Raspberry Pi Bullseye Getting Started

Contents

Raspberry Pi Install Bullseye

Raspberry Pi OS is Linux: All commands are **case sensitive.**

NOTE: Remove all USB drives from computer except the MicroSD adapter.

1. Insert a MicroSD adapter with a minimum 8 GB MicroSD card into a USB port on your computer.
2. Download and install **Raspberry Pi Imager:** https://www.raspberrypi.com/software
3. Start Raspberry Pi Imager → Choose Device: **Raspberry Pi3 or Pi4.**
4. Choose OS → **Raspberry Pi OS Bullseye (Legacy 32-bit) for Pi3, 64-bit for Pi4**. Security updates and desktop environment
5. Click **CHOOSE STORAGE → TS-RDF5 SD Transcend** (or whatever device has the MicroSD card),
6. Click Next.
7. Would you like to apply OS customization settings?
8. **Edit Settings**.
    a. Set hostname
    b. Set username and password: pi Password01
    c. Configure wireless LAN
    d. Set locale settings
    e. Go to Services: Enable SSH → Use password authentication
    f. Click **Save**.
    g. Click **Yes**.
9. All existing data will be erased. Click **Yes**.
10. When prompted: Remove the MicroSD adapter.

Boot and Connect to the Raspberry Pi

1. Power off the Pi.
2. Plug in the external Wi-Fi adapter.
3. Insert the MicroSD card in the Raspberry Pi.
4. Power up the Pi. This will take a little longer the first time you boot the robot.

The Pi should connect to your wireless network.

There are a couple of ways to find the Pi's IP address. Note the IP address, you will need it to connect with SSH.

Network Scanner Method

- Advanced IP Scanner - https://www.advanced-ip-scanner.com
- Use ZenMap with Quick Scan setting www.nmap.org

Your Pi should show up on your network scan with an IP address.

Plug in an Ethernet Cable

You may have to plug in an Ethernet cable to the Pi. Rescan.

Last Resort: Keyboard, Mouse, Monitor

Connect a keyboard, mouse and monitor to the GoPiGo3. Connect to or point to the wireless or wired connection. You want the IP address.

You finally have the IP address.

1. Go to https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html
2. Download the **PuTTY** client.
3. Start the **PuTTY** client. Type in the **IP address** of the GiPiGo3 → Click **Open**.
4. **Accept** the **PuTTY Security Alert**.
5. Login as the username and password that you set.
6. Type: **sudo raspi-config**
    a. **Interface Options → VNC** → Select **Yes.**
    b. **Interface Options -> I2C →** Select **Yes.**
7. Exit the **raspi-config** interface. Reboot when prompted.

Update Raspberry Pi OS

Reconnect with PuTTY at a terminal. Run the following commands to update the Pi OS.

```
# Update the apt package list
sudo apt update
# Upgrade all packages -y no prompt
sudo apt full-upgrade -y
# Remove any packages that are not needed, there may not be any
sudo apt autoremove
# It is a good idea to reboot after an update
sudo reboot
```

Disable Onboard Wi-Fi

The internal Pi antenna works just fine. For better signal strength and range you may want to use an external USB Wi-Fi antenna.

To use an external Wi-Fi antenna only, disable the internal Wi-Fi.

1. Reconnect using PuTTY.

```
# Edit this file with nano
sudo nano /boot/config.txt
# Add this line to the end of the file and save it
dtoverlay=disable-wifi
```

2. Restart the Pi.

```
sudo reboot
```

NOTE: After you have disabled the on-board Wi-Fi, you must always plug a Wi-Fi adapter into a USB port.

Turn Off Wi-Fi Power Saving

If your Pi experiences WiFi connection issues, turn off the power saving.

```
# Turn off wifi power saving
# Show the connection name
sudo nmcli connection show
sudo nmcli connection modify <connection name> 802-11-wireless.powersave 2
```

Modify connection name.

```
sudo nmcli connection modify <connection-name> connection.id <new-connection-name>
```

Multiple SSID's

Edit the following file if you wish to setup more than one wifi SSID. If there is more than SSID in range, priority=5 sets 'YourSSID' over priority=4 for 'YourOtherSSID' If they are not in range of each other, make them both 1.

Use the following command to edit the wpa_supplicant.conf file.

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

The following shows an example of how you might configure another SSID.

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

network={
      ssid="YourSSID"
      psk="YourPSK"
      priority=1
}
network={
      ssid="YourOtherSSID"
      psk="YourOtherPSK"
      priority=1
}
```

1. **CTRL+S** (Saves the file)
2. **CTRL+X** (Exit nano)

The pi will automatically connect to whichever wireless network is closer and has better signal. You can add as many wireless networks to this file as you wish.

~~Configure VNC Display Settings~~

~~Connect with PuTTY.~~

~~Uncomment and modify the following:~~

```
# Edit the config.txt file
sudo nano /boot/config.txt
```

```
hdmi_force_hotplug=1
hdmi_group=2
hdmi_mode=23 # 1280x768
hdmi_mode=35 # 1280x1024
```

RealVNC Viewer

RealVNC viewer allows us to remotely control the Pi in headless mode over the network. Headless mode is when there isn't a keyboard, video, or mouse.

1. Go to https://www.realvnc.com/en/connect/download/viewer/
2. Download the VNC Viewer Standalone EXE anywhere you want to run the program from. You don't have to install it.
3. Double Click the downloaded **VNC Viewer**.
4. Type in the IP address of your Pi → Click **Connect**.

If RealVNC doesn't work, try TigerVNC.

TigerVNC Viewer

You can remote control the GoPiGo3 in headless mode.

1. https://sourceforge.net/projects/tigervnc/
2. Download the latest **vncviewer64.exe** file.
3. This is a self executing program, it does not need an installation
4. Double Click the downloaded file.
5. Type in the IP address of your robot → Click **Connect**.
6. If the desktop is not displayed, you may need to connect with PuTTY. Use **sudo reboot** to restart the Pi.

Configure Raspberry Pi OS

1. Right Click Desktop → **Desktop Preferences** → **Layout**: No image
    a. Colour: Choose a colour you like.
2. **Change Clock Display:** Right Click Clock, Digital Clock Settings

a. Clock Format: **%I:%M %p**

3. **Add Temperature Monitor:** Right Click Task Bar → Panel Settings → Panel Applets tab.
    a. **Add** → **Temperature Monitor** → **Add**.
    b. Click **Up** to move the Temperature Monitor to the left on the taskbar.
    c. Click **Preferences**.
        i. **Normal color**: **#00008b** (Dark blue)
        ii. **Warning1 temperature**: 70
        iii. **Warning2 temperature**: 90

Email IP on Boot

1. Create a Code folder → **home/pi/Code**
2. Copy **startup_mailer.py** to this folder
3. Open a terminal.
4. Type in the following to make the script executable.

```
sudo chmod 733 /home/pi/Code/startup_mailer.py
```

5. There should not be any errors if the command was successful.
6. Test the script with the following command.

```
/home/pi/Code/startup_mailer.py
```

7. In a few moments, you should receive an email with your Raspberry Pi IP address.

Run startup_mailer.py Script on Startup

1. At the terminal, type in the following command to access the Raspbian scheduler. (Don't add sudo)

```
crontab -e
```

2. Press **Enter** to edit the file with nano.
3. Cursor to the bottom of the file. (The mouse will not work.)

4. Enter the following information. (**sleep 10** waits 10 seconds after startup to run the script.)

```
@reboot sleep 10 && /home/pi/Code/startup_mailer.py
```

5. Type **CTRL+S** to Save the file.
6. Press **CTRL+X** to Exit nano.
7. Type **sudo reboot**
8. You should receive an email with your IP address.

Wi-Fi Signal Strength

The **iwconfig** command will give you a snapshot of Wi-Fi quality.

wavemon will monitor Wi-Fi signal strength in real time.

```
# Install wavemon
sudo apt install wavemon -y
# Run wavemon
wavemon
# Quit wavemon
q
```

iwconfig

sudo iwlist wlan0 scan | egrep "Cell|ESSID|Signal|Rates"

Signal Strength

The higher the signal strength, the more reliable the connection and higher speeds are possible. The signal strength is specified as -dBm (decibels related to one milliwatt).

Values between 0 and -100 are possible, with more being better. -51 dBm is a better signal strength than -60 dBm.

The value 0 is not realistic. Even -30 dBm is hard to reach, and you must stand almost directly next to the access point.

Some guidance on how to read the results:

- -50 dBm is considered an excellent signal strength.
- -67 dBm is said to be the minimum signal strength for reliable and relatively fast packet delivery.

- -70 dBm is the minimum signal strength for reliable packet delivery.
- -80 dBm is the minimum value for a basic connection. However, packet delivery is no longer necessarily reliable.
- -90 dBm is already very close to the basic noise. Here a connection probably does not work anymore.

Link Quality

A network can have very good signal strength without good link quality.

This is how much of the data you send and receive will make it to the destination in good condition.

The quality indicator includes data like Bit Error Rate (BER), i.e., the number of bit errors in received bits that have been altered due to noise, interference, distortion, or bit synchronization errors. Others are Signal-to-Noise and Distortion Ratio (SINAD).

It is measured in percentage or on a scale of up to 70. So you will see a value like "60/70".

Unlike signal strength, it is somewhat harder to say which values are still considered to be ok.

If the value is low and your signal strength is high, you may have interference from, e.g., kitchen appliances or other electronic devices. Moving them further away may improve the link quality.

Frequency

Another interesting indicator is the Wi-Fi frequency.

This shows if your Raspberry Pi connects to the slower and longer range 2.4 GHz network, or the faster but shorter range 5 GHz version, provided, of course, that your router offers both networks.

Speedtest

Install speedtest-cli from Speedtest.net

```
sudo apt update
sudo apt dist-upgrade -y

# Install support software
sudo apt install apt-transport-https gnupg1 dirmngr lsb-release

# Install keychain to download speed-cli
curl -L https://packagecloud.io/ookla/speedtest-cli/gpgkey | gpg --dearmor |
sudo tee /usr/share/keyrings/speedtestcli-archive-keyring.gpg >/dev/null

sudo apt update

sudo apt install speedtest-cli

speedtest
```

Find Ports with ls dev/tty

Pi serial port is ttyAMA0

```
sudo ls /dev/tty*
```

This will list all of the terminal interfaces.

Find all serial ports

```
dmesg | grep tty
```

Bluetooth and Serial Port

```
vcgencmd measure_clock isp / v3d
vcgencmd measure_clock core
```

mini uart settings

```
# Set cpu core to 250 or 500
core_freq=250
# or
force_turbo=1
# Enable Bluetooth to use miniuart
dtoverlay=miniuart-bt
```

another

```
force_turbo=1
gpu_freq=250
gpu_freq_min=250
```

Turn Off HDMI

vcgencmd display_power 0 turns off the screen

vcgencmd display_power 1 turns on the screen

Hardware Information

```
# The top command will show memory, cpu, processes, etc
top
```

```
cat /proc/cpuinfo
```

```
sudo apt update
sudo apt install lshw
sudo lshw
```

Enable snaps on Raspberry Pi and install btop

Snaps are applications packaged with all their dependencies to run on all popular Linux distributions from a single build. They update automatically and roll back gracefully.

Snaps are discoverable and installable from the Snap Store, an app store with an audience of millions.

On a Raspberry Pi running the latest version of Raspbian snap can be installed directly from the command line:

```
sudo apt update
sudo apt install snapd
```

You will also need to reboot your device:

```
sudo reboot
```

To install btop, simply use the following command:

```
sudo snap install btop
```

Filesystem Checks and Repair

The Linux filesystem can be damaged under various circumstances, e.g., system crash, power loss, disconnected disk, accidentally overwritten i-node, etc. Thus it is a good idea to check the integrity of the filesystem regularly to minimize the risk of filesystem corruption.

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check the integrity of the filesystem regularly to minimize the risk of filesystem corruption. Add the following to `/boot/cmdline.txt`:

```
fsck.mode=force
```

Make sure that file remains all one line. Parameters should be separated with spaces.

You'll probably notice `fsck.repair=yes` is already there; these are not the same thing. From `man systemd-fsck` (these are parameters that are passed on by the kernel to init, i.e., systemd):

fsck.mode=

One of "auto", "force", "skip". Controls the mode of operation. The default is "auto", and ensures that file system checks are done when the file system checker deems them necessary. "force" unconditionally results in full file system checks. "skip" skips any file system checks.

fsck.repair=

One of "preen", "yes", "no". Controls the mode of operation. The default is "preen", and will automatically repair problems that can be safely fixed. "yes " will answer yes to all questions by fsck and "no" will answer no to all questions.

To do a filesystem check on the next reboot, do the following

```
sudo touch /forcefsck
```

Once you create an empty file named `forcefsck` in the root directory, it will force filesystem check the next time you boot up. After successful booting, `/forcefsck` will automatically be removed.

An alternative is to shut down the system with the `-F` option like this:

```
sudo shutdown -r -F now
```

Fastest Cards

Samsung Evo+, SanDisk Extreme

Static IP

We now need to plug this information into the Pi's network configuration file using a text editor. I always use nano text editor. . .

sudo nano /etc/network/interfaces

Simply change the line that reads:

iface eth0 inet dhcp to **iface eth0 inet static**

Then directly below this line enter the following (Please Note. **You will need your own addresses we gathered in Part B, more details below**). . . .

address 192.168.9.30
netmask 255.255.255.0
network 192.168.9.0
broadcast 192.168.9.255
gateway 192.168.9.1

CTRL X to save and exit