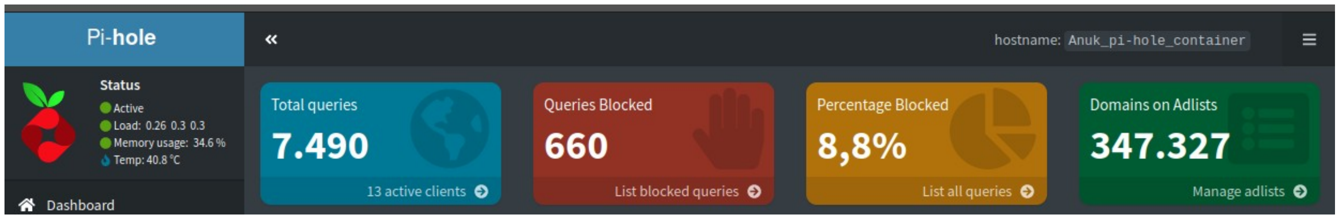
With time, the response time will significantly improve due to the caching mechanisms in place in both Pi-hole and Unbound.



```
daniel@Anuk:~$ dig duckduckgo.com @192.168.1.10

; <<>> DiG 9.18.19-1~deb12u1-Debian <<>> duckduckgo.com @192.168.1.10
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 29453
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
;; QUESTION SECTION:
;duckduckgo.com.                        IN      A

;; ANSWER SECTION:
duckduckgo.com.         69      IN      A       52.142.124.215

;; Query time: 0 msec
;; SERVER: 192.168.1.10#53(192.168.1.10) (UDP)
;; WHEN: Sun Jan 14 21:54:22 CET 2024
;; MSG SIZE  rcvd: 59
```

Viewing Statistics in the Pi-hole Web Interface

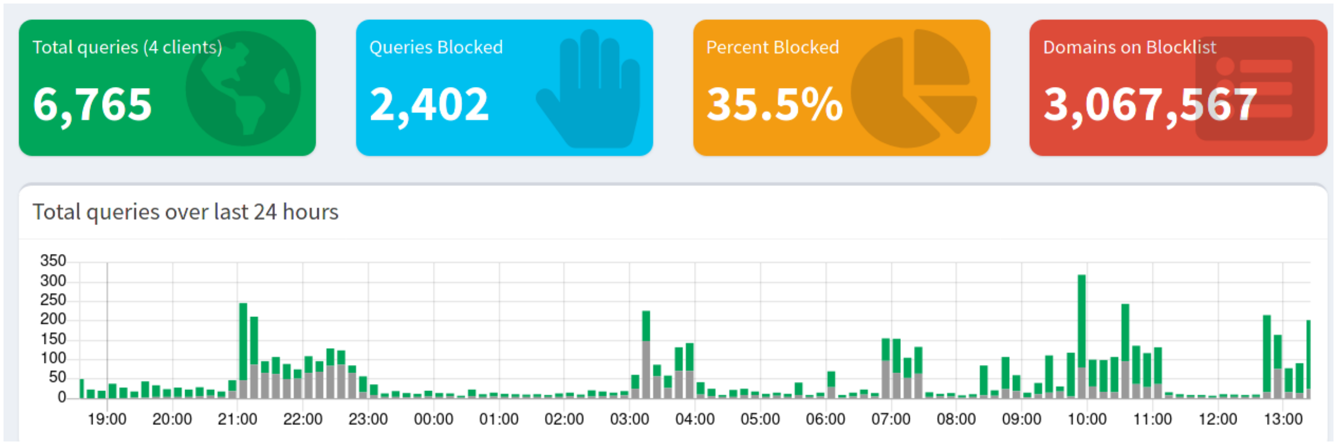
Once you log in to the Pi-hole web interface, you'll begin to see various statistics displayed. These statistics provide valuable insights into your network's DNS traffic.



Observing the Increase in Blocked Queries:

- As time progresses, you can monitor the increase in the number of queries that Pi-hole blocks. This is a key metric in understanding the effectiveness of Pi-hole in filtering unwanted content and ads.
- The web interface will display real-time updates, showing how many queries were made, how many were blocked, and what percentage of total traffic this represents.
- The visual graphs and charts in the dashboard offer an easy-to-understand overview of these statistics, highlighting trends and patterns in your network's DNS queries.

By regularly checking these statistics, you gain a better understanding of your network's behavior and the impact of Pi-hole in enhancing your online privacy and security.



Enhancing filtering with Pi-hole: blocklists, blacklists, adlists, and whitelists

To optimize your Pi-hole setup, it's crucial to first identify the types of content you wish to block. This can range from advertising and telemetry to parental controls, NSFW content, malware domains, and more. Here's a guide to effectively expanding your filtering capabilities:

Understanding default blocklists: Pi-hole includes a default blocklist, which is optional and can be chosen during installation. This list is regularly maintained and updated, providing a solid foundation for basic filtering.

Adding additional blocklists: For more specific needs, explore external blocklist collections. A prominent resource is Firebog (The Big Blocklist Collection), which categorizes lists into:

- Suspicious
- Advertising
- Tracking & Telemetry
- Malicious
- Other

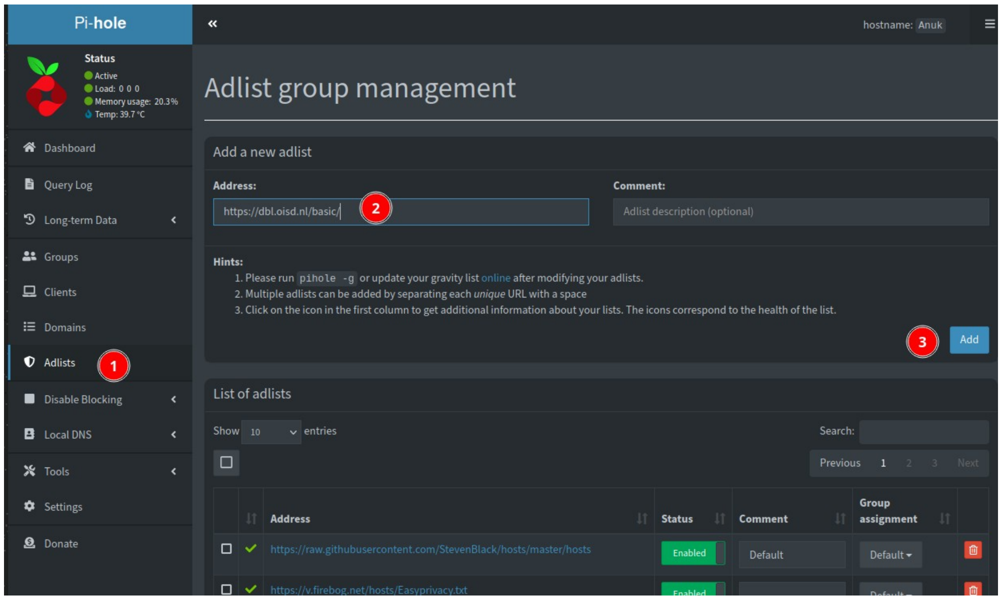
You can choose one to three lists from each category relevant to your filtering objectives.

Before adding new lists: Visit the Firebog page and carefully read the descriptions and notes for each list. This will help you understand the focus and potential impact of each list on your network traffic.

How to add new lists: Once logged into the Pi-hole web interface, navigate to the 'Adlists' section. Here, you can add new blocklists by pasting their URLs.

By tailoring your blocklists, you can significantly enhance the effectiveness of Pi-hole in managing your network's content. Remember, the key is to strike a balance between robust filtering and maintaining access to legitimate content. Over-blocking can be just as problematic as under-blocking, so choose your lists judiciously.

Successful addition: When a new list is successfully added to Pi-hole, you'll see a



Adlist group management

Add a new adlist

Address: https://dbl.oisd.nl/basic/

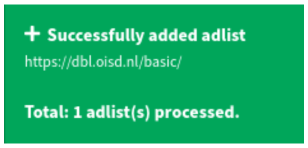
Comment: Adlist description (optional)

Hints:
1. Please run `pihole -g` or update your gravity list online after modifying your adlists.
2. Multiple adlists can be added by separating each *unique* URL with a space
3. Click on the icon in the first column to get additional information about your lists. The icons correspond to the health of the list.

List of adlists

	Address	Status	Comment	Group assignment
✓	https://raw.githubusercontent.com/StevenBlack/hosts/master/hosts	Enabled	Default	Default
✓	https://v.firebog.net/hosts/Easyprivacy.txt	Enabled		Default

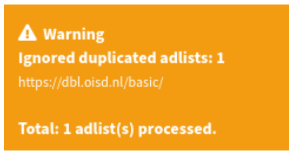
confirmation message indicating successful inclusion.



+ Successfully added adlist
https://dbl.oisd.nl/basic/

Total: 1 adlist(s) processed.

Duplicate lists: If you attempt to add a list that's already present, Pi-hole will ignore it and display a warning message to avoid duplication.



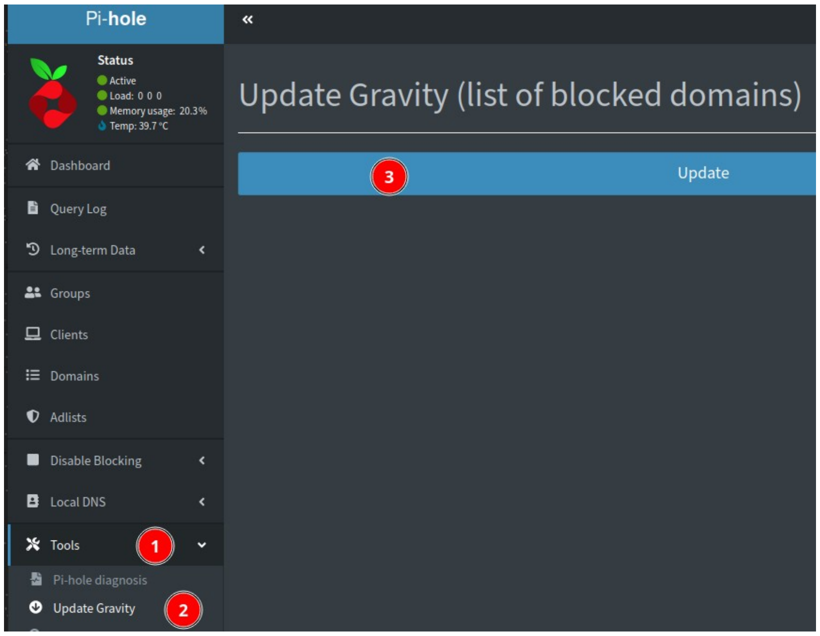
Warning
Ignored duplicated adlists: 1
https://dbl.oisd.nl/basic/

Total: 1 adlist(s) processed.

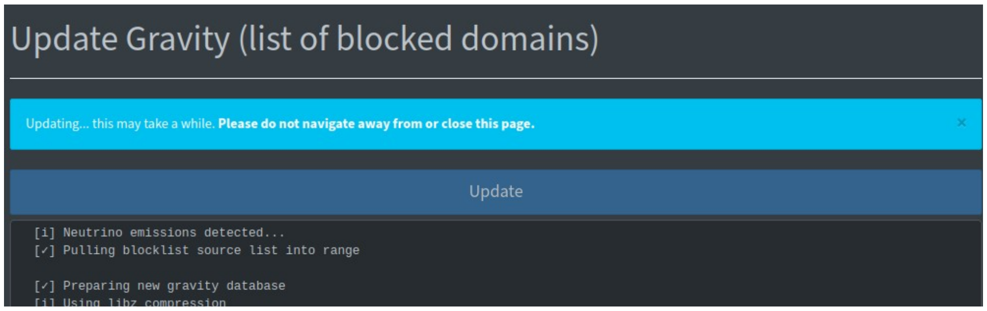
Updating the internal database

After adding all desired lists, it's crucial to update Pi-hole's internal database to apply the new blocklists. This can be done in two ways:

1. Command Line: Run `pihole -g` in the terminal.
2. Web Interface: Click the 'Update Gravity' button located in the web interface.



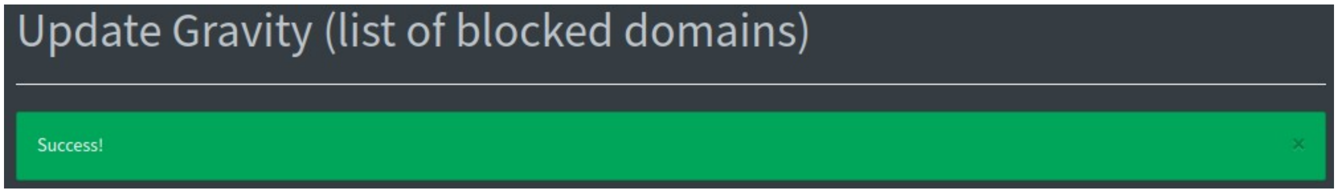
The update process might take some time. During this period, do not navigate away from or close the page.



Updating... this may take a while. **Please do not navigate away from or close this page.**

```
[i] Neutrino emissions detected...
[✓] Pulling blocklist source list into range

[✓] Preparing new gravity database
[i] Using libz compression
```

Wait for a success message to confirm the completion of the update.

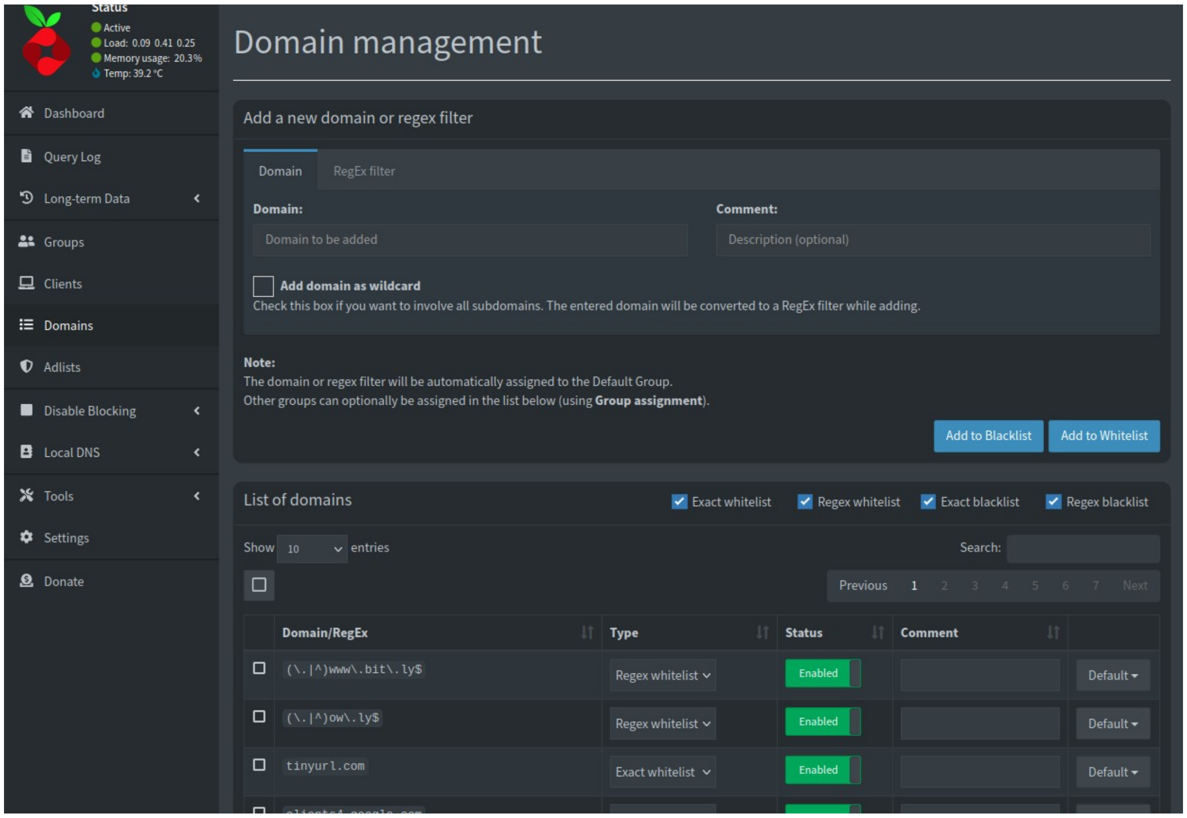


Success!

It's important to remember that adding too many lists can lead to false positives. This excessive filtering might make some internet services inaccessible, unreachable, or not fully functional. To avoid such issues, some domains may need to be whitelisted.

Whitelisting and blacklisting domains

Manage domains effectively by adding them to the Blacklist or Whitelist under the 'Domains' menu in the web interface.



Domain management

Add a new domain or regex filter

Domain: Domain to be added

Comment: Description (optional)

Add domain as wildcard
Check this box if you want to involve all subdomains. The entered domain will be converted to a RegEx filter while adding.

Note:
The domain or regex filter will be automatically assigned to the Default Group.
Other groups can optionally be assigned in the list below (using **Group assignment**).

List of domains

Domain/RegEx	Type	Status	Comment	
`(\.|^)www\.bit\.ly$`	Regex whitelist	Enabled		Default
`(\.|^)ow\.ly$`	Regex whitelist	Enabled		Default
`tinyurl.com`	Exact whitelist	Enabled		Default

For example, if you encounter issues with Gmail icons not appearing, you might need to whitelist the domain `gstaticadssl.l.google.com`.

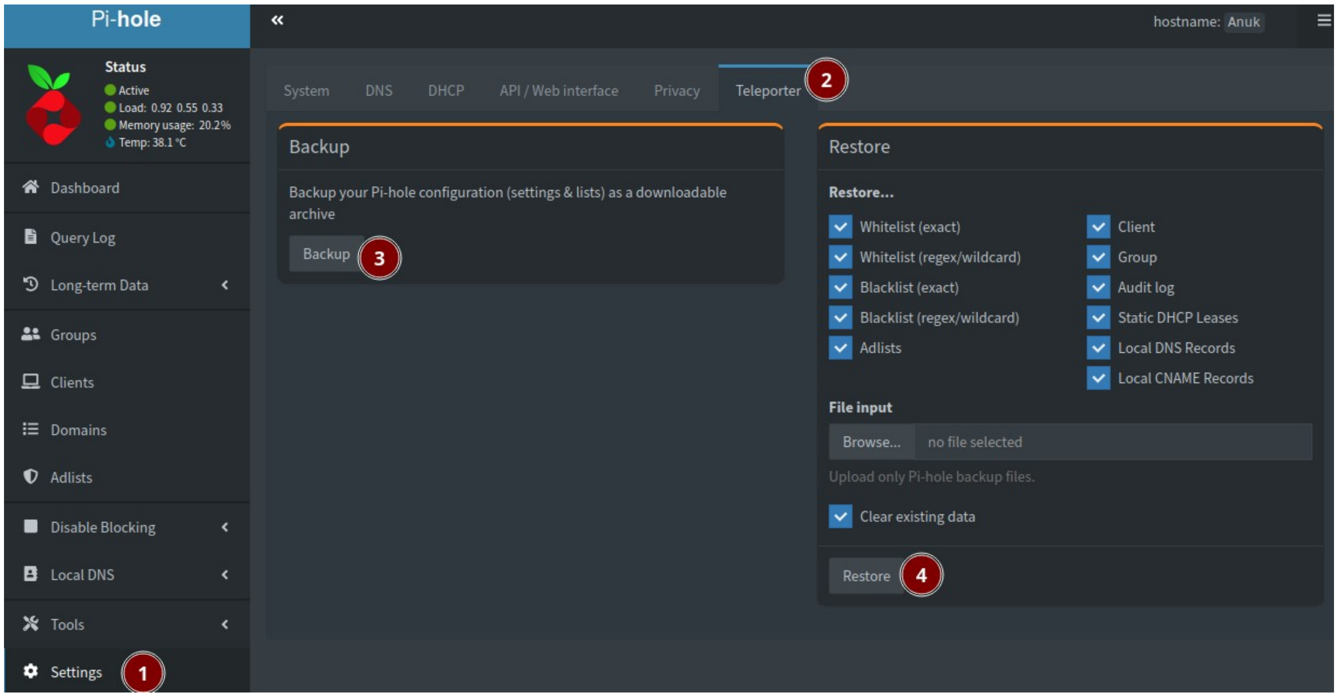
Removing existing blocklists

To remove an existing blocklist, execute the following command:

```
$sudo sqlite3 /etc/pihole/gravity.db "DELETE FROM adlist"
```

Backing up Pi-hole configuration

After configuring Pi-hole, it's wise to create a backup. This can be done through the web interface, which generates a file that can be imported to the same or a different Pi-hole setup, saving time on configuration.



Backup

Backup your Pi-hole configuration (settings & lists) as a downloadable archive

Restore

Restore...

✓ Whitelist (exact)	✓ Client
✓ Whitelist (regex/wildcard)	✓ Group
✓ Blacklist (exact)	✓ Audit log
✓ Blacklist (regex/wildcard)	✓ Static DHCP Leases
✓ Adlists	✓ Local DNS Records
	✓ Local CNAME Records

File input

Upload only Pi-hole backup files.

✓ Clear existing data

Additional functionalities of Pi-hole

Pi-hole offers several other functionalities, including but not limited to:

- Transforming Pi-hole into your DHCP service provider.
- Managing clients and groups.
- Disabling blocking temporarily.
- Using the Query Log to review and manage the blacklist and whitelist, allowing easy addition or removal of domains.

Installing WireGuard

Overview

WireGuard is a lightweight, secure, and fast VPN server designed to facilitate remote and secure access. As a communication protocol and free, open-source software, WireGuard focuses on ease of use, high-speed performance, and a minimal attack surface. Compared to other VPN servers like IPsec and OpenVPN, it aims to deliver superior performance and efficiency (Source: Wikipedia).

Configuration and Installation

Debian 12:

WireGuard is available in the Debian 12 repositories. Install necessary packages:

```
$sudo apt install software-properties-common python3-launchpadlib

$sudo apt-get install wireguard wireguard-tools linux-headers-$(uname -r)
qrencode
```

Debian 11:

Raspbian, by default, does not trust the Debian package repository. To resolve this, add Debian's public keys to the trusted set:

```
$sudo apt-key adv --keyserver http://p80.pool.sks-keyservers.net:80 --recv-
keys 04EE7237B7D453EC 648ACFD622F3D138
```

Add the Debian unstable repository:

```
$sudo sh -c "echo 'deb http://deb.debian.org/debian/ unstable main' >>
/etc/apt/sources.list.d/unstable.list"
```

To prevent conflicts with normal Raspbian packages, limit the use of the Debian distribution:

```
$sudo sh -c "printf 'Package: *\nPin: release a=unstable\nPin-Priority: 90\
n' >> /etc/apt/preferences.d/limit-unstable"
```

Import additional Debian keys:

```
$wget -O - https://ftp-master.debian.org/keys/archive-key-$(lsb_release -
sr).asc | sudo apt-key add -
```

Update the system database and install WireGuard along with necessary packages:

```
$sudo apt-get update
```

```
$sudo apt-get install wireguard wireguard-dkms wireguard-tools linux-
headers-$(uname -r) qrencode
```

Note for Raspbian OS users: Kernel headers are required.

```
$sudo apt-get install raspberrypi-kernel-headers
```

Installing a DDNS Service

Purpose

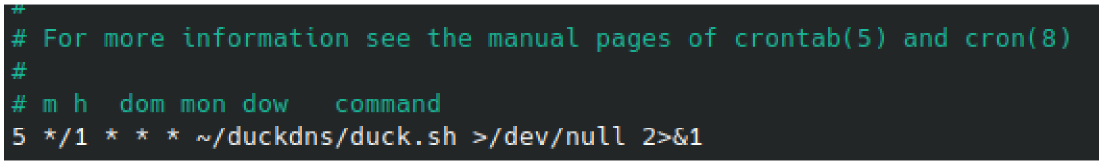
When accessing your network remotely via a VPN (like WireGuard), it's essential to know your public IP address or have a domain name linked to it. Since most IP addresses are dynamic and can change, and static IP addresses are limited and often costly, a practical solution is to use a DDNS (Dynamic Domain Name System) service. This service provides a free domain that points to your public IP address. A script updates your public IP with the service periodically, ensuring that the domain redirects to the new IP if it changes.

Instructions

1. **Requirement Check:** If you have a static public IP address, this step is not necessary.
2. **Choosing a DDNS Service:** For this guide, we'll use the DuckDNS DDNS service. DuckDNS offers detailed instructions and scripts for various devices, including the Raspberry Pi.
3. **Setting Up the Script:** We'll create a cron job to run a script that updates the DDNS. The script, named `duck.sh`, will be set to execute at 5 minutes past every hour. This frequency is sufficient, as updating every 5 minutes is generally unnecessary.
4. **Creating the Cron Job:** Open the crontab with the command:

```
$sudo crontab -e
```

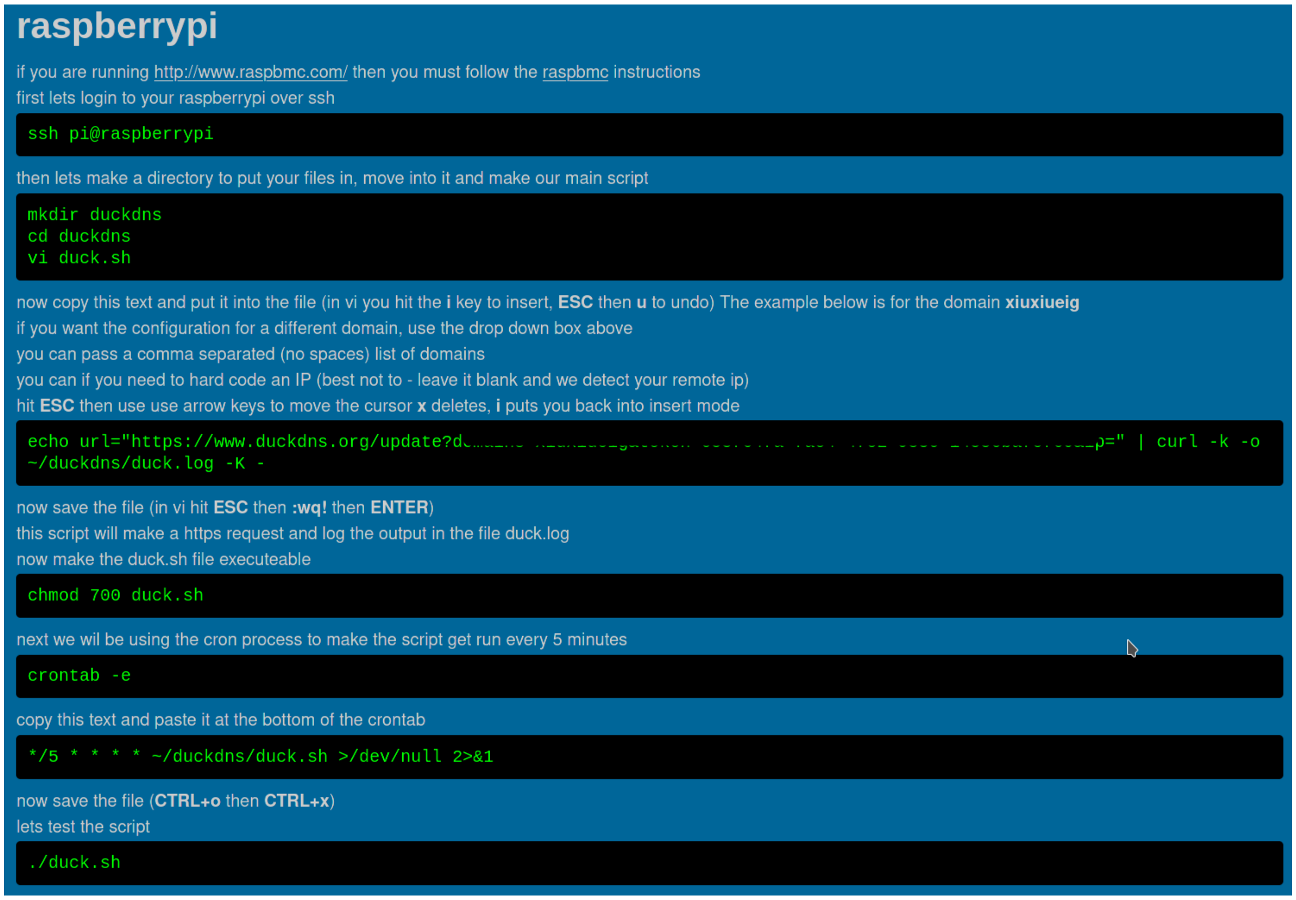
Configure the cron job. Here's an example of what the crontab entry might look like:



```
#
# For more information see the manual pages of crontab(5) and cron(8)
#
# m h  dom mon dow   command
5 */1 * * * ~/duckdns/duck.sh >/dev/null 2>&1
```

(This runs the script at 5 minutes past every hour.)

Crontab Scheduling: To explore different scheduling combinations for the cron job, you can use Crontab Guru: https://crontab.guru/.



raspberrypi

if you are running http://www.raspbmc.com/ then you must follow the raspbmc instructions
first lets login to your raspberrypi over ssh

```
ssh pi@raspberrypi
```

then lets make a directory to put your files in, move into it and make our main script

```
mkdir duckdns
cd duckdns
vi duck.sh
```

now copy this text and put it into the file (in vi you hit the **i** key to insert, **ESC** then **u** to undo) The example below is for the domain **xiuxiueig**
if you want the configuration for a different domain, use the drop down box above
you can pass a comma separated (no spaces) list of domains
you can if you need to hard code an IP (best not to - leave it blank and we detect your remote ip)
hit **ESC** then use use arrow keys to move the cursor **x** deletes, **i** puts you back into insert mode

```
echo url="https://www.duckdns.org/update?d[redacted]p=" | curl -k -o
~/duckdns/duck.log -K -
```

now save the file (in vi hit **ESC** then **:wq!** then **ENTER**)
this script will make a https request and log the output in the file duck.log
now make the duck.sh file executeable

```
chmod 700 duck.sh
```

next we wil be using the cron process to make the script get run every 5 minutes

```
crontab -e
```

copy this text and paste it at the bottom of the crontab

```
*/5 * * * * ~/duckdns/duck.sh >/dev/null 2>&1
```

now save the file (**CTRL+o** then **CTRL+x**)
lets test the script

```
./duck.sh
```

Setting up and configuring a WireGuard VPN Server

Objective

We will configure WireGuard VPN access for both a phone and a laptop. For enhanced security, we will use a non-default port, opting for port 5900 instead of the standard 5820.

Generating security keys

To secure the connection and restrict access, we need to generate public/private key pairs and preshared keys. Execute the following commands as root:

Switch to root user and navigate to the WireGuard directory:

```
$sudo su -
#cd /etc/wireguard
#umask 077
```

Generate keys for the server, phone, and laptop:

```
#wg genkey | tee server_private_key | wg pubkey > server_public_key
#wg genkey | tee phone_private_key | wg pubkey > phone_public_key
#wg genkey | tee laptop_private_key | wg pubkey > laptop_public_key
```

Generate preshared keys for additional security:

```
#wg genpsk < phone_private_key > phone_preshared_key
#wg genpsk < laptop_private_key > laptop_preshared_key
```

Server configuration

Create the server configuration file `wg0.conf`:

```
#nano /etc/wireguard/wg0.conf
```

Edit the file with the following structure, replacing keys with the ones you generated:

```
### Server Configuration ###
[Interface]
PrivateKey = <server private key>
Address = 10.6.0.1/24
PostUp = iptables -A FORWARD -i %i -j ACCEPT; iptables -A FORWARD -o %i -j
ACCEPT; iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
```

```
PostDown = iptables -D FORWARD -i %i -j ACCEPT; iptables -D FORWARD -o %i -j ACCEPT; iptables -t nat -D POSTROUTING -o eth0 -j MASQUERADE
ListenPort = 51900

### Phone Configuration ###
[Peer]
PublicKey = <phone public key>
PresharedKey = <phone preshared key>
AllowedIPs = 10.6.0.2/32
# Optional: PersistentKeepalive = 25

### Laptop Configuration ###
[Peer]
PublicKey = <laptop public key>
PresharedKey = <laptop preshared key>
AllowedIPs = 10.6.0.3/32
# Optional: PersistentKeepalive = 25
```

Editing the server configuration:

If you need to edit the server configuration later, stop the interface first:

```
#systemctl stop wg-quick@wg0.service
```

After editing, restart the interface:

```
#systemctl start wg-quick@wg0.service
```

Firewall configuration and IP masquerading on the server

Configuring the Firewall

Ensure your server's firewall allows traffic on the WireGuard port (here, 51900/UDP):

```
$sudo ufw allow 51900/udp
```

Edit the UFW default policy:

```
$sudo nano /etc/default/ufw
```

Change the default forward policy from "DROP" to "ACCEPT":

```
DEFAULT_FORWARD_POLICY="ACCEPT"
```

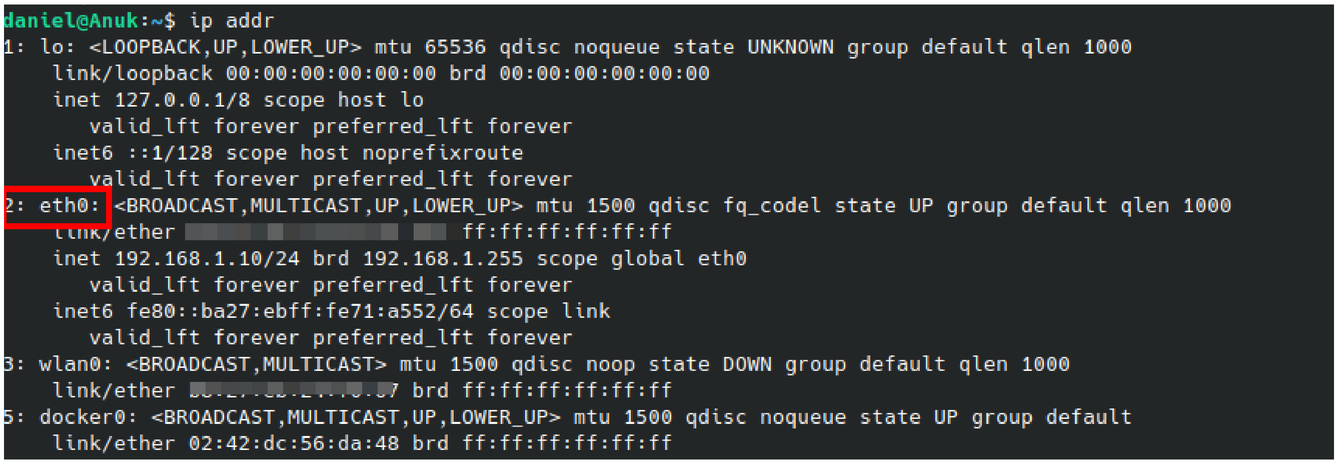
Save and close the file.

Identifying network interface:

Determine your server's main network interface name:

```
$ip addr
```

(For this guide, it's assumed to be `eth0`.)



```
daniel@Anuk:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether [redacted] ff:ff:ff:ff:ff:ff
    inet 192.168.1.10/24 brd 192.168.1.255 scope global eth0
       valid_lft forever preferred_lft forever
    inet6 fe80::ba27:ebff:fe71:a552/64 scope link
       valid_lft forever preferred_lft forever
3: wlan0: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group default qlen 1000
    link/ether [redacted] brd ff:ff:ff:ff:ff:ff
5: docker0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default
    link/ether 02:42:dc:56:da:48 brd ff:ff:ff:ff:ff:ff
```

Configuring IP masquerading

Edit the UFW configuration file to add IP masquerading rules:

```
$sudo nano /etc/ufw/before.rules
```

At the end of the file, add the following lines (replace `eth0` with your network interface name if different):

```
# Start IP Masquerading setup
*nat
:POSTROUTING ACCEPT [0:0]
-A POSTROUTING -o eth0 -j MASQUERADE
COMMIT
# End IP Masquerading setup
```

Save and close the file.

Important Considerations

- **Replace Key Values:** Ensure to replace `PrivateKey`, `PublicKey`, and `PresharedKey` in the WireGuard configuration with your generated values.

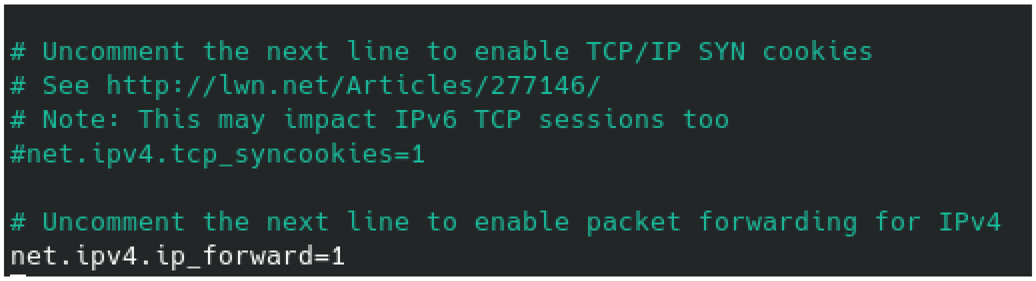
- **Network Interface Type:** The configuration assumes a wired ethernet connection (`eth0`). For WiFi (`wlan0`), modify `PostUp` and `PostDown` commands in the WireGuard configuration to use `-o wlan0`.

Enabling IP forwarding

Edit `sysctl.conf`:

```
#nano /etc/sysctl.conf
```

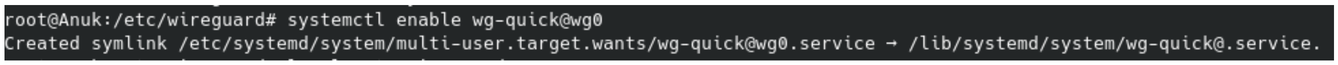
Uncomment `net.ipv4.ip_forward=1` and save the changes.



```
# Uncomment the next line to enable TCP/IP SYN cookies
# See http://lwn.net/Articles/277146/
# Note: This may impact IPv6 TCP sessions too
#net.ipv4.tcp_syncookies=1

# Uncomment the next line to enable packet forwarding for IPv4
net.ipv4.ip_forward=1
```

Enable the WireGuard interface:

```
#systemctl enable wg-quick@wg0
```

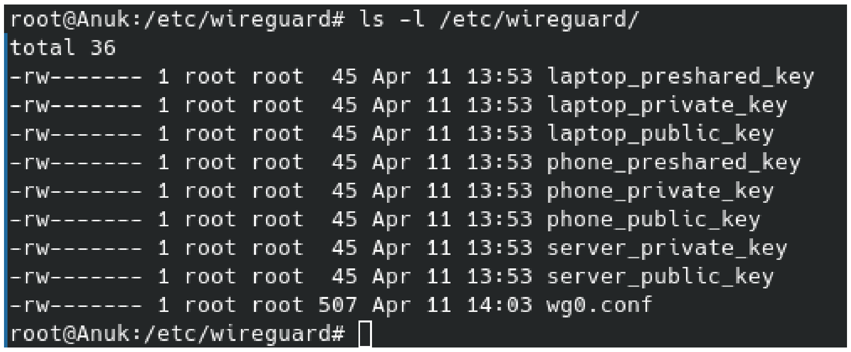


```
root@Anuk:/etc/wireguard# systemctl enable wg-quick@wg0
Created symlink /etc/systemd/system/multi-user.target.wants/wg-quick@wg0.service → /lib/systemd/system/wg-quick@.service.
```

Securing sensitive files

Protect sensitive WireGuard files:

```
#chown -R root:root /etc/wireguard/
#chmod -R og-rwx /etc/wireguard/*
```



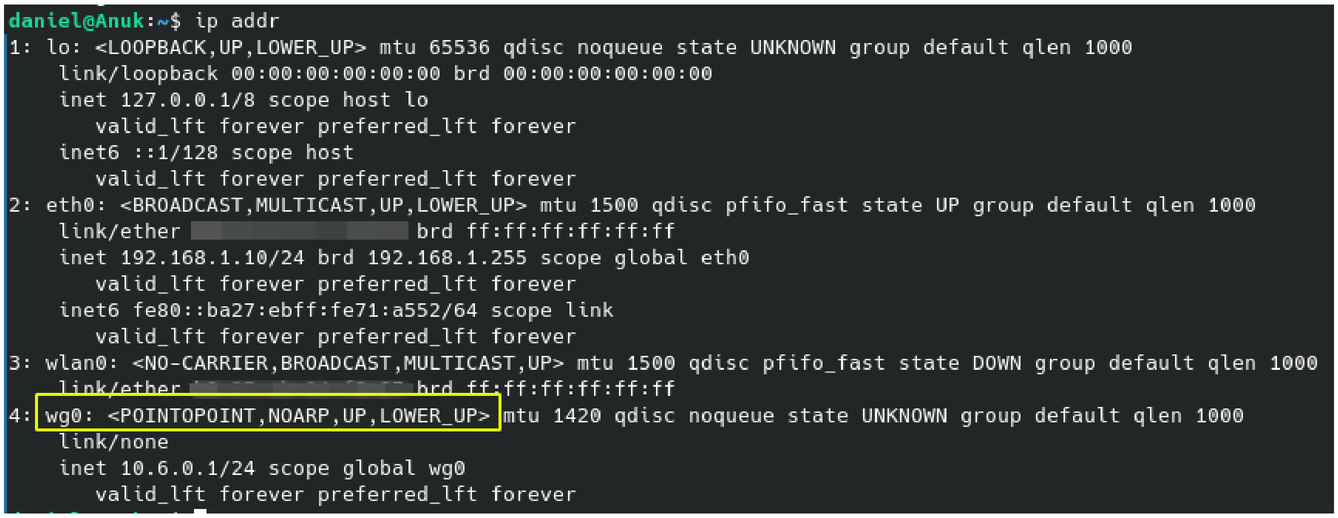
```
root@Anuk:/etc/wireguard# ls -l /etc/wireguard/
total 36
-rw------- 1 root root  45 Apr 11 13:53 laptop_preshared_key
-rw------- 1 root root  45 Apr 11 13:53 laptop_private_key
-rw------- 1 root root  45 Apr 11 13:53 laptop_public_key
-rw------- 1 root root  45 Apr 11 13:53 phone_preshared_key
-rw------- 1 root root  45 Apr 11 13:53 phone_private_key
-rw------- 1 root root  45 Apr 11 13:53 phone_public_key
-rw------- 1 root root  45 Apr 11 13:53 server_private_key
-rw------- 1 root root  45 Apr 11 13:53 server_public_key
-rw------- 1 root root 507 Apr 11 14:03 wg0.conf
root@Anuk:/etc/wireguard# 
```

Reboot the Raspberry Pi:

```
$sudo reboot
```

After rebooting, verify the WireGuard interface:

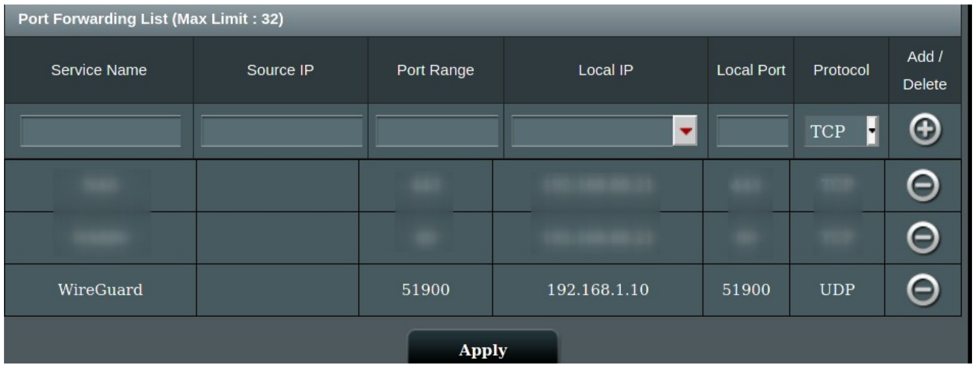
```
$ip addr
```



```
daniel@Anuk:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether [redacted] brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.10/24 brd 192.168.1.255 scope global eth0
       valid_lft forever preferred_lft forever
    inet6 fe80::ba27:ebff:fe71:a552/64 scope link
       valid_lft forever preferred_lft forever
3: wlan0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast state DOWN group default qlen 1000
    link/ether [redacted] brd ff:ff:ff:ff:ff:ff
4: wg0: <POINTOPOINT,NOARP,UP,LOWER_UP> mtu 1420 qdisc noqueue state UNKNOWN group default qlen 1000
    link/none
    inet 10.6.0.1/24 scope global wg0
       valid_lft forever preferred_lft forever
```

Configuring port forwarding:

Access your router's settings and set up port forwarding. Forward external port 51900 (UDP) to the internal IP address and port 51900 of the Raspberry Pi. Example:



Port Forwarding List (Max Limit : 32)

Service Name	Source IP	Port Range	Local IP	Local Port	Protocol	Add / Delete
					TCP	⊕
[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	⊖
[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	⊖
WireGuard		51900	192.168.1.10	51900	UDP	⊖

Setting up WireGuard clients

Common setup for clients

VPN Server Address: Use the domain server created with DuckDNS as `vpn_server_address`.

Setting up access

Open the configuration file for the phone client:

```
sudo nano /etc/wireguard/phone.conf
```

Add the following content, replacing placeholders with actual values:

```
[Interface]
Address = 10.6.0.2/24
PrivateKey = <insert phone_private_key>
DNS = 10.6.0.1

[Peer]
PublicKey = <insert server_public_key>
PresharedKey = <insert phone_preshared_key>
Endpoint = <vpn_server_address>:51900
AllowedIPs = 0.0.0.0/0, ::/0
```

Open the configuration file for the laptop client:

```
$sudo nano /etc/wireguard/laptop.conf
```

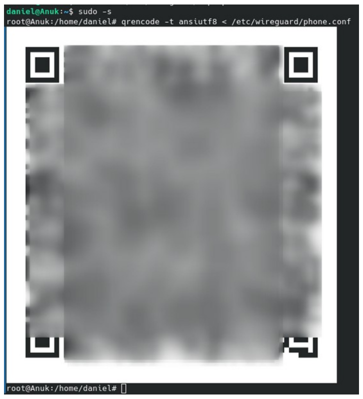
Add similar content as for the phone, replacing placeholders:

```
[Interface]
Address = 10.6.0.3/24
PrivateKey = <insert laptop_private_key>
DNS = 10.6.0.1

[Peer]
PublicKey = <insert server_public_key>
PresharedKey = <insert laptop_preshared_key>
Endpoint = <vpn_server_address>:51900
AllowedIPs = 0.0.0.0/0, ::/0
```

Generate QR code for easy import

Use `qrencode` to create a QR code:

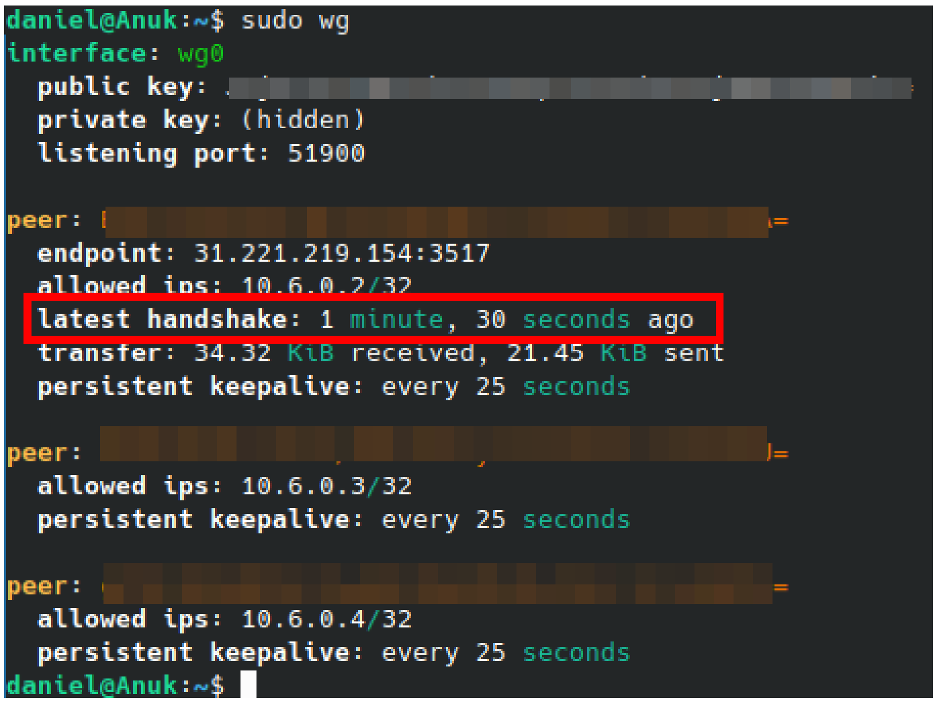
```
#qrencode -t ansiutf8 < /etc/wireguard/phone.conf
```



```
daniel@Anuk:~$ sudo -s
root@Anuk:/home/daniel# qrencode -t ansiutf8 < /etc/wireguard/phone.conf
[redacted]
root@Anuk:/home/daniel#
```

Testing the Connection

After connecting the phone to the local network, test the connection running the command wg:



```
daniel@Anuk:~$ sudo wg
interface: wg0
  public key: [redacted]
  private key: (hidden)
  listening port: 51900

peer: [redacted]
  endpoint: 31.221.219.154:3517
  allowed ips: 10.6.0.2/32
  latest handshake: 1 minute, 30 seconds ago
  transfer: 34.32 KiB received, 21.45 KiB sent
  persistent keepalive: every 25 seconds

peer: [redacted]
  allowed ips: 10.6.0.3/32
  persistent keepalive: every 25 seconds

peer: [redacted]
  allowed ips: 10.6.0.4/32
  persistent keepalive: every 25 seconds
daniel@Anuk:~$
```

Attempt to access local resources (e.g., Pi-hole web interface).

Adding Unattended Upgrades (Optional):

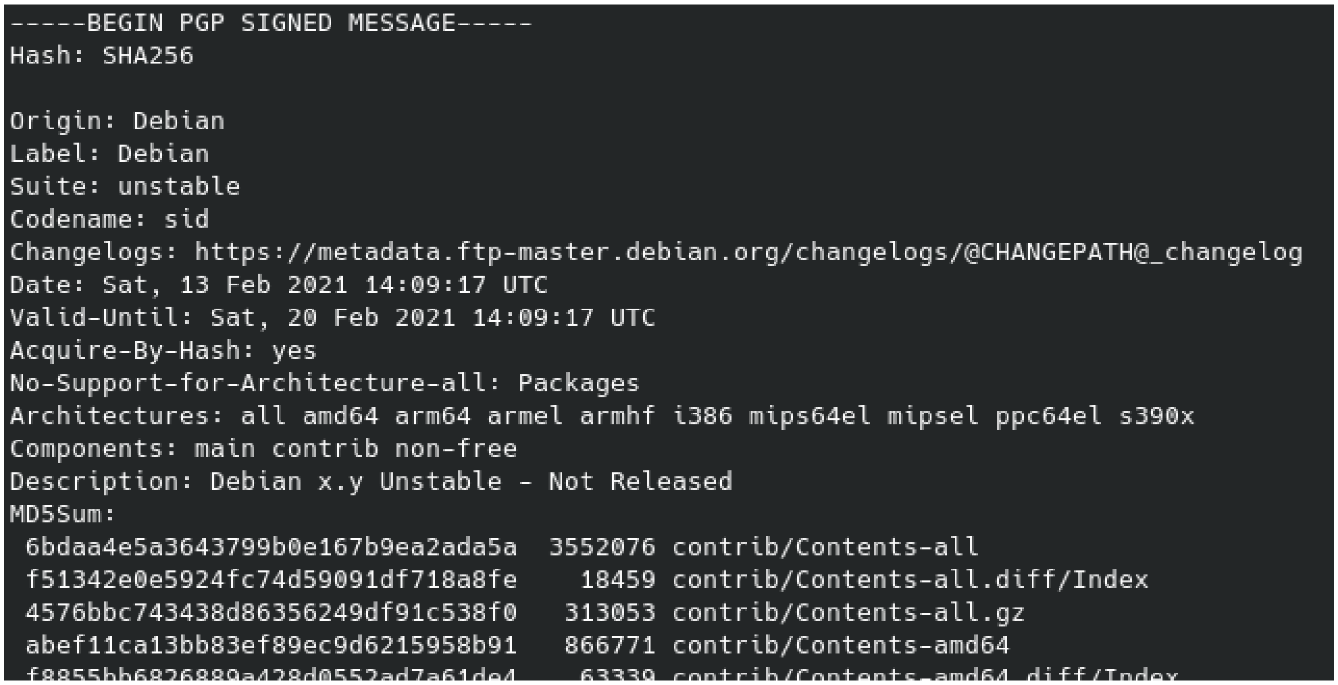
For third-party packages (e.g., from PPAs), manually include them for security updates.

Determining PPA Origin and Suite:

Check `/var/lib/apt/lists` for files ending with `InRelease`.

Use `less` to view details:

```
$less /var/lib/apt/lists/deb.debian.org_debian_dists_unstable_InRelease
```



```
-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA256

Origin: Debian
Label: Debian
Suite: unstable
Codename: sid
Changelogs: https://metadata.ftp-master.debian.org/changelogs/@CHANGEPATH@_changelog
Date: Sat, 13 Feb 2021 14:09:17 UTC
Valid-Until: Sat, 20 Feb 2021 14:09:17 UTC
Acquire-By-Hash: yes
No-Support-for-Architecture-all: Packages
Architectures: all amd64 arm64 armel armhf i386 mips64el mipsel ppc64el s390x
Components: main contrib non-free
Description: Debian x.y Unstable - Not Released
MD5Sum:
 6bdaa4e5a3643799b0e167b9ea2ada5a  3552076 contrib/Contents-all
 f51342e0e5924fc74d59091df718a8fe    18459 contrib/Contents-all.diff/Index
 4576bbc743438d86356249df91c538f0   313053 contrib/Contents-all.gz
 abef11ca13bb83ef89ec9d6215958b91   866771 contrib/Contents-amd64
 f8855bb6826889a428d0552ad7a61de4    63339 contrib/Contents-amd64.diff/Index
```

Note the `Origin` and `Suite` fields to provide to `unattended-upgrade` for automatic updates.

Installing Pi.Alert, a network security scanner & notification framework (optional)

Pi.Alert is a compact and effective project designed to detect Wi-Fi and LAN intruders by monitoring connected devices and alerting you to any unknown devices. It also notifies you when "always connected" devices are disconnected. Originally developed by pucherot and available at pucherot/Pi.Alert, it has not been updated since 2021. Recognizing its potential, several forks quickly emerged. For this installation, we'll be using a containerized version by jokob-sk, available at jokob-sk/Pi.Alert, though non-container alternatives like leiweibau/Pi.Alert are also available.

Installation Guide

This guide will cover setting up the container using a configuration file through the stacks menu in Portainer. The configuration will include:

- Healthcheck feature to monitor the container's health status.
- Volume mapping for:
  - Synchronizing device data between Pi.Alert and Pi.Hole by mapping the Pi-hole folder where the pihole-FTL.db file is stored (optional).
  - Mapping the Pi.Alert log folder for log access (optional).
- Configuring the TimeZone and port.
- Setting the user and group ID.
- Setting the network mode.

Docker Compose Configuration:

```
version: "3.9"
services:
  pi.alert:
    container_name: Pi.Alert
    healthcheck:
      test: curl -f http://localhost:20211/ || exit 1
      interval: 5m
      timeout: 10s
      retries: 5
    volumes:
      - /home/daniel/DockerVol/pialert/config:/home/pi/pialert/config:rw
      - /home/daniel/DockerVol/pialert/db:/home/pi/pialert/db:rw
      # Optional log volume. Uncomment to enable it
      #- /home/daniel/DockerVol/pialert/log:/home/pi/pialert/front/log:rw
      # Optional Pi-hole synchronization. Uncomment to enable it
      #- /home/daniel/DockerVol/pihole/etc-pihole:/etc/pihole/:rw
    environment:
      TZ: Europe/Madrid # Change to your timezone
      PORT: 20211
      HOST_USER_ID: 1000
      HOST_USER_GID: 1000
    network_mode: host
    restart: unless-stopped
    image: jokobsk/pi.alert:latest
```

Firewall Configuration:

If you've enabled a firewall, remember to open the TCP port and reload the firewall to allow access to the Pi.Alert web interface:

```
$sudo ufw allow 20211/tcp
$sudo ufw reload
```

Securing Access:

As the default setup is not password-protected, it's advisable to change the default password (123456) and enable login protection:

1. Navigate to the 'Set Password' option within the System menu in settings.
2. Enter your desired password in the `SETPWD_password` field.
3. Change `SETPWD_RUN` from disabled to `before_config_save` and click the play button. A notification should confirm that the password is set.
4. Access the General settings under the Core menu and enable `PIALERT_WEB_PROTECTION`.
5. Finally, click the Pi.Alert icon in the upper right corner and select 'Sign out'. You will now be prompted for a password upon logging in.

Installing a monitoring tool

When it comes to system monitoring, there are a plethora of options ranging from lightweight applications to more comprehensive solutions that offer extensive functionalities at the expense of higher resource consumption.

Initially, I opted for RPi-Monitor for its simplicity and light footprint, offering all the basic monitoring parameters one might need. However, it became apparent that RPi-Monitor has not been updated since August 2017, prompting a search for a modern, actively maintained alternative. This search led me to discover NetData, a robust, open-source tool designed for real-time metrics collection. NetData excels in presenting metrics such as CPU usage, disk activity, bandwidth utilization, and website traffic through live, intuitive charts. It also allows for the creation of a free cloud account which adds enhanced features like:

- Infrastructure-level dashboards aggregating data from multiple nodes.
- Centralized alert notifications.
- Custom dashboard editor.
- Intelligent troubleshooting assistance to identify root causes of issues.

Although NetData offers premium features, the free account promises to remain free indefinitely.

For those requiring a more powerful monitoring solution with extensive integrations and capabilities, including machine learning, Grafana is an excellent choice. Grafana provides a sandbox environment for experimenting with dashboards and data visualization.

Installing RPi-Monitor (Deprecated)

As RPi-Monitor's maintenance has ceased, its installation is only recommended for historical reference or specific legacy applications. To install RPi-Monitor, follow these commands:

```
$sudo apt-get install dirmngr
$sudo apt-key adv --recv-keys --keyserver hkp://keyserver.ubuntu.com:80 2C0D3C0F
$sudo wget http://goo.gl/vewCLL -O /etc/apt/sources.list.d/rpimonitor.list
$sudo apt-get update
```

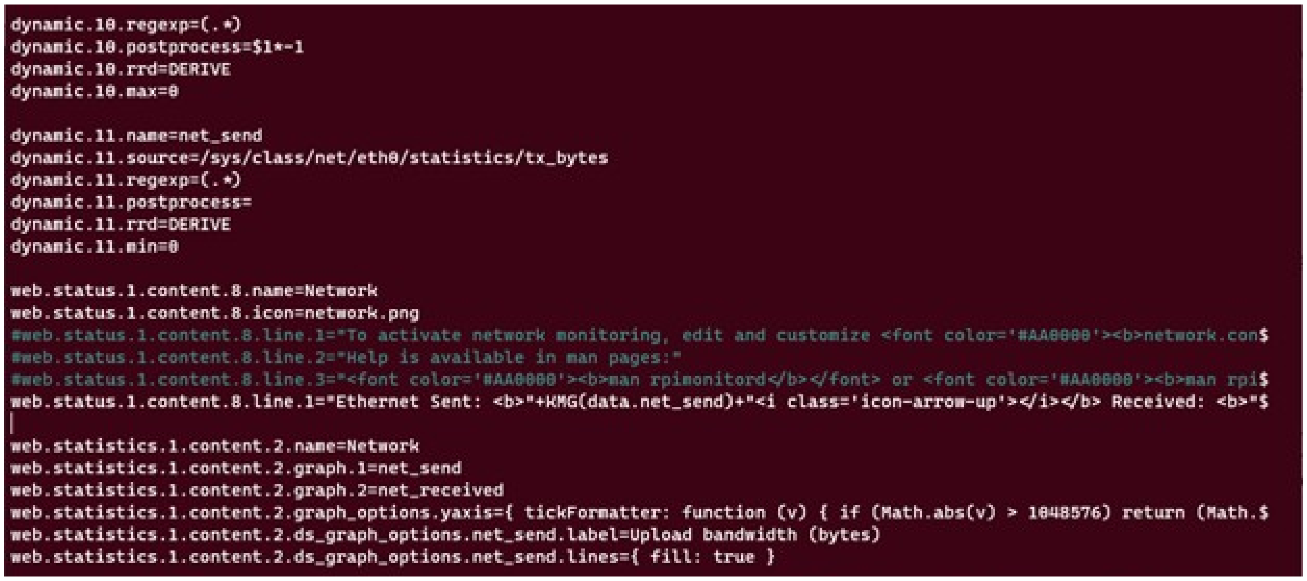
```
$sudo apt-get install rpimonitor
```

Configuring RPi-Monitor for Network Statistics:

1. Edit the network configuration template:

```
$sudo nano /etc/rpimonitor/template/network.conf
```

2. Adjust the configuration by uncommenting and commenting sections as detailed in the original instructions to tailor the displayed network statistics.



```
dynamic.10.regexp=(.*)
dynamic.10.postprocess=$1*-1
dynamic.10.rrd=DERIVE
dynamic.10.max=0

dynamic.11.name=net_send
dynamic.11.source=/sys/class/net/eth0/statistics/tx_bytes
dynamic.11.regexp=(.*)
dynamic.11.postprocess=
dynamic.11.rrd=DERIVE
dynamic.11.min=0

web.status.1.content.8.name=Network
web.status.1.content.8.icon=network.png
#web.status.1.content.8.line.1="To activate network monitoring, edit and customize <font color='#AA0000'><b>network.con$
#web.status.1.content.8.line.2="Help is available in man pages:"
#web.status.1.content.8.line.3="<font color='#AA0000'><b>man rpimonitord</b></font> or <font color='#AA0000'><b>man rpi$
web.status.1.content.8.line.1="Ethernet Sent: <b>"+KMG(data.net_send)+"<i class='icon-arrow-up'></i></b> Received: <b>"$

web.statistics.1.content.2.name=Network
web.statistics.1.content.2.graph.1=net_send
web.statistics.1.content.2.graph.2=net_received
web.statistics.1.content.2.graph_options.yaxis={ tickFormatter: function (v) { if (Math.abs(v) > 1048576) return (Math.$
web.statistics.1.content.2.ds_graph_options.net_send.label=Upload bandwidth (bytes)
web.statistics.1.content.2.ds_graph_options.net_send.lines={ fill: true }
```

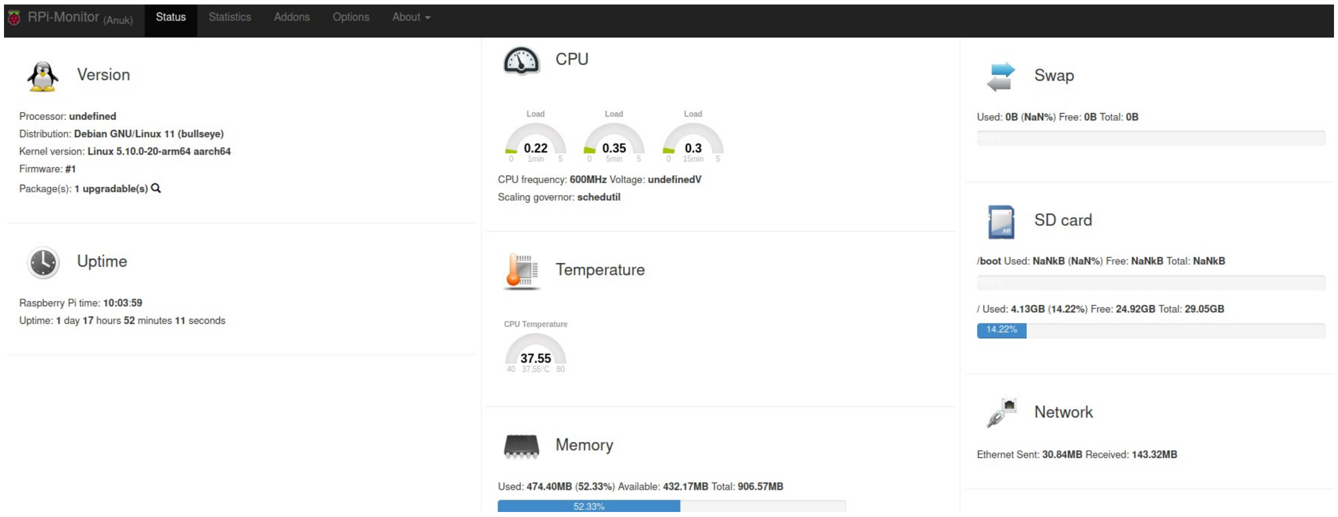
3. Restart RPi-Monitor to apply changes:

```
$sudo service rpimonitor restart
```

4. Update RPi-Monitor's package status:

```
$sudo /etc/init.d/rpimonitor update
```

Access the RPi-Monitor web interface at `http://<IPAddress>:8888` to view your server's status and historical data, facilitating effective monitoring and troubleshooting.



Version

Processor: **undefined**
Distribution: **Debian GNU/Linux 11 (bullseye)**
Kernel version: **Linux 5.10.0-20-arm64 aarch64**
Firmware: **#1**
Package(s): **1 upgradable(s)**

Uptime

Raspberry Pi time: **10:03:59**
Uptime: **1** day **17** hours **52** minutes **11** seconds

CPU

CPU frequency: **600MHz** Voltage: **undefinedV**
Scaling governor: **schedutil**

Temperature

Memory

Used: **474.40MB (52.33%)** Available: **432.17MB** Total: **906.57MB**

Swap

Used: **0B (NaN%)** Free: **0B** Total: **0B**

SD card

/boot Used: **NaNkB (NaN%)** Free: **NaNkB** Total: **NaNkB**

/ Used: **4.13GB (14.22%)** Free: **24.92GB** Total: **29.05GB**

Network

Ethernet Sent: **30.84MB** Received: **143.32MB**

Installing Netdata on Raspberry Pi (Recommended)

Netdata is a powerful tool designed to monitor and troubleshoot a variety of devices and the applications running on them, including Raspberry Pi and Pi-hole. With its quick installation process and no need for additional configuration, Netdata provides instant access to over 1,500 metrics, such as CPU load, memory and disk usage, and bandwidth, collected every second.

Installation process

Bare metal installation

To install Netdata on a Raspberry Pi, you only need to run a single command script that handles dependency installation and compiles Netdata from the source. On Raspberry Pis running Raspbian, the best way to install Netdata is our one-line kickstart script. This script asks you to install dependencies, then compiles Netdata from source via GitHub.

```
$wget -O /tmp/netdata-kickstart.sh https://get.netdata.cloud/kickstart.sh
&& sh /tmp/netdata-kickstart.sh --stable-channel --disable-telemetry
```

Parameters Explained

- `--stable-channel`: Use this to install from the stable release channel (default nightly).
- `--disable-telemetry`: Opt out of sending anonymous statistics.
- `--no-updates`: To disable automatic updates.

This command opts for a nightly version for the most updated features, disables anonymous statistics, and opts out of automatic updates.

During installation, the script will prompt for administrator credentials to install all necessary packages.

Container installation

We are going to install netdata inside a container using a docker-compose configuration following the instrucions from here: https://learn.netdata.cloud/docs/installing/docker. Below is the Docker Compose file to load in Portainer's stacks menu:

```
version: '3'
services:
  netdata:
    image: netdata/netdata
    container_name: netdata
    environment:
      - TZ=Europe/Madrid # Change to your timezone
    pid: host
    network_mode: host
    ports:
      - 19999:19999
    restart: unless-stopped
    cap_add:
      - SYS_PTRACE
      - SYS_ADMIN
    security_opt:
      - apparmor:unconfined
    volumes:
      - netdataconfig:/etc/netdata
      - netdatalib:/var/lib/netdata
      - netdatacache:/var/cache/netdata
      - /etc/passwd:/host/etc/passwd:ro
      - /etc/group:/host/etc/group:ro
      - /etc/localtime:/etc/localtime:ro
      - /proc:/host/proc:ro
      - /sys:/host/sys:ro
      - /etc/os-release:/host/etc/os-release:ro
      - /var/log:/host/var/log:ro
      - /var/run/docker.sock:/var/run/docker.sock:ro
volumes:
  netdataconfig:
  netdatalib:
  netdatacache:
```

Key Components of the Configuration:

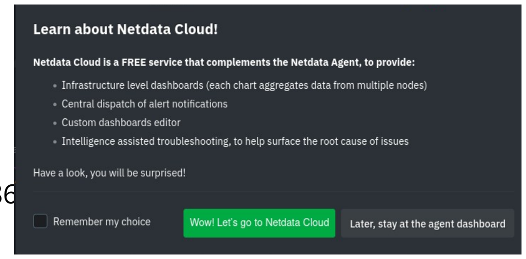
- **Ports:** The Netdata web interface is exposed on port 19999, which you can access via `http://<your-raspberry-pi-ip>:19999`.
- **Volumes:** Uses persistent storage for configuration, data libraries, and cache to ensure data persists across container restarts. Mounts `proc` and `sys` filesystems to allow Netdata to collect system metrics. Remeber, container volumen are mounted under /var/lib/docker/volumes host folder.
- **Environment Variables:** `TZ` is set for timezone configuration. Adjust it to match your local timezone.
- **Capabilities and Security:** Adds `SYS_PTRACE` and `SYS_ADMIN` to enhance metrics collection capabilities. Sets AppArmor to `unconfined` to avoid restrictions that could limit Netdata's monitoring capabilities.
- **Default Location of Docker Volumes:** On a Linux system, the default location for Docker volumes is under /var/lib/docker/volumes/. So, if you have a named volume `netdataconfig`, the data stored in this volume can be found at: /var/lib/docker/volumes/netdataconfig/_data

Navigate to the Stacks menu and select "+ Add stack". Enter a stack name in lowercase and choose the "Web editor" option. Paste the Docker Compose file provided earlier, modifying any necessary parameters. Next, click the "Deploy the stack" button and wait a few minutes.

Accessing Netdata

Navigate to `http://[your raspberry pi IP]:19999` in your browser to view the Netdata dashboard. Upon first login, you'll be prompted to create a cloud account to access additional features such as:

- Infrastructure-level dashboards.



Learn about Netdata Cloud!

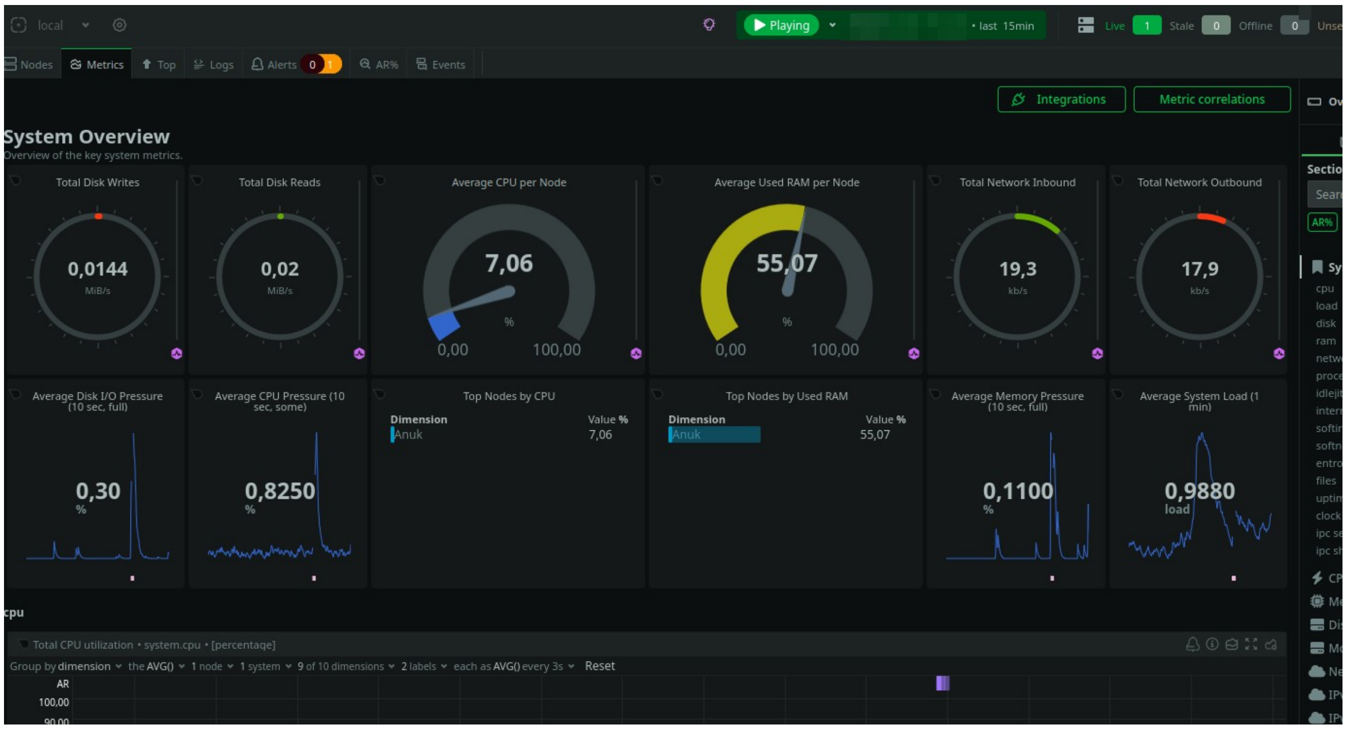
Netdata Cloud is a FREE service that complements the Netdata Agent, to provide:

- Infrastructure level dashboards (each chart aggregates data from multiple nodes)
- Central dispatch of alert notifications
- Custom dashboards editor
- Intelligence assisted troubleshooting, to help surface the root cause of issues

Have a look, you will be surprised!

Remember my choice
Wow! Let's go to Netdata Cloud
Later, stay at the agent dashboard

- Centralized alert notifications.
- Custom dashboard editor.
- Assisted troubleshooting intelligence.



local
Playing
last 15min
Live 1
Stale 0
Offline 0
Nodes
Metrics
Top
Logs
Alerts
AR%
Events
Integrations
Metric correlations
System Overview
Overview of the key system metrics.
Total Disk Writes 0,0144 MiB/s
Total Disk Reads 0,02 MiB/s
Average CPU per Node 7,06 % 0,00 100,00
Average Used RAM per Node 55,07 % 0,00 100,00
Total Network Inbound 19,3 kb/s
Total Network Outbound 17,9 kb/s
Average Disk I/O Pressure (10 sec, full) 0,30 %
Average CPU Pressure (10 sec, some) 0,8250 %
Top Nodes by CPU
Dimension Value %
Anuk 7,06
Top Nodes by Used RAM
Dimension Value %
Anuk 55,07
Average Memory Pressure (10 sec, full) 0,1100 %
Average System Load (1 min) 0,9880 load
cpu
Total CPU utilization • system.cpu • [percentage]
Group by dimension the AVG() 1 node 1 system 9 of 10 dimensions 2 labels each as AVG() every 3s Reset
AR
100,00

Through the dashboard, you can explore various metrics collected by Netdata, from device-specific data like CPU, memory, disk, network, and temperature (found under the Sensors section), to application-specific metrics for software like Fail2ban, firewall, Pi-hole, and WireGuard.

Configuring Netdata

Enabling temperature sensor monitoring

After installation, you'll need to modify a configuration file to enable temperature sensor monitoring. This involves uncommenting the `sensors=force` line in the `charts.d.conf` configuration file. The location of this file varies depending on your operating system:

For container installation:

```
$sudo -s
#cd /var/lib/docker/volumes/netdata_netdataconfig/_data
```

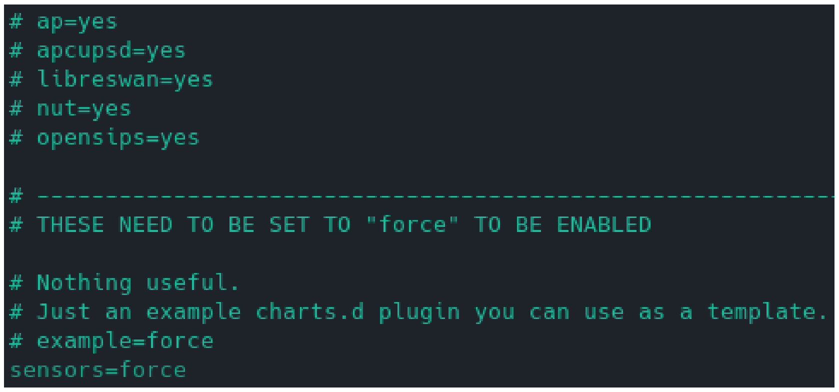
```
$sudo ./edit-config charts.d.conf
```

For Debian:

```
$cd /etc/netdata
$sudo ./edit-config charts.d.conf
```

For Raspbian:

```
$cd /opt/netdata
$sudo cp usr/lib/netdata/conf.d/charts.d.conf etc/netdata/
$cd etc/netdata
$sudo ./edit-config charts.d.conf
```



```
# ap=yes
# apcupsd=yes
# libreswan=yes
# nut=yes
# opensips=yes

# ----------------------------------------------------------
# THESE NEED TO BE SET TO "force" TO BE ENABLED

# Nothing useful.
# Just an example charts.d plugin you can use as a template.
# example=force
sensors=force
```

After making the changes, restart the Netdata service to activate temperature sensor monitoring:

```
$sudo systemctl restart netdata
```

Increasing Historical Metrics Storage

Netdata recommends adjusting the data storage settings to accommodate more historical metrics. Utilize their database sizing calculator and guide on storing historical metrics your Raspberry Pi accordingly.

Cloud account and remote monitoring

Creating a cloud account provides a command to install an agent on your device for data collection and cloud transmission. Additionally, leveraging their mobile app is highly recommended for remote system monitoring.

Grafana Integration

For those interested in integrating with Grafana, detailed instructions on installing a Grafana agent on a raspberry pi are available on their website, providing step-by-step guidance for this process.

Enhancing the Raspberry security

In addition to the measures mentioned in the previous sections, such as enabling the firewall, installing fail2ban to protect against brute force attacks, securing SSH access, not using default ports, or disabling default users, we can take an additional step like disabling WiFi if we do not use it.

Disabling Wi-Fi

If your Raspberry Pi is equipped with a Wi-Fi interface that you do not use, disabling it can enhance security and reduce potential attack vectors. Here's how to disable the onboard Wi-Fi:

Method 1: Disable Wi-Fi via /boot/config.txt

For Raspberry Pi 3 and Raspberry Pi 4, you can disable the onboard Wi-Fi directly through the firmware by modifying the `/boot/config.txt` file. This approach is recommended for a more permanent solution. Add the following lines to `/boot/config.txt`:

- For all models with onboard Wi-Fi:

```
dtoverlay=disable-wifi
```

- Specifically for Raspberry Pi 3 (this line is not needed for Pi 4 as the above line covers all models):

```
dtoverlay=pi3-disable-wifi
```

This method disables the Wi-Fi hardware at the firmware level, preventing it from being activated by the operating system.

Method 2: Blacklisting Wi-Fi Modules

Alternatively, you can disable the Wi-Fi by blacklisting the kernel modules responsible for the Wi-Fi interface. This method effectively prevents the Wi-Fi drivers from being loaded during system startup, which disables the Wi-Fi interface. Add the following lines to a new blacklist file within `/etc/modprobe.d/`:

Open or create the blacklist configuration file:

```
$sudo nano /etc/modprobe.d/raspi-blacklist.conf
```

Add these lines to the file to blacklist the Wi-Fi drivers:

```
blacklist brcmfmac
blacklist brcmutil
```

Save and exit the editor (in nano, press `CTRL+X`, then `Y` to confirm, and `Enter` to save).

After adding these lines, reboot your Raspberry Pi for the changes to take effect. This approach is useful if you might want to re-enable Wi-Fi in the future, as you can simply remove these lines or comment them out by prefixing with `#`.

Both methods are effective in disabling the Wi-Fi interface on a Raspberry Pi. Choose the method that best suits your needs based on whether you prefer a firmware-level solution or a reversible kernel module blacklist approach.

Backup & restore strategies for Raspberry Pi

Backing up your Raspberry Pi is crucial for ensuring that your data, configurations, and the entire system can be restored to a previous state in case of failure, corruption, or before making significant changes. Here are detailed methods for backing up your Raspberry Pi:

Method 1: Copy the SD Card Image

Creating a direct image of your SD card or USB drive is a straightforward way to backup your entire system. This method clones the entire partition, including the operating system, applications, user data, and settings.

To create an SD card image, use the dd command:

```
$sudo dd bs=4M if=/dev/sdb of=raspbian_bck.img conv=fdatasync
status=progress
```

- `bs=4M` sets the block size to 4 megabytes to speed up the backup process.
- `if=/dev/sdb` specifies the input file (your SD card). Be sure to replace `/dev/sdb` with the correct device identifier for your SD card. Use the `lsblk` or `fdisk -l` command to identify your SD card.
- `of=raspbian_bck.img` defines the output file, the name of the disk image.
- `conv=fdatasync` ensures that the data is written and synchronized before the process completes.
- `status=progress` displays the progress of the backup as it happens.

Restoring from an SD card image:

To restore your Raspberry Pi from the backup image, use the dd command in reverse:

```
bash

sudo dd bs=4M if=raspbian_bck.img of=/dev/sdb conv=fdatasync
status=progress
```

Ensure you specify the correct output file (`of=/dev/sdb`), which should be your SD card.

Method 2: Zip the Home Directory

This method involves compressing and backing up the home directory or any specific directories you wish to backup. This is useful for backing up user data and configurations without cloning the entire system.

Backup the home directory:

```
$sudo zip -r home_backup.zip /home/pi
```

- `zip -r home_backup.zip` creates a compressed zip file named `home_backup.zip`.
- `/home/pi` specifies the directory to backup. Adjust the path according to your needs or to backup other directories.

Restoring from the zip file:

To restore, simply unzip the backup file to the desired location:

```
$sudo unzip home_backup.zip -d /home/pi
```

Method 3: Scheduled Backups with `rsync` or `cron`

Scheduled backups can be set up using `cron` jobs and the `rsync` tool, allowing for incremental backups of specified directories to an external storage device or network location.

Setup a `cron` job for regular backups:

1. Open the `cron` table for editing:

```
$sudo crontab -e
```

2. Add a line to schedule your backup. For example, to backup daily at midnight:

```
cron
0 0 * * * /usr/bin/rsync -a /home/pi /path/to/backup/location
```

- `/usr/bin/rsync -a /home/pi /path/to/backup/location` specifies the `rsync` command to perform the backup. Replace `/path/to/backup/location` with your actual backup destination.
- Adjust the `cron` schedule syntax as needed for your backup frequency.

Bonus track. Setting up Vaultwarden: a lightweight password manager

When it comes to managing passwords securely, the choice of tools can greatly influence both the security and ease of use. Initially, I opted for keePass, a lightweight and open-source solution, and even shared my setup and usage tips on my blog. Over time, however, the landscape of password management tools has evolved, bringing more feature-rich options to the forefront, such as Bitwarden. Despite Bitwarden's robust offerings, its official server can be resource-intensive, making it less ideal for all users.

This is where Vaultwarden comes into play. Vaultwarden is an alternative implementation of the Bitwarden server's API, written in Rust. It's designed to be compatible with Bitwarden clients but is significantly more lightweight, making it an excellent choice for self-hosting, especially on less powerful hardware like a Raspberry Pi.

Basic Installation of Vaultwarden

The installation process for Vaultwarden is straightforward and can be followed from the official documentation. Given my setup, where one Raspberry Pi is already dedicated to privacy filtering and serving as a VPN server, I opted to deploy Vaultwarden on a separate Raspberry Pi to avoid overloading a single device with multiple services.

Requirements for Accessing Vaultwarden

- **Proxy Manager (Nginx):** To access Vaultwarden securely, especially from outside your local network, you'll need a reverse proxy. Nginx is a popular choice for this role, providing the necessary redirection and encryption for web traffic.
- **Container Manager (Portainer):** Vaultwarden and Nginx will run inside containers, simplifying deployment, isolation, and management of these services. Portainer is an intuitive container management tool that facilitates the management of Docker containers.

Ensuring Secure Remote Access

- **DDNS Service:** If you plan to access your Vaultwarden server from the internet, a Dynamic Domain Name System (DDNS) service is crucial. DDNS ensures that your server can be reached at a consistent address, even if your home IP address changes.

- **Mandatory HTTPS:** Given the sensitive nature of a password manager, ensuring secure access via HTTPS is non-negotiable. Accessing your password vault through an unencrypted HTTP connection is unsafe. The use of a reverse proxy like Nginx allows for the easy setup of SSL certificates, often through automated tools like Let's Encrypt, to secure your connections.

Final Thoughts

Choosing Vaultwarden for self-hosted password management offers a balance between functionality and resource efficiency, making it an excellent choice for individuals looking to maintain control over their password data without requiring extensive server resources. The setup, while involving several steps, provides a robust and secure system for managing passwords across devices and from any location, ensuring your sensitive information remains protected.

By following these guidelines, you can establish a secure, private, and self-hosted password management solution that respects your resources and privacy.

Updating the software components on your Raspberry Pi, especially when using Docker containers, is crucial for security, performance improvements, and accessing new features. Here's a streamlined guide on how to update key components like Portainer, individual Docker containers, and Nginx within your setup.

Updating Portainer

Portainer is an essential tool for managing your Docker environments. Follow these steps to update Portainer to the latest version:

1. Stop the Portainer container:

```
$docker stop portainer
```

2. Remove the existing Portainer container

```
$docker rm portainer
```

3. Pull the latest Portainer image:

```
$docker pull portainer/portainer-ce:latest
```

4. Run the new Portainer container:

```
$sudo docker run -d -p 9000:9000 --name=portainer --restart=always -v
/var/run/docker.sock:/var/run/docker.sock -v portainer_data:/data
portainer/portainer-ce:latest
```

Updating Vaultwarden

Containers should be regularly checked for updates to ensure you're running the most secure and efficient versions.

Updating through Portainer:

1. **Stop the container:** Navigate to Containers in Portainer, then stop the container you wish to update.
2. **Recreate the container:** Select the container, then click on "Recreate". Make sure to select "Pull latest image" before recreating.
3. **Restart the container:** Once recreated, start the container. It will now run the latest image version.

Updating via Command Line:

To update a specific container, such as Vaultwarden, follow these steps:

1. **Pull the latest image:**

```
$docker pull vaultwarden/server:latest
```

2. **Run the new container (example for Vaultwarden):** Ensure to remove the previous container if necessary and adjust the volume mappings and port bindings as per your configuration.

```
$sudo docker run -d --name vaultwarden --restart=always -v /bw-data/:/data/
-p 127.0.0.1:8080:80 -p 127.0.0.1:3012:3012 vaultwarden/server:latest
```

Updating Nginx

For Nginx, which serves as a reverse proxy, it's vital to keep both the application and its database containers up to date:

1. **Update the Nginx application container:**

```
$sudo docker update --restart always nginx_app_1
```

2. **Update the Nginx database container:**

```
$sudo docker update --restart always nginx_db_1
```

General tips for updating Docker containers:

- **Backup first:** Always backup your data before updating, especially for critical services like databases or personal data management systems.
- **Use tags wisely:** When pulling new images, consider using specific version tags instead of always using `:latest` to ensure compatibility.
- **Clean Up:** After updating, clean up old images and containers with `docker system prune` to free up space.

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