



California State
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PI 5 Portable VPN

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Devices and Technologies Used:

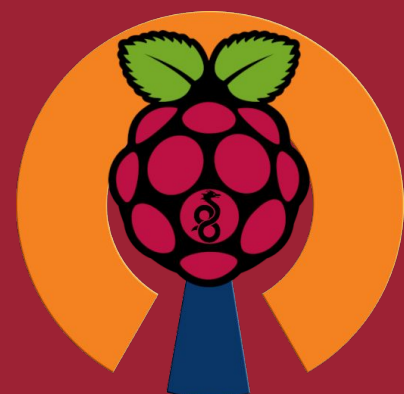
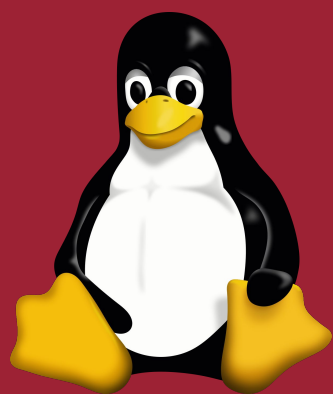
- Raspberry Pi 5
- WireGuard
- OpenDNS
- Linux Ubuntu
- PiVPN
- Apple Airport Extreme

QR Code to Instructions:



Link:

<https://github.com/Nathan-Mortell/490-V-PN-Capstone-Project>



Introduction

I've always wanted to have my own VPN due to how secure and reliable they are. Instead of using an existing provider like ExpressVPN, I realized that it would be a fun learning experience to make my own. This project consisted of:

1. Turning a Raspberry Pi 5 into a VPN host that can connect to my computer, laptop, and phone.
2. Creating a Github readme that contains an in depth guide on how I did it and how you can do it yourself.
3. A VPN research paper that's an overview of its history, functions, types, popularity, and future advancements.

Planning and Setup

The reason I chose to use a Pi 5 is due to their size and cost. For the simple use of being a VPN host it doesn't need to be an entire computer. And since a Pi 5 can fit in the palm of my hand it can be considered a portable device where all I need is a power supply. Since the VPN needs to go through a router I used my Apple Airport Extreme, it took some time to configure it properly. Once I figured it out I documented how I did it on Github. After that I used WireGuard for my secure VPN tunnel. It's a free, open-source communication protocol that allows the VPN to talk to my laptop, desktop, and phone. I made sure the PiVPN had a DHCP reservation set for it and used OpenDNS for the DNS protocol. The figure below shows the Pi 5 GUI.

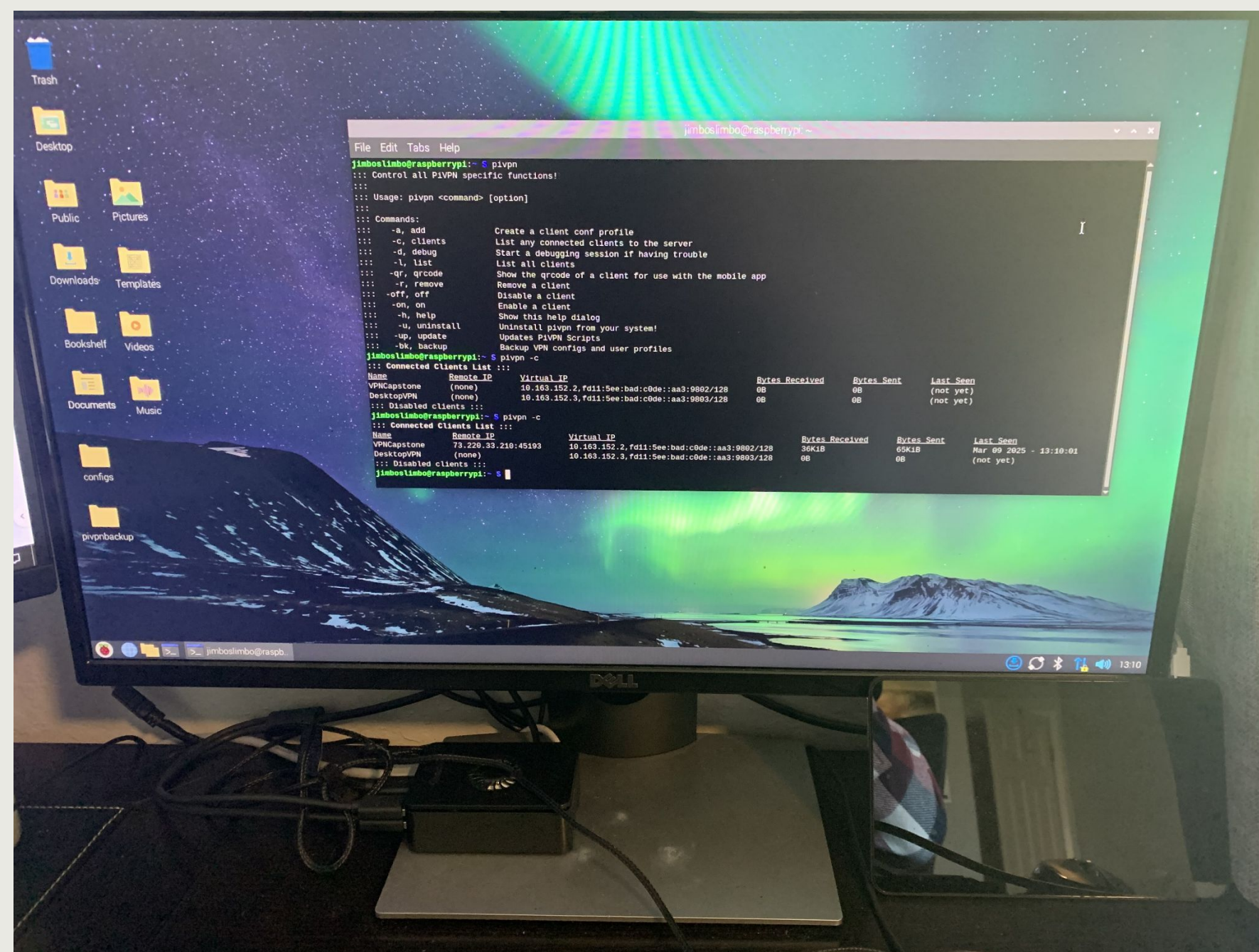


Figure 1. Setup of the Pi 5

The final process was getting all the profiles made for each device, pinging their address to the VPN to make sure the connection was good, and making sure all devices could access the internet. See the figure below for how the profiles are displayed.

```
::: Connected Clients List :::  
Name Remote IP Virtual IP Bytes Received Bytes Sent Last Seen  
VPNCapstone (none) 10.163.152.2, fd11:5ee:bad:c0de::aa3:9802/128 0B 0B (not yet)  
DesktopVPN (none) 10.163.152.3, fd11:5ee:bad:c0de::aa3:9803/128 0B 0B (not yet)  
::: Disabled clients :::  
jimboslimbo@raspberrypi:~$ pvpn -c  
::: Connected Clients List :::  
Name Remote IP Virtual IP Bytes Received Bytes Sent Last Seen  
VPNCapstone 73.220.33.210:45193 10.163.152.2, fd11:5ee:bad:c0de::aa3:9802/128 36KiB 65KiB Mar 09 2025 - 13:10:01  
DesktopVPN 10.163.152.3, fd11:5ee:bad:c0de::aa3:9803/128 0B 0B (not yet)  
::: Disabled clients :::
```

Figure 2. PiVPN profiles and connections

Final Result

Making your own personal VPN that can fit in the palm of your hand turned out to be pretty fun. Once all the documentation was written up it can now be easily replicated. Getting the entire Pi 5 bundle for around \$100 makes this process decently affordable. But you still need to supply it with a keyboard, mouse and monitor. The next step for my Capstone project was to write a research paper that was an overview/introduction on VPNs.

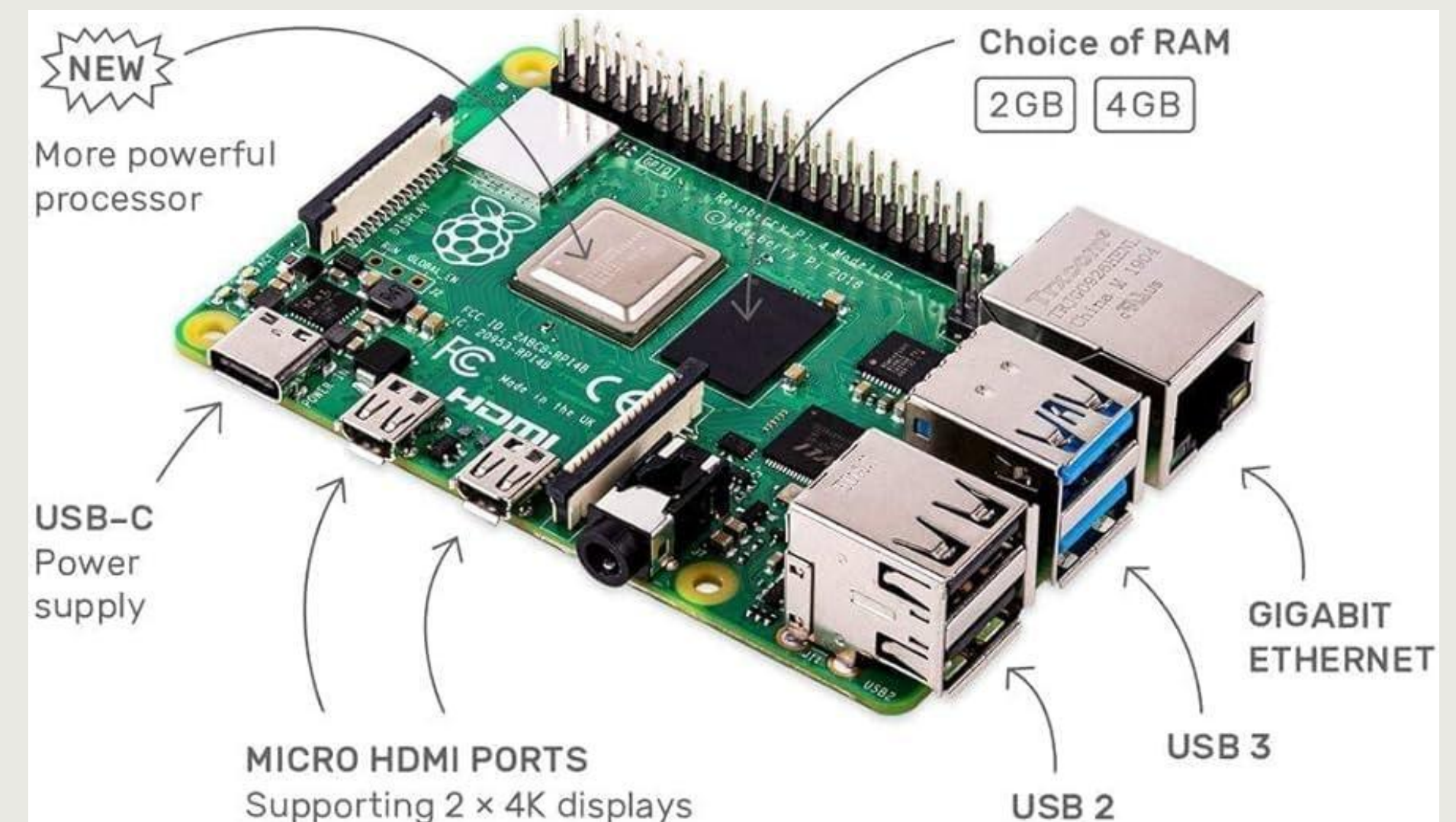


Figure 3. Internal hardware of a Pi 5

Research Paper

The research paper was the final part of the Capstone project. Its purpose is to be a good introduction to VPNs and to cover what was mentioned. When gathering references for this, I found something that I thought was interesting. The history of VPNs can be traced back to an early form of the Internet.

'In the late 1960s, the Advanced Research Projects Agency (ARPA) developed a method to link distant computers. They introduced a system in 1969 that relied on packet switching, where data packets were transferred between machines. This system, known as ARPANET, grew throughout the 1970s, connecting multiple educational and research institutions.' [2]

References

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