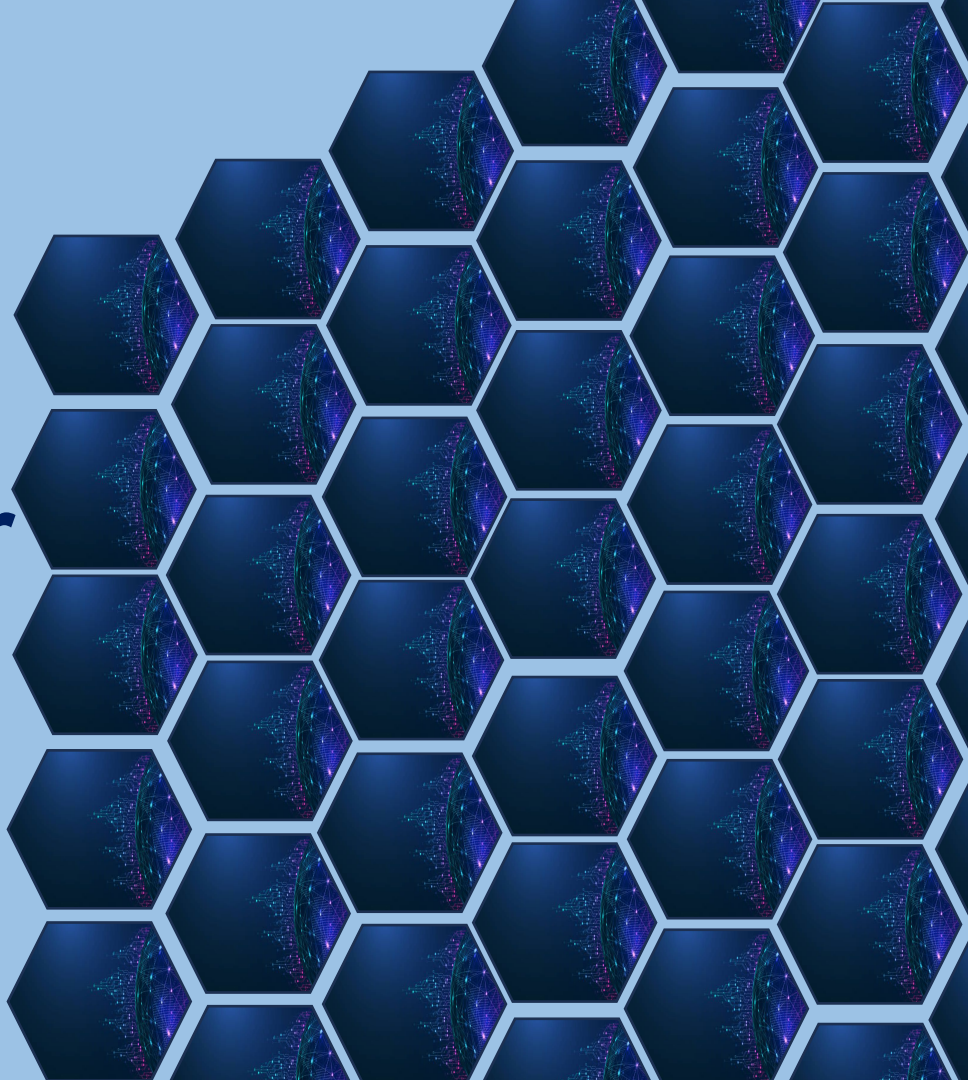
Robotics Corner



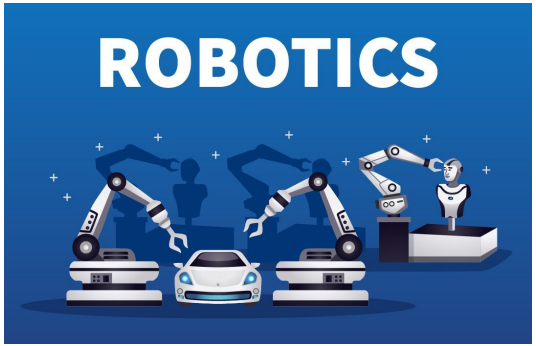
Raspberry Pi

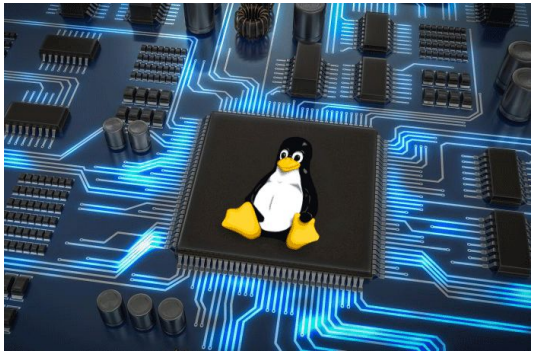
Agenda

- What is Raspberry Pi
- Getting Started with Raspberry pi
- Connecting to RPI

What is RPi?

It’s an Embedded Linux board which can be used for several educational and industrial purposes





01 RPI Versions

MODEL A

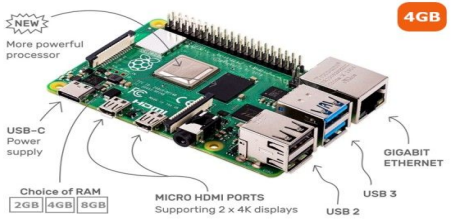
MODEL B

RASPBERRY PI 2 MODEL B

RASPBERRY PI 3 MODEL B

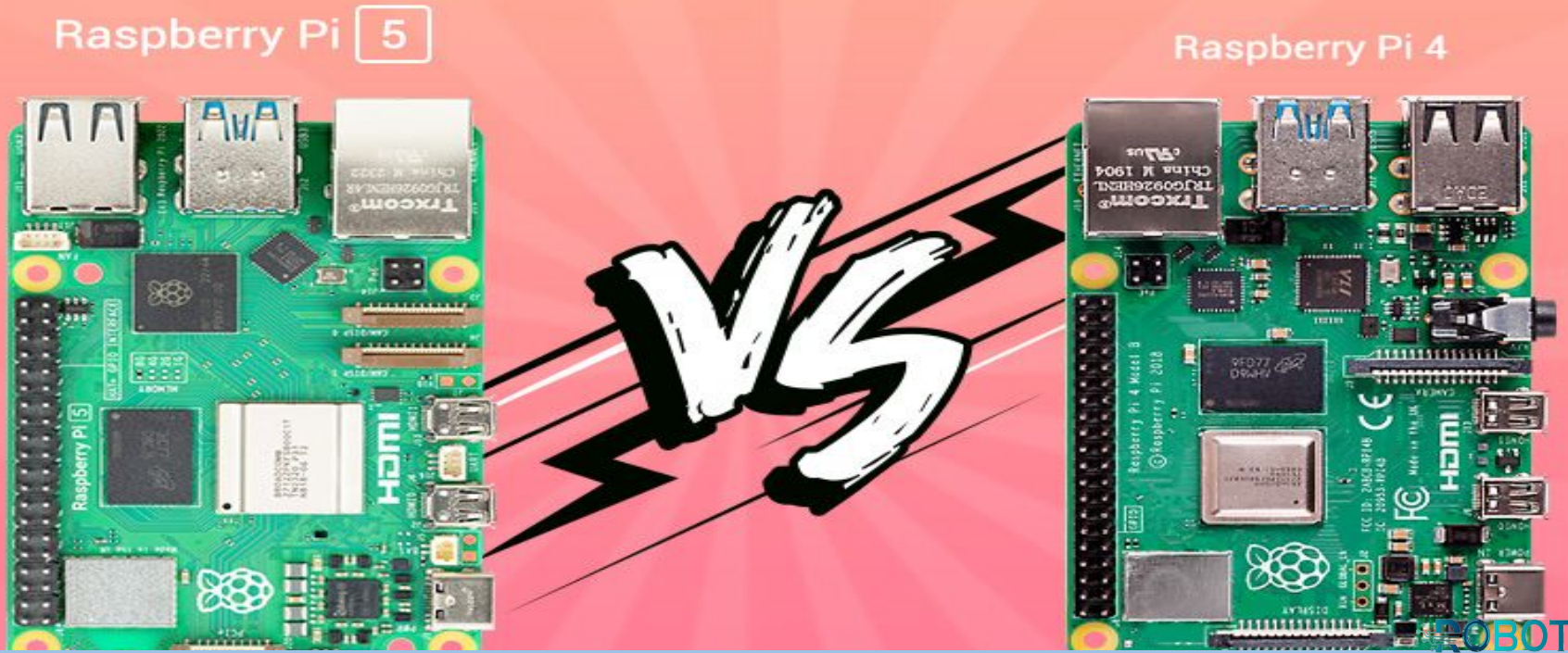
MODEL A+

MODEL B+

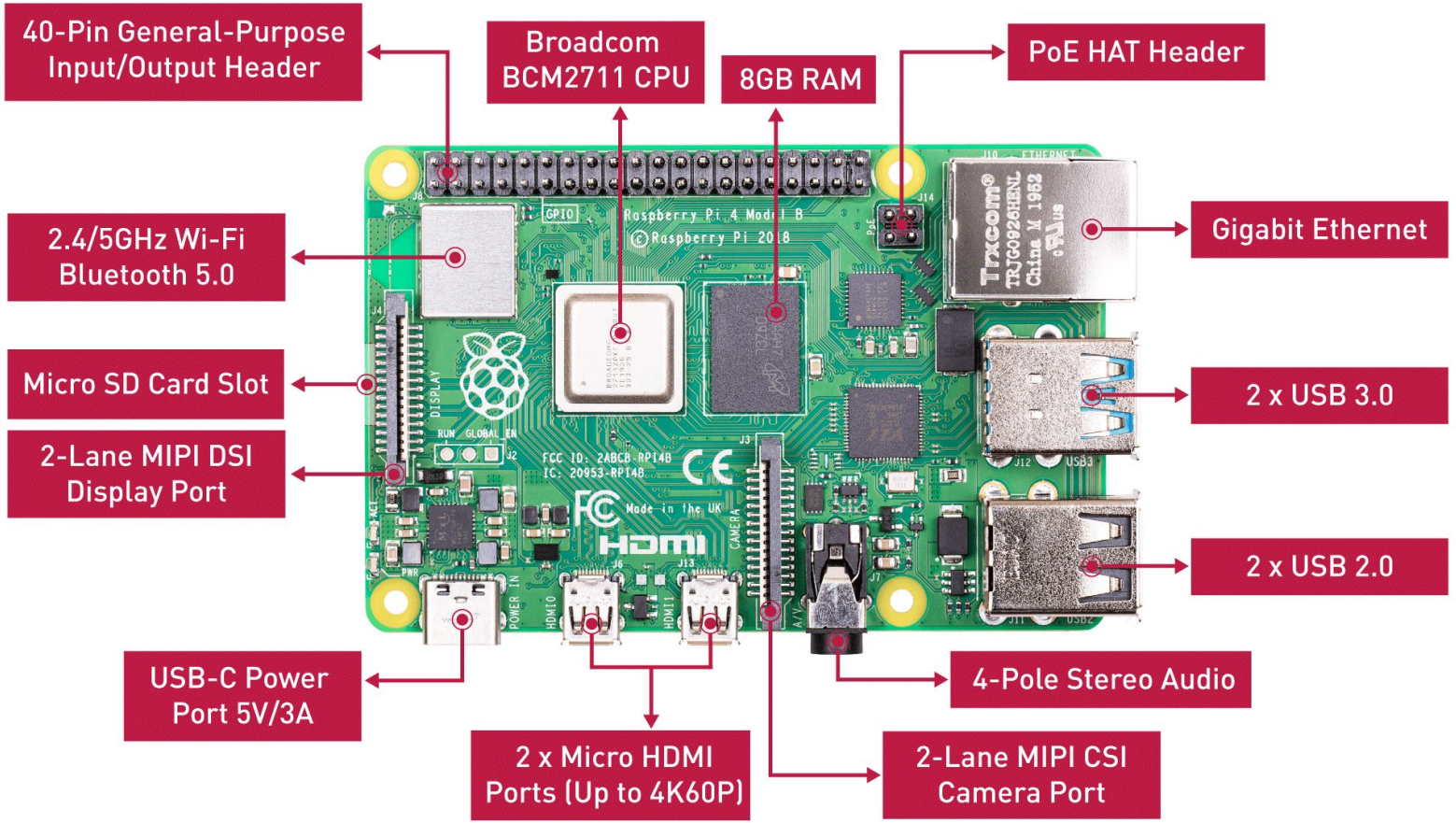


Raspberry Pi 5 Vs Raspberry Pi 4

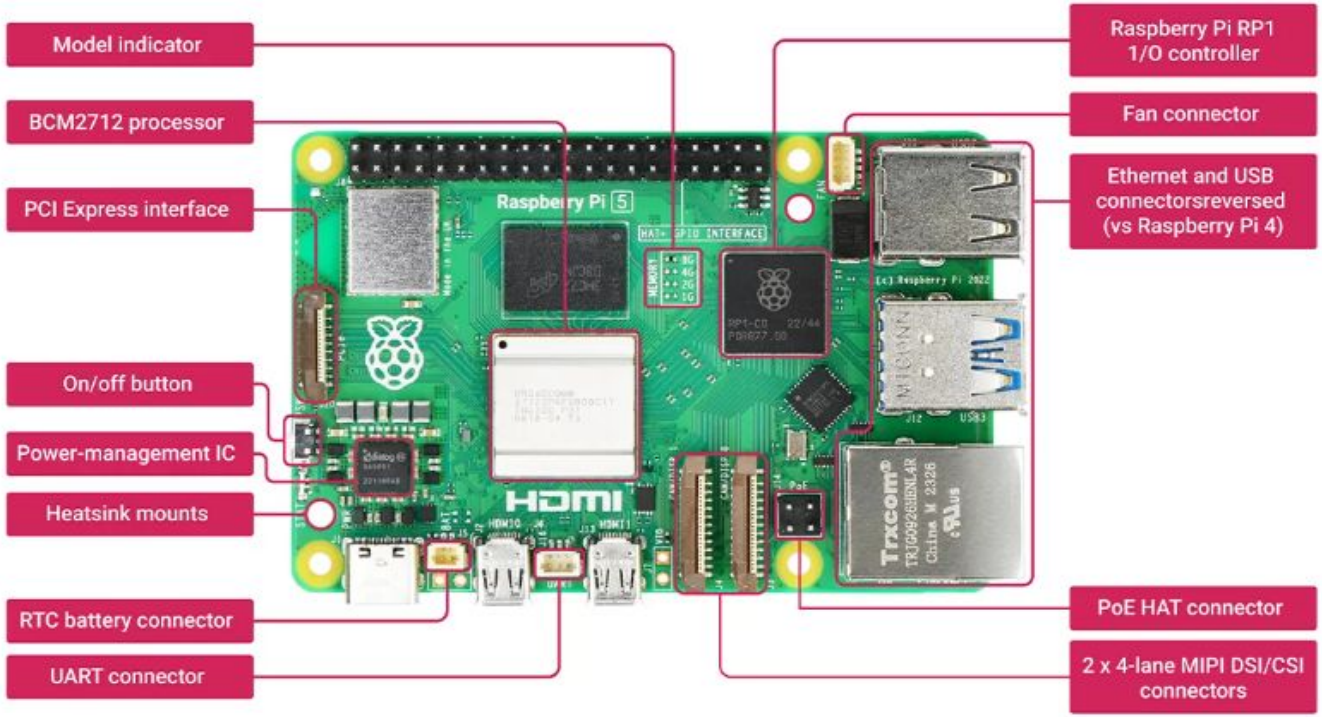
The Detailed Differences and Comparisons



01 RPI Versions



01 RPI Versions



01 RPI Versions

Processor:

- Broadcom BCM2712 2.4GHz quad-core 64-bit Arm Cortex-A76 CPU.
- Cryptographic Extension, 512KB L2 cache per core, and 2MB shared L3 cache.

Graphics:

- VideoCore VII GPU supporting OpenGL ES 3.1, Vulkan 1.2.
- Dual 4Kp60 HDMI display output with HDR support.
- 4Kp60 HEVC decoder for high-quality video decoding.

Memory:

- LPDDR4X-4267 SDRAM, available in 4GB and 8GB SKUs at launch.

Connectivity:

- Dual-band 802.11ac Wi-Fi for high-speed wireless connection.
- Bluetooth 5.0/Bluetooth Low Energy (BLE) for efficient wireless communication.
- PoE+ supported Gigabit Ethernet for various wired connections (requires a separate PoE+ HAT).
- 2 × USB 3.0 ports supporting simultaneous 5Gbps operation.
- 2 × USB 2.0 ports for additional peripheral connections.
- MicroSD card slot supporting high-speed SDR104 mode for expandable storage.

Camera and Display:

- 2 × 4-lane MIPI camera/display transceiver for advanced camera and display features.

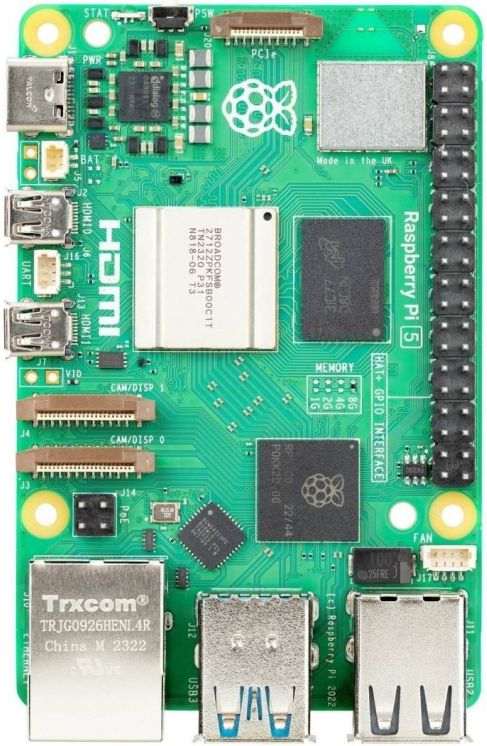
Expansion and Peripherals:

- PCIe 2.0 x1 interface for fast peripherals (requires a separate M.2 HAT or another adapter).
- Raspberry Pi standard 40-pin header for extensive GPIO (General Purpose Input/Output) capabilities.

Power and Convenience:

- 5V/5A DC power via USB-C for reliable and efficient power delivery, with Power Delivery support.
- Real-Time Clock (RTC) powered by an external battery for timekeeping.
- Power button for easy control.

01 Pinout



3V3 power	1	2	5V power
GPIO 2 (SDA)	3	4	5V power
GPIO 3 (SCL)	5	6	Ground
GPIO 4 (GPCLK0)	7	8	GPIO 14 (TXD)
Ground	9	10	GPIO 15 (RXD)
GPIO 17	11	12	GPIO 18 (PCM_CLK)
GPIO 27	13	14	Ground
GPIO 22	15	16	GPIO 23
3V3 power	17	18	GPIO 24
GPIO 10 (MOSI)	19	20	Ground
GPIO 9 (MISO)	21	22	GPIO 25
GPIO 11 (SCLK)	23	24	GPIO 8 (CE0)
Ground	25	26	GPIO 7 (CE1)
GPIO 0 (ID_SD)	27	28	GPIO 1 (ID_SC)
GPIO 5	29	30	Ground
GPIO 6	31	32	GPIO 12 (PWM0)
GPIO 13 (PWM1)	33	34	Ground
GPIO 19 (PCM_FS)	35	36	GPIO 16
GPIO 26	37	38	GPIO 20 (PCM_DIN)
Ground	39	40	GPIO 21 (PCM_DOUT)

40 GPIO Pins Description of Raspberry Pi 5

Download your preferred OS

- It's a software that has access to all Raspberry Pi Os'es and versions and give you the info to which OS compatible with which RPI version

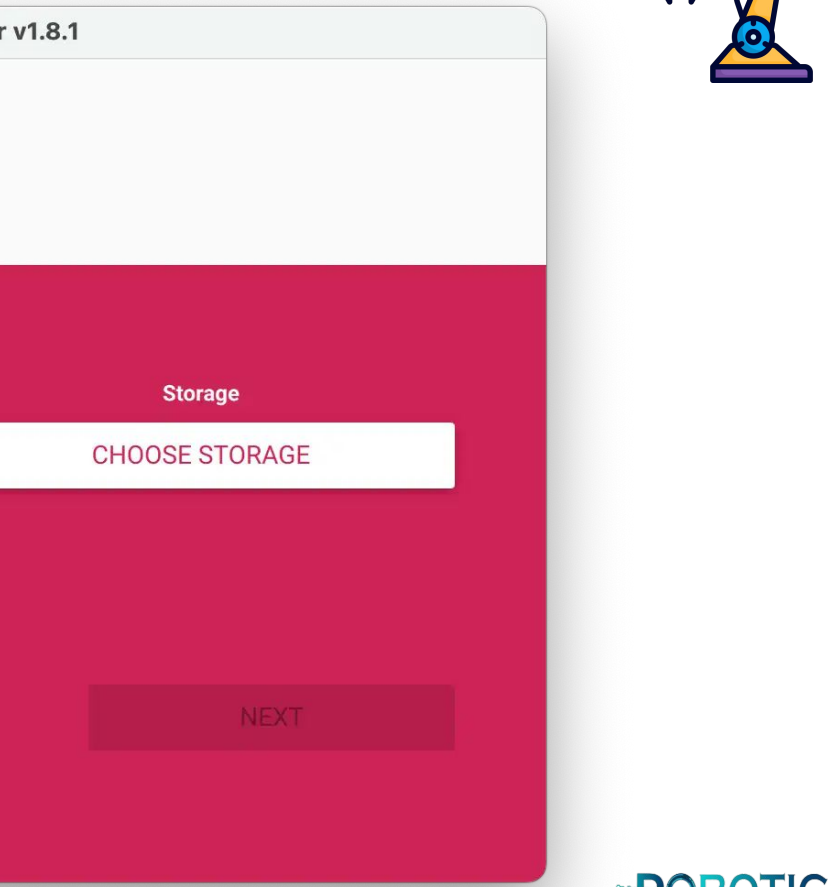
Example: Raspberry Pi 5 is compatible with Ubuntu 24.04.2

Note if you want to get the maximum of a Raspberry Pi you, it's required to enable

Installation:

```
$ sudo apt install rpi-imager

# Run imager
$ rpi-imager
```

02 Raspberry Pi Imager



Use Ubuntu to flash OS

- Check if the SD card is valid and plugged and then flash
  - commands:

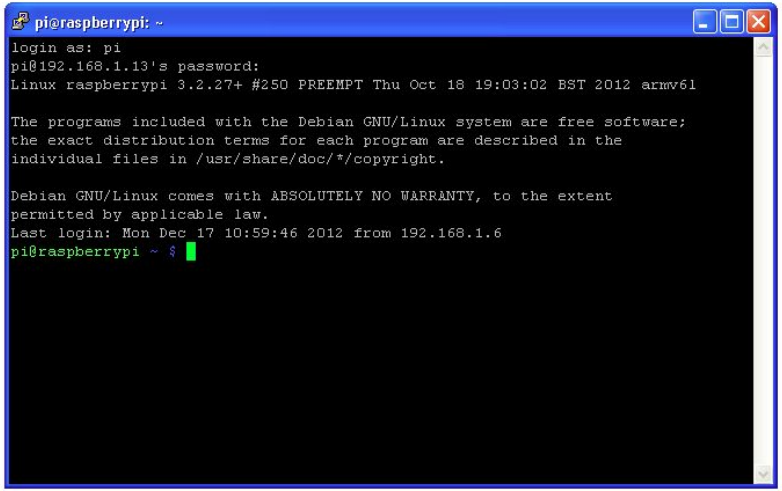
```
$ df -h
Or
$ lsblk
Identify your SD card (e.g., /dev/sdX or /dev/mmcblk0).

$ sudo dd if=ubuntu-24.04.2-preinstalled-server-arm64+raspi.img of=/dev/sdX bs=4M
status=progress

$ sync
$ sudo eject /dev/sdX
```

- **HDMI** here you treat your RPi as a small PC and then will need a screen
- **VNC** Connection with RPI through LAN network over IP
- **SSH** tunnel to connect to RPI

note: in VNC and SSH internet source is required

03 Access RPi

Connection	OS compatibility	require
VNC	Windows and Mac	LAN network
SSH	Windows using PuTTY, Mac and Linux using Terminal	LAN Network
HDMI	Doesn’t require Host OS	Screen
Serial	Doesn’t require Host OS	USB to Serial TTL (HW)



Setup/install raspi-config

Enable various configuration

sudo apt update

sudo apt install raspi-config

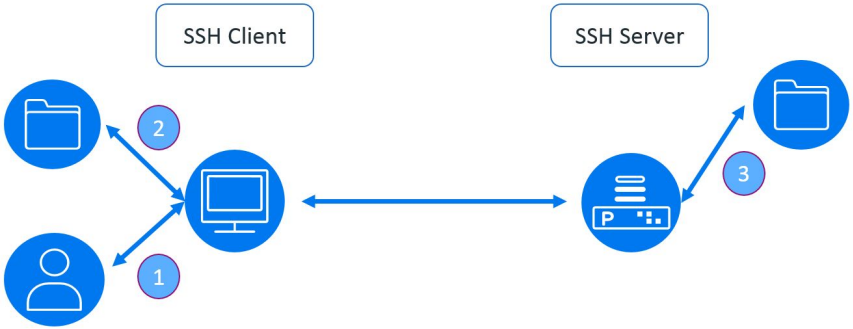
sudo raspi-config

select /Enable: SSH connection

Serial > UART > Enable

Wireless >SSID Wifi & password

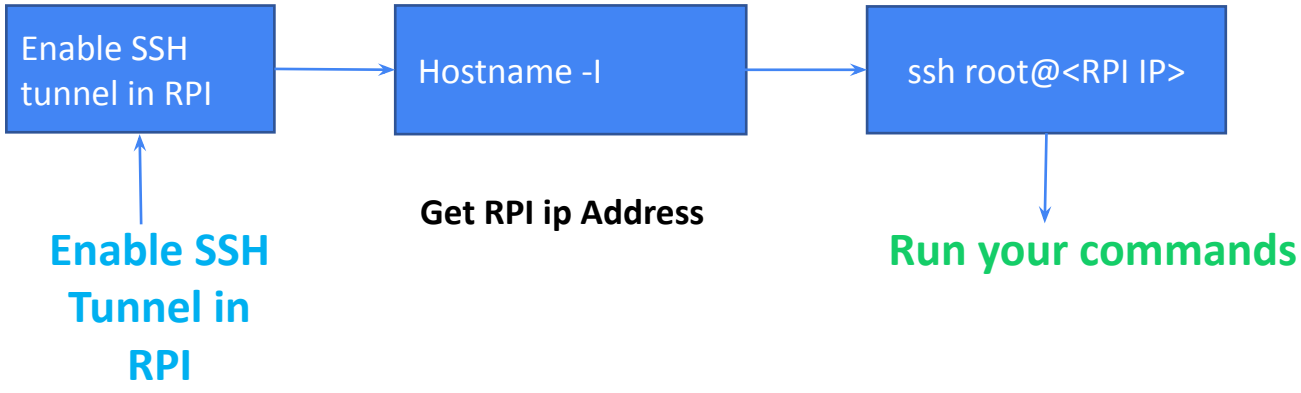
It’s a secured connection between a client and server

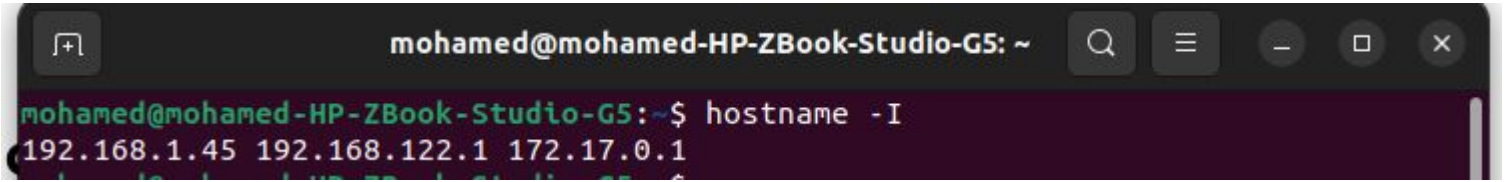


(1) Public/private user key created
(2) Private key kept in users home directory on workstation
(3) The users public key is placed in the users home directory on the SSH server

Based on key exchange then you can access an interactive shell, used to access remote server without GUI.

Steps to ssh connection to RPI

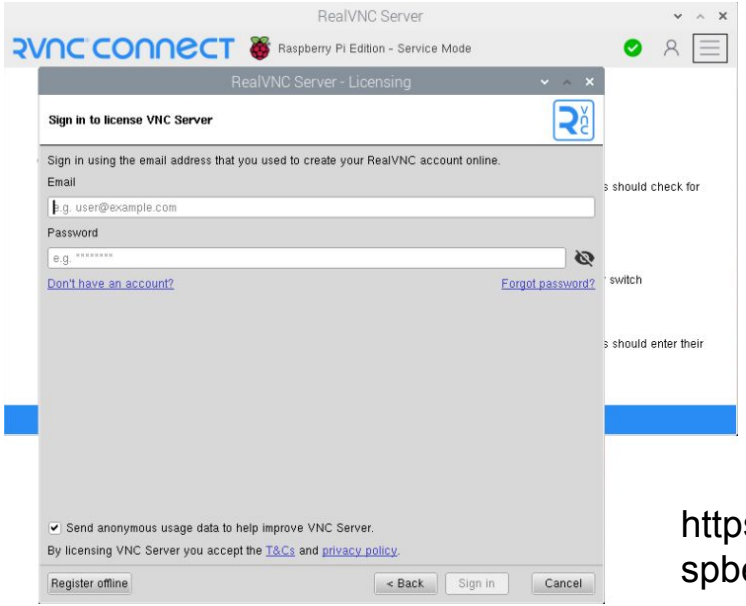




Install VNC

```
sudo apt-get update
sudo apt-get install realvnc-vnc-server
```

Enable VNC in Raspberry Pi



Install VNC install VNC on your windows or mac

Get Raspberry Pi IP

https://www.realvnc.com/en/blog/raspberry-pi-vnc/

Start connection

Transfer files using scp

Secure Copy Protocol : from raspberry to host

```
$ scp pi@<IP Address of Raspberry Pi>:<Path to File> .
```

Copy from Host to raspberry pi:

scp <Path to File To Copy> pi@<IP Address of Raspberry Pi>:<Path that File will Go>

Thank You

Do you have any questions?

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