STUDY GUIDE FOR MODULE NO. LAB 03

NETWORK PERFORMANCE MONITORING IN RPI

MODULE OVERVIEW

In the contemporary digital landscape, network performance monitoring emerges as a pivotal aspect of system management. Within this context, the Raspberry Pi, an affordable and compact single-board computer, assumes a noteworthy role. This introduction explores the utilization of Cacti, an open-source network monitoring tool, as an instrumental solution for enhancing network performance oversight on the Raspberry Pi platform. Network performance monitoring involves systematically collecting and analyzing data related to network behavior, providing administrators with valuable insights to optimize resource utilization and ensure efficient infrastructure operation. Leveraging Cacti's web-based interface and the Simple Network Management Protocol (SNMP), the Raspberry Pi becomes a formidable ally in pursuing streamlined and effective network monitoring, applicable to diverse settings such as home networks, small businesses, and educational institutions.

MODULE LEARNING OUTCOMES

By the end of this module, participants should be able to:

- ✓ Demonstrate the ability to install any network monitoring tool such as Cacti on a Raspberry Pi, understanding dependencies and prerequisites.
- ✓ Configure network monitoring tool settings to align with specific network requirements, adjusting monitoring parameters for optimal performance.
- ✓ Integrate and configure Simple Network Management Protocol (SNMP) settings for effective data collection from network devices.
- ✓ Utilize Cacti's graphical interface to interpret and analyze network performance metrics visually.
- ✓ Develop skills to troubleshoot installation issues, rectify configuration errors, and implement maintenance routines.
- ✓ Implement security measures to safeguard the integrity and confidentiality of monitoring data.
- ✓ Apply network monitoring in practical scenarios such as home networks, small businesses, and educational environments.
- ✓ Create concise documentation detailing key steps and considerations for future reference.

LEARNING CONTENT (Installing Cacti Network Monitoring Tool in Raspberry Pi)

Step 1: You must follow several vital steps to install the Cacti Monitoring Tool on a Raspberry Pi. First, ensure you have all the necessary materials, including a compatible Raspberry Pi model, a microSD card (8GB or larger is recommended), a microSD card reader, a computer with an SD card reader, and an internet connection. Considering that you have fulfilled the requirements, you can insert it into your laptop to boot an OS to your SD card, as shown in Figure 3.1

Figure 3.1 – Inserting SD Card into Laptop with RPi Imager

Step 2: Choose the preferred operating system for your Raspberry Pi boot SD Card. In this case, we will use the Raspberry Pi OS Lite (32-bit) since we don't need to use a desktop environment for installing a Cacti Monitoring Tool, and we only need SSH in this case. You can customize your configuration here or even go wireless and enable SSH for easier access. See Figure 3.2 for reference.

Figure 3.2 – Choosing the RPi OS for SD Card

Step 3: After burning your OS in your SD Card, you can access your file explorer to access the freshly installed OS named boot (D:) and create an empty text file named ssh (should be lowercase), as shown in Figure 3.3.

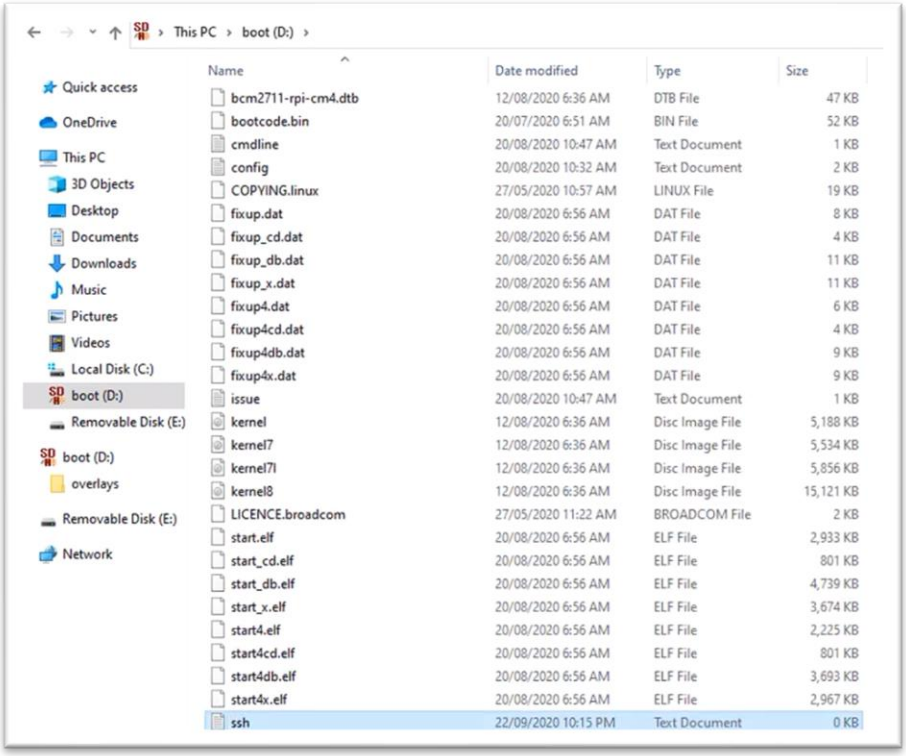
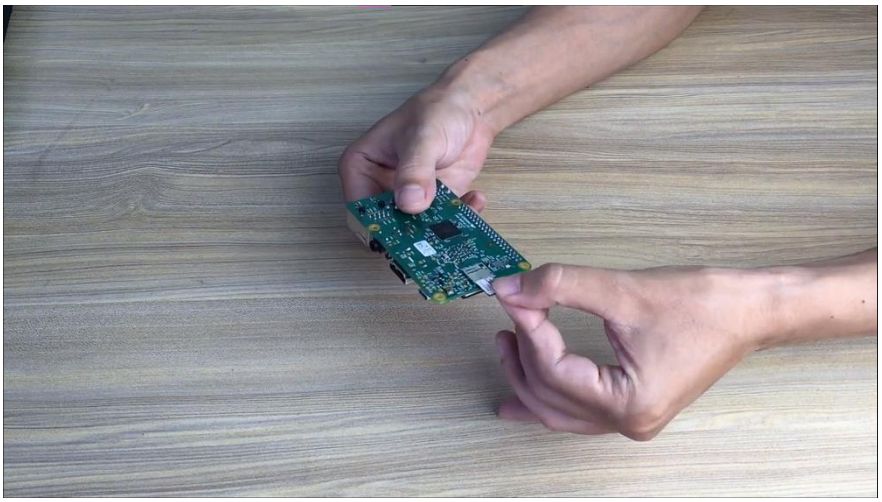


Figure 3.3 – Creating empty SSH text file.

Step 4: Remove your SD Card from your laptop or computer, then insert it into your Raspberry Pi, as shown in Figure 3.4. After that, you can now boot your RPi. You can choose to connect to your AP Router headless or wired, as shown in Figure 3.5.



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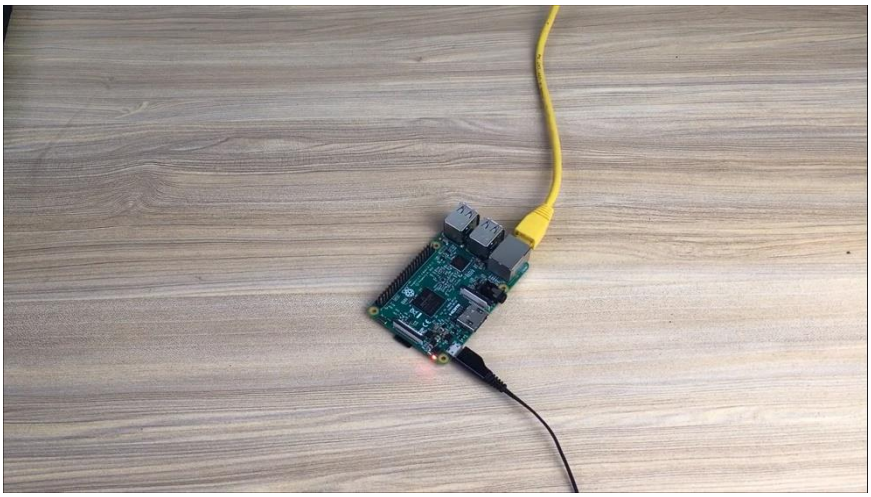


Figure 3.5 – Booting your RPi in Wired Setting

Step 5: Go to your preferred browser, then access the web of your AP router. Next, authenticate your login using the credentials you have. In this case, we will use "username: admin" and "password: admin" for more convenience later, as shown in figure 3.6.

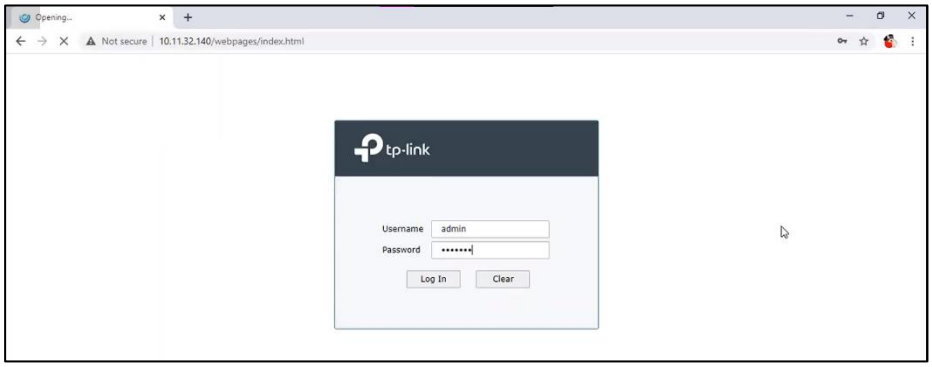


Figure 3.6 – Accessing the AP Router to check IP Address

Step 6: Go to the network drop-down menu and click the LAN option. Since your RPi network relies on DHCP, it is easily found. In this case, it has an IP Address of 10.11.32.130 and is named raspberry pi, as shown in Figure 3.7.

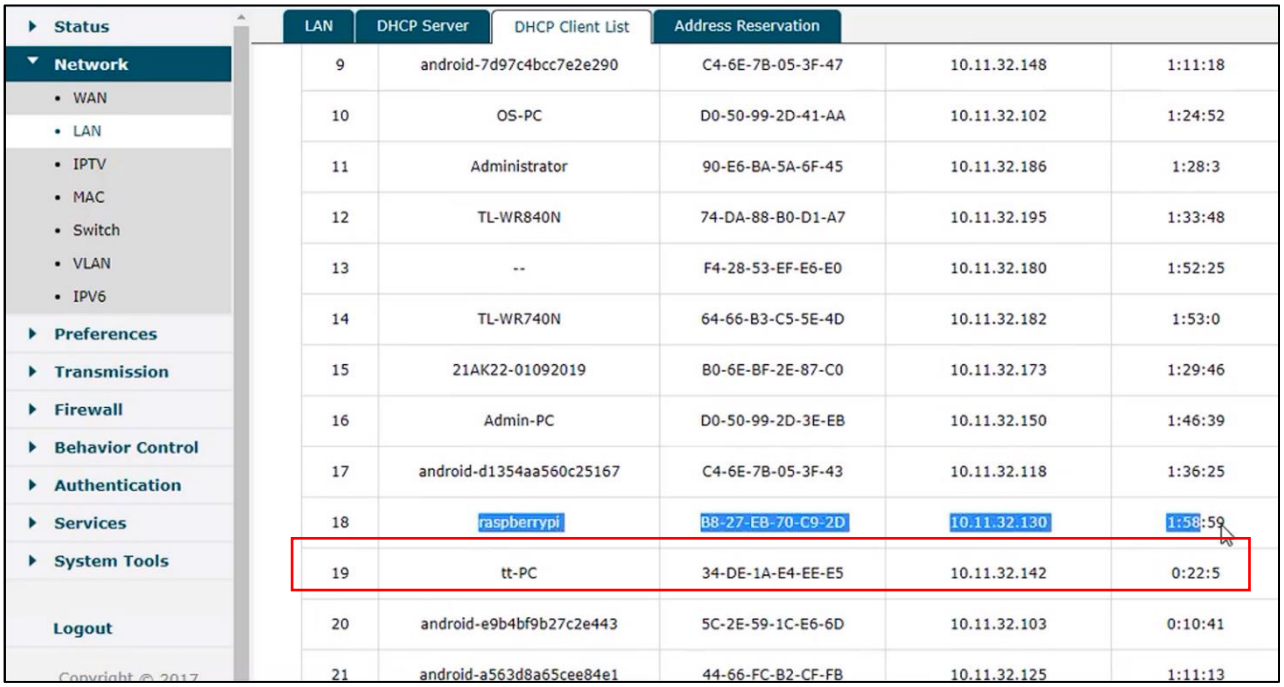


Figure 3.7 – Finding the IP Address of Raspberry Pi

Step 7: Now that you know the IP Address, you can go to your Command Prompt and connect to your Raspberry Pi through an SSH connection. To connect with your RPi, type the command:

ssh pi@10.11.32.130

Where:

ssh – the command for SSH connection
pi – the username used for authentication
10.11.32.130 – IP Address of the RPi

Note: The command varies depending on the configuration of your Raspberry Pi, so it is important that you configure the credentials in RPi Imager beforehand.

Now, the RPi will ask for your password. It means that you can access the machine through an SSH connection. What is left is the password, and the password here is pi since it is a default password. See Figure 3.8.

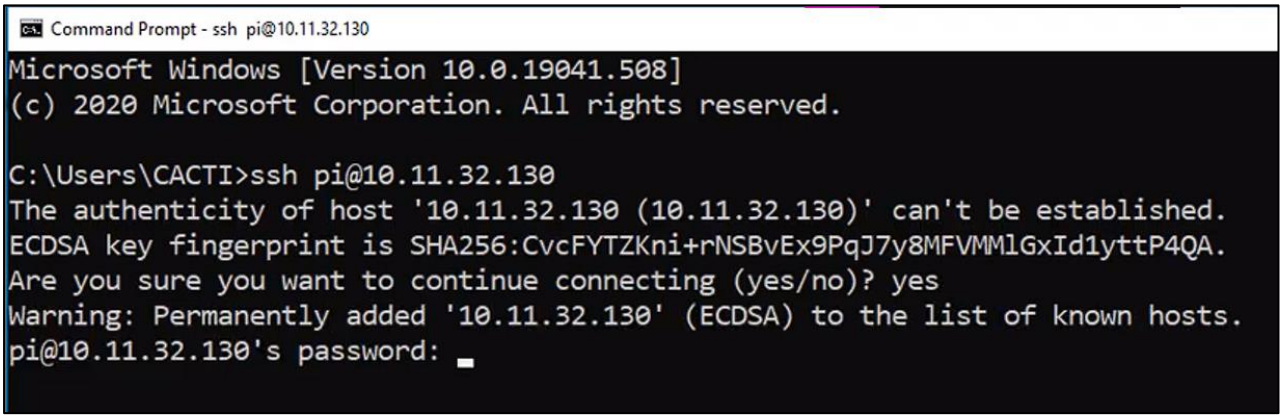


Figure 3.8 – Accessing the RPi with SSH

Step 8: Since your RPi still has the default password, change it to your preference using the command sudo passwd. Then, change your login to root login, as shown in Figure 3.9. Root access will be needed later on for installing the required dependencies.

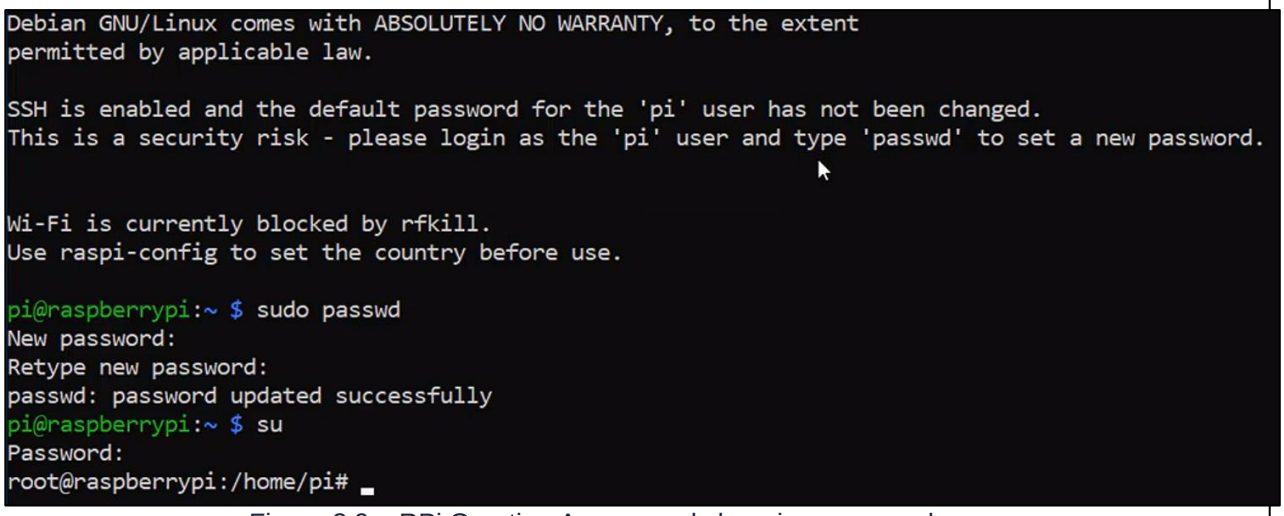


Figure 3.9 – RPi Granting Access and changing password.

Step 9: Update your apt package repository using the commands sudo apt update && sudo apt upgrade (this will take time). After the update, install the cacti monitoring tool using the command sudo apt install cacti -y (this will also take time) (see Figure 3.10).

Figure 3.10.1 – Updating and upgrading apt packages.

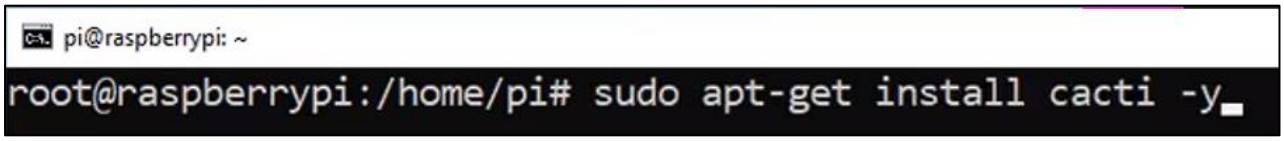


Figure 3.10.2 – apt installation of cacti monitoring tool.

Step 10: The package installation asks for your configurations in the database. You should choose the Yes option here, as shown in Figure 3.11.1.

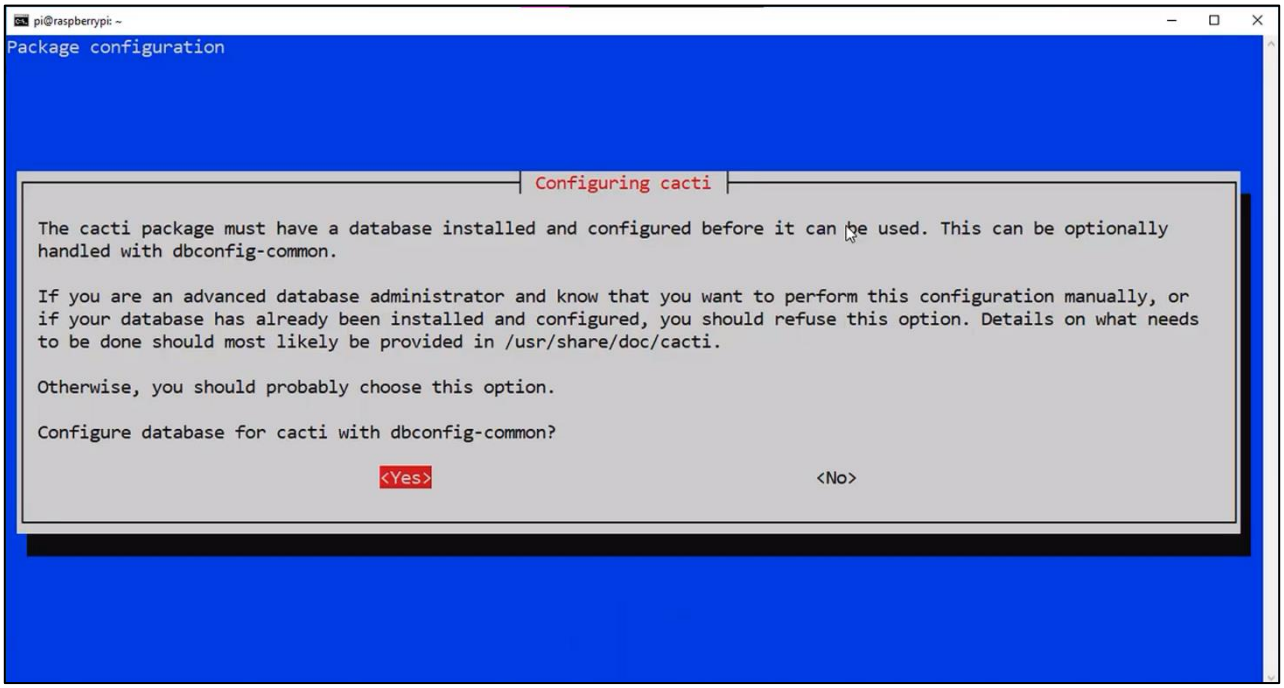


Figure 3.11.1 – configuring cacti database.

Step 11: The package installation will ask you for a password for the MySQL application. Just create a password on your preference, then choose an OK option, as shown in Figure 3.11.2

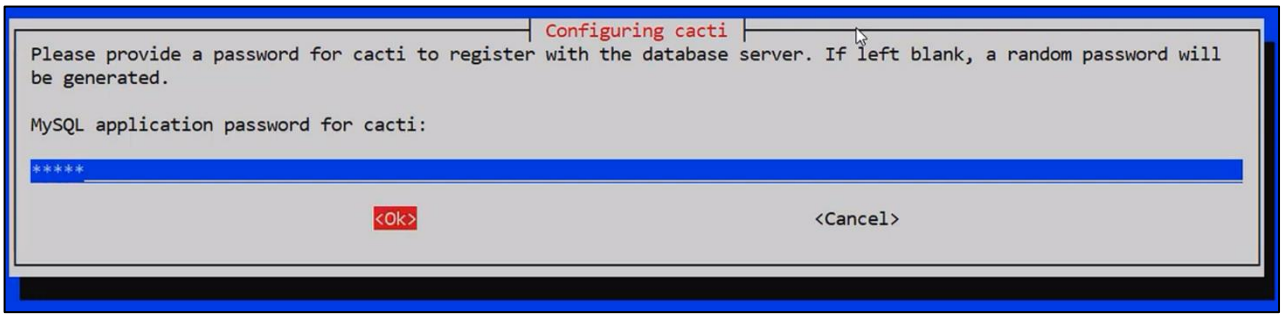


Figure 3.11.2 – configuring MySQL database.

Step 12: Go back to your browser, then type the URL of your webserver. In this case, this will be http://10.11.32.130/cacti (This depends on your hostname). After that, the web service will prompt you to authenticate before granting access. You can use the default credential "admin" as your username and password, as shown in Figure 3.12. Then, click log in.

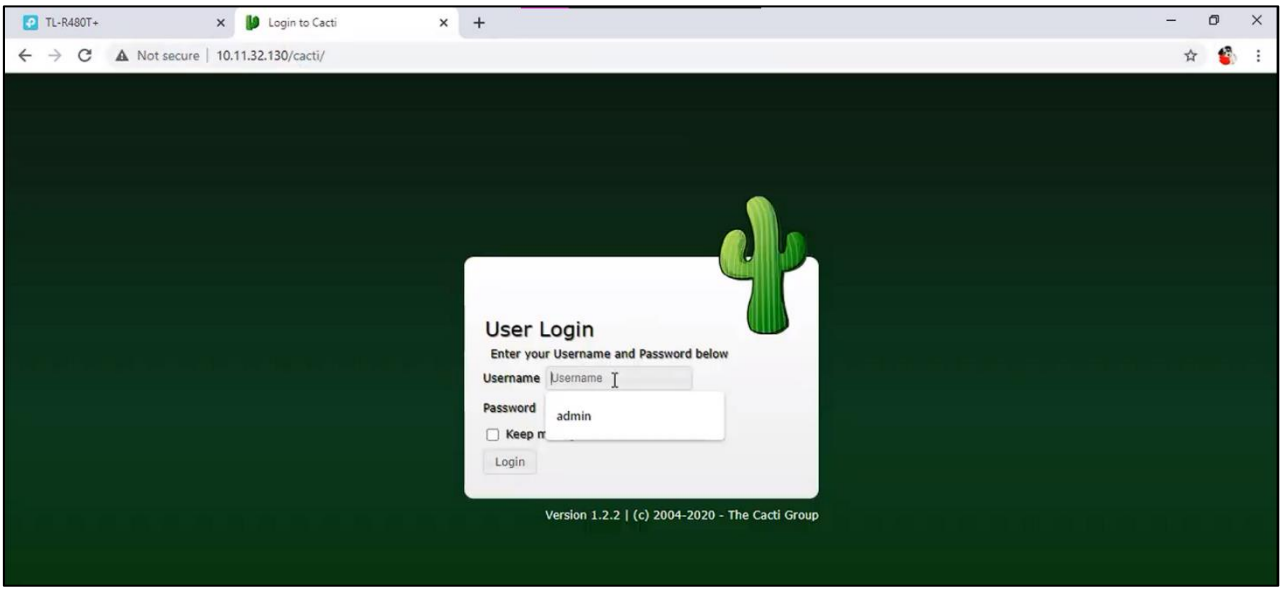


Figure 3.12 – Accessing Cacti Web Server

Step 13: Go back to your Router link, go to the system tools drop-down menu, and choose the SNMP option. Then, click the box of SNMP to enable, then click save, as shown in Figure 3.13.

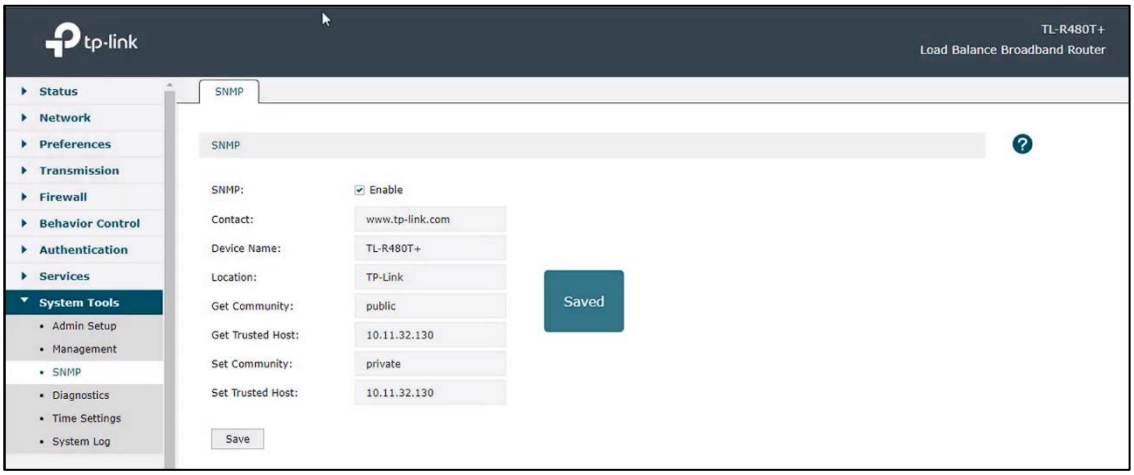


Figure 3.13 – Enabling Router's SNMP

Step 14: Go back to your Cacti, go to devices, and click the add button since no devices have been added yet, as shown in Figure 3.14.

Figure 3.14 – Adding SNMP Devices on Cacti

Step 15: Add a description to your SNMP Device distinct from other devices in the new configuration. Next, click the device templates drop-down menu, then choose the generic SNMP device option, as shown in Figure 2.15. After that, you can leave other configurations as default and proceed to save the configurations.

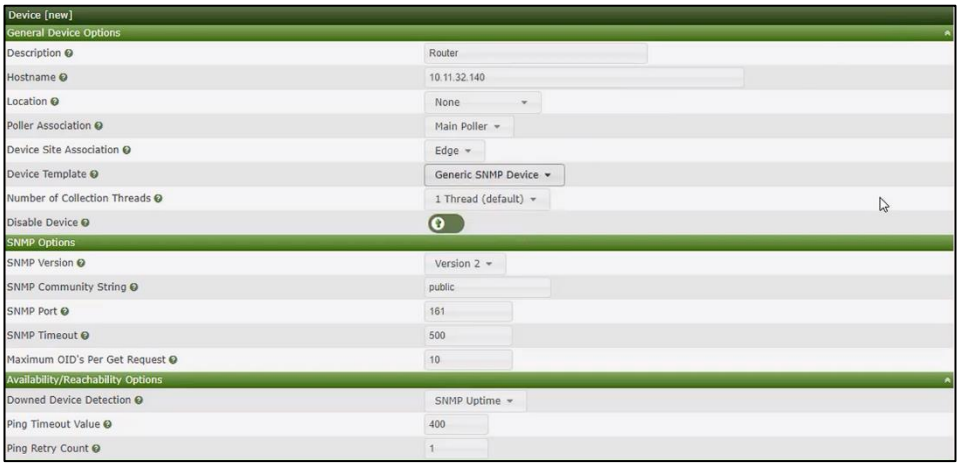


Figure 3.15 – Configuring Router SNMP.

Step 16: After the configuration, click the create graphs for this device, as shown in 3.16.1. In Data Query, click the box of each option you want to monitor on your SNMP Devices. Choose the option with up status, as shown in Figure 3.16.2, then click Create.

Figure 3.16.1 – Creating graphs for newly-added SNMP Device.

Figure 3.16.2 – Choosing interface statistics for SNMP data query.

Step 17: After the Data Query, go to Devices from management options, click the check box of the Router (which is our SNMP Device), then click choose an Action drop-down menu and choose Place on a Tree option, as shown in Figure 3.17. Then click the Go button.

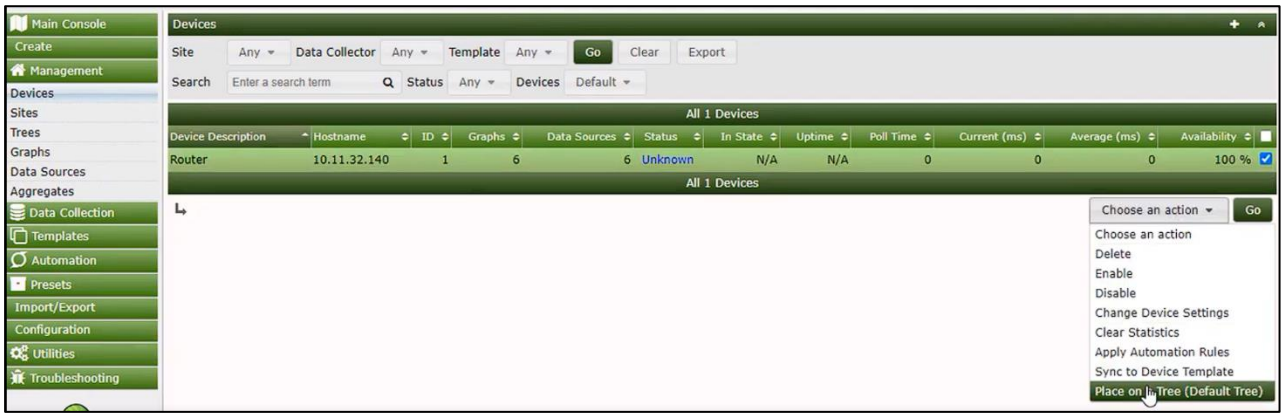


Figure 3.17 – Placing the SNMP Device on a Tree.

Step 18: Now that you have an SNMP for your Router. The next thing you need to do is to create an SNMP Device for your Windows. Just repeat the step 14 to step 16, as shown in figure 3.18.

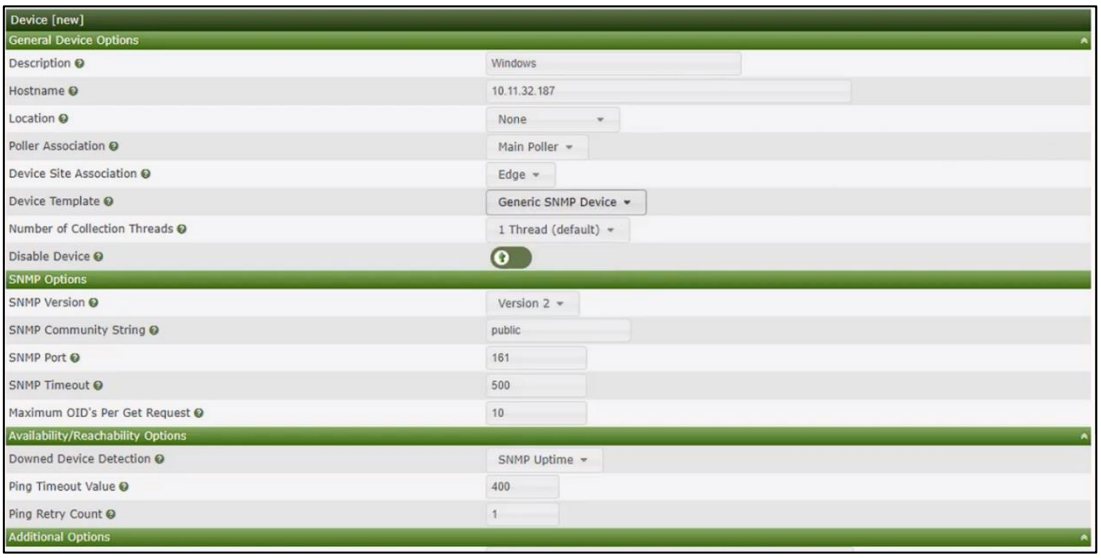
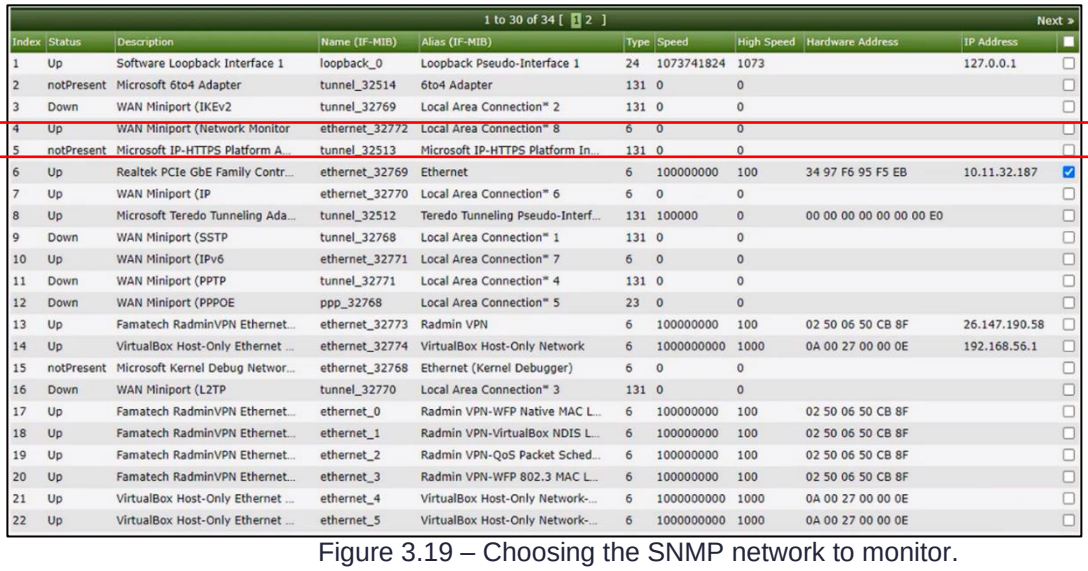


Figure 3.18 – Creating an SNMP Device for Windows

Step 19: Choose your Network Interface Controller, which has an ethernet alias from the option, since we are trying to monitor the network latency from Router to Windows, as shown in figure 3.19. After that, click Create.



Index	Status	Description	Name (IF-MIB)	Alias (IF-MIB)	Type	Speed	High Speed	Hardware Address	IP Address	
1	Up	Software Loopback Interface 1	loopback_0	Loopback Pseudo-Interface 1	24	1073741824	1073		127.0.0.1	☐
2	notPresent	Microsoft 6to4 Adapter	tunnel_32514	6to4 Adapter	131	0	0			☐
3	Down	WAN Miniport (IKEv2	tunnel_32769	Local Area Connection* 2	131	0	0			☐
4	Up	WAN Miniport (Network Monitor	ethernet_32772	Local Area Connection* 8	6	0	0			☐
5	notPresent	Microsoft IP-HTTPS Platform A...	tunnel_32513	Microsoft IP-HTTPS Platform In...	131	0	0			☐
6	Up	Realtek PCIe GbE Family Contr...	ethernet_32769	Ethernet	6	100000000	100	34 97 F6 95 F5 EB	10.11.32.187	☑
7	Up	WAN Miniport (IP	ethernet_32770	Local Area Connection* 6	6	0	0			☐
8	Up	Microsoft Teredo Tunneling Ada...	tunnel_32512	Teredo Tunneling Pseudo-Interf...	131	100000	0	00 00 00 00 00 00 00 E0		☐
9	Down	WAN Miniport (SSTP	tunnel_32768	Local Area Connection* 1	131	0	0			☐
10	Up	WAN Miniport (IPv6	ethernet_32771	Local Area Connection* 7	6	0	0			☐
11	Down	WAN Miniport (PPTP	tunnel_32771	Local Area Connection* 4	131	0	0			☐
12	Down	WAN Miniport (PPPOE	ppp_32768	Local Area Connection* 5	23	0	0			☐
13	Up	Famatech RadminVPN Ethernet...	ethernet_32773	Radmin VPN	6	100000000	100	02 50 06 50 CB 8F	26.147.190.58	☐
14	Up	VirtualBox Host-Only Ethernet ...	ethernet_32774	VirtualBox Host-Only Network	6	1000000000	1000	0A 00 27 00 00 0E	192.168.56.1	☐
15	notPresent	Microsoft Kernel Debug Networ...	ethernet_32768	Ethernet (Kernel Debugger)	6	0	0			☐
16	Down	WAN Miniport (L2TP	tunnel_32770	Local Area Connection* 3	131	0	0			☐
17	Up	Famatech RadminVPN Ethernet...	ethernet_0	Radmin VPN-WFP Native MAC L...	6	100000000	100	02 50 06 50 CB 8F		☐
18	Up	Famatech RadminVPN Ethernet...	ethernet_1	Radmin VPN-VirtualBox NDIS L...	6	100000000	100	02 50 06 50 CB 8F		☐
19	Up	Famatech RadminVPN Ethernet...	ethernet_2	Radmin VPN-QoS Packet Sched...	6	100000000	100	02 50 06 50 CB 8F		☐
20	Up	Famatech RadminVPN Ethernet...	ethernet_3	Radmin VPN-WFP 802.3 MAC L...	6	100000000	100	02 50 06 50 CB 8F		☐
21	Up	VirtualBox Host-Only Ethernet ...	ethernet_4	VirtualBox Host-Only Network-...	6	1000000000	1000	0A 00 27 00 00 0E		☐
22	Up	VirtualBox Host-Only Ethernet ...	ethernet_5	VirtualBox Host-Only Network-...	6	1000000000	1000	0A 00 27 00 00 0E		☐

Figure 3.19 – Choosing the SNMP network to monitor.

Step 20: After the Data Query, go to Devices from management options, click the check box of Windows (another SNMP Device), then click Choose an action drop-down menu and choose the Place on a Tree option, as shown in Figure 3.20. Then click the Go button.

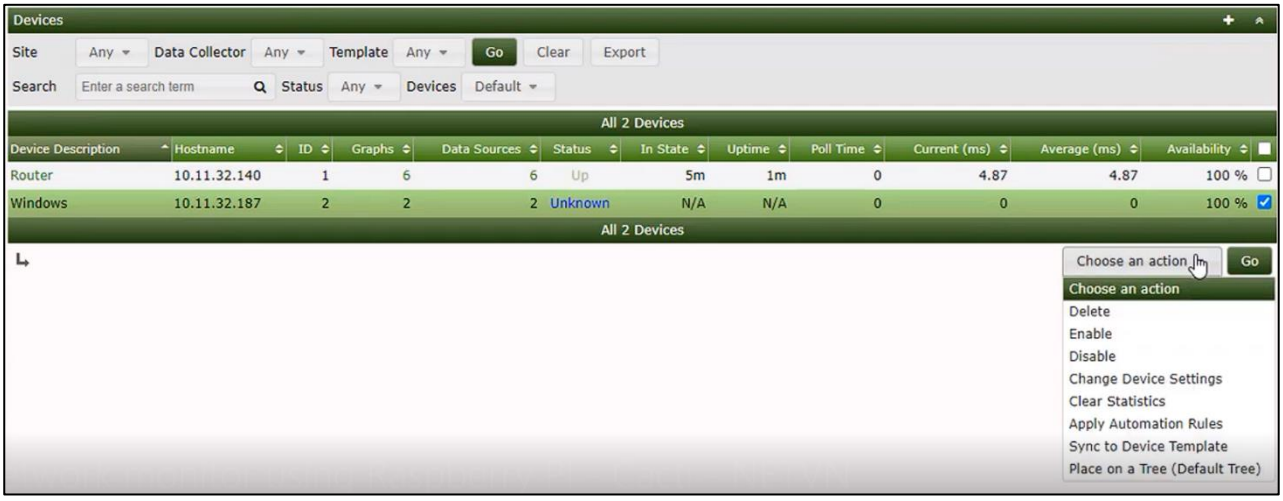


Figure 3.20 – Placing the Windows SNMP on a Tree.

With all that trouble configuring the SNMP Devices, you can now go to graphs and check all the graphs of the SNMP Devices. See Figures 3.21 and 3.22.[3]

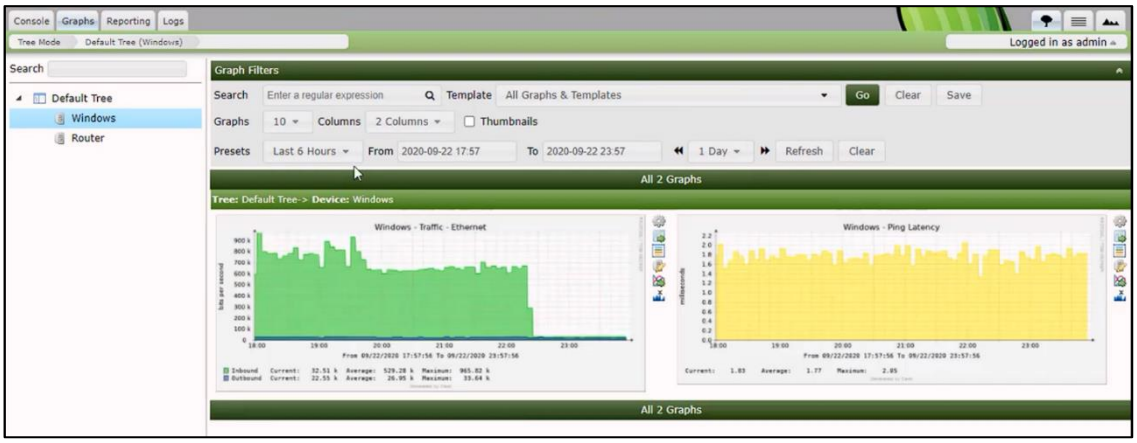


Figure 3.21 – Windows Network Graph

Figure 3.22 – Route

LEARNING ACTIVITY 1

Name: Cerujano, Erman Ace M. Due date: February 19, 2024

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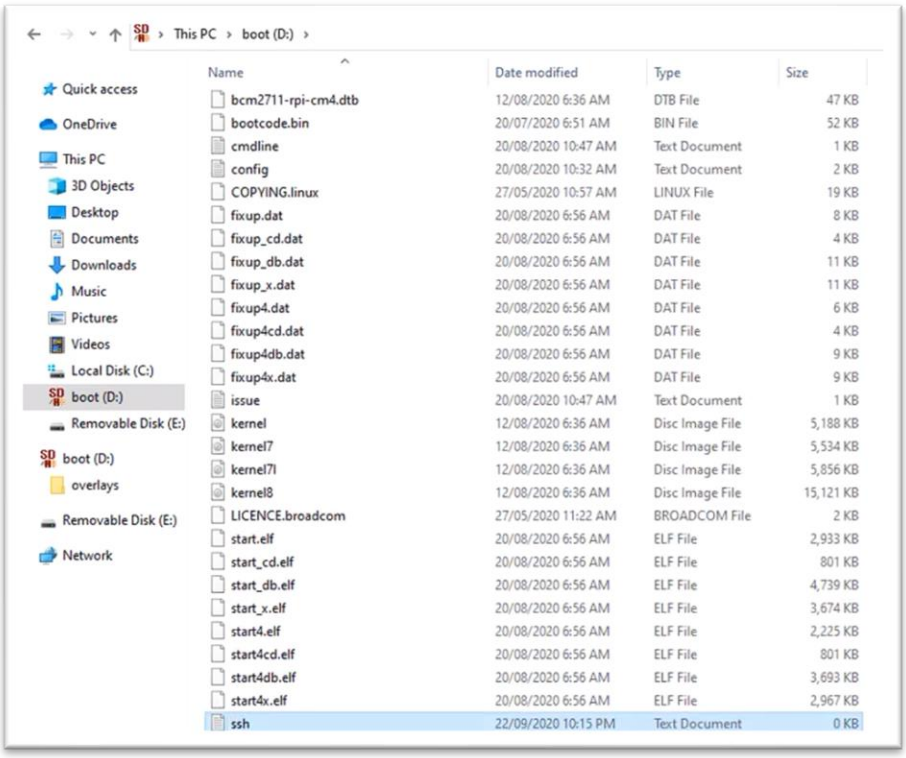

Figure 3.3 – Creating empty SSH text file.

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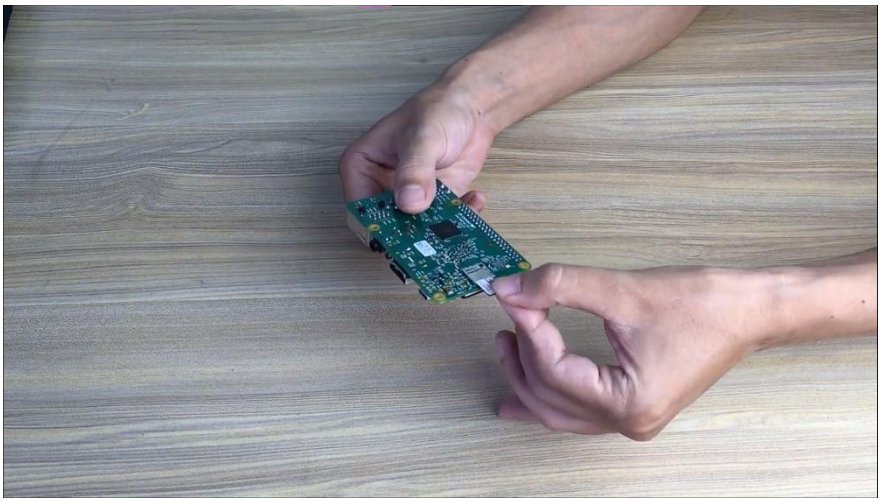
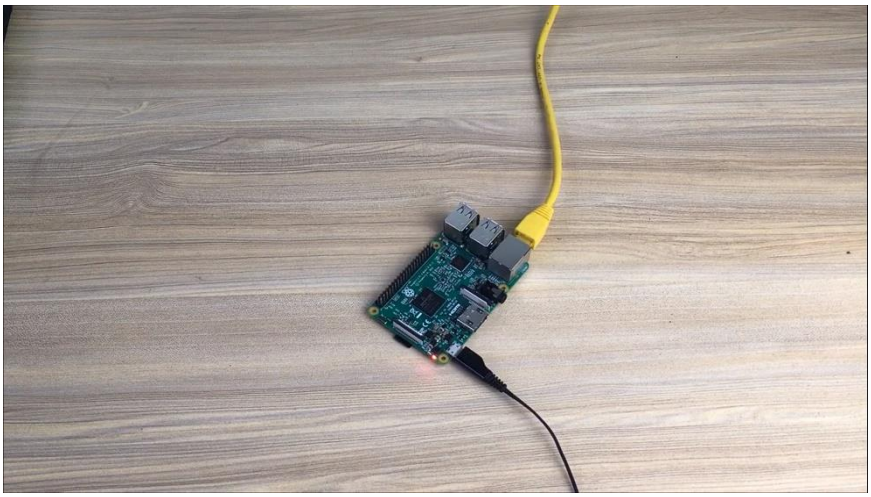


Figure 3.4 – Inserting SD Card on Raspberry Pi



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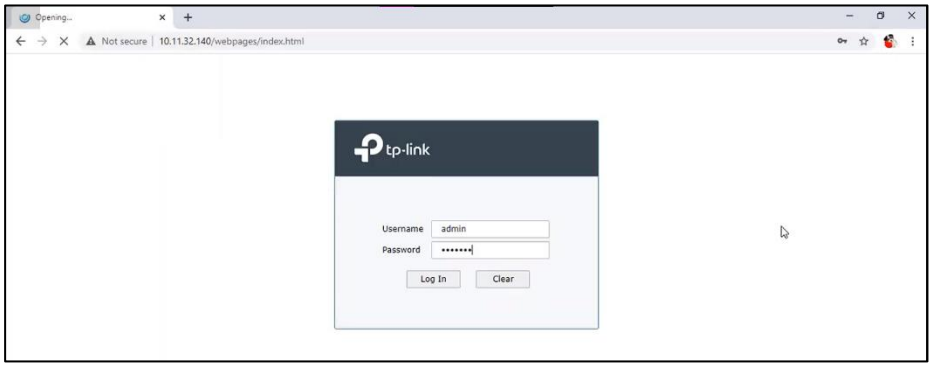

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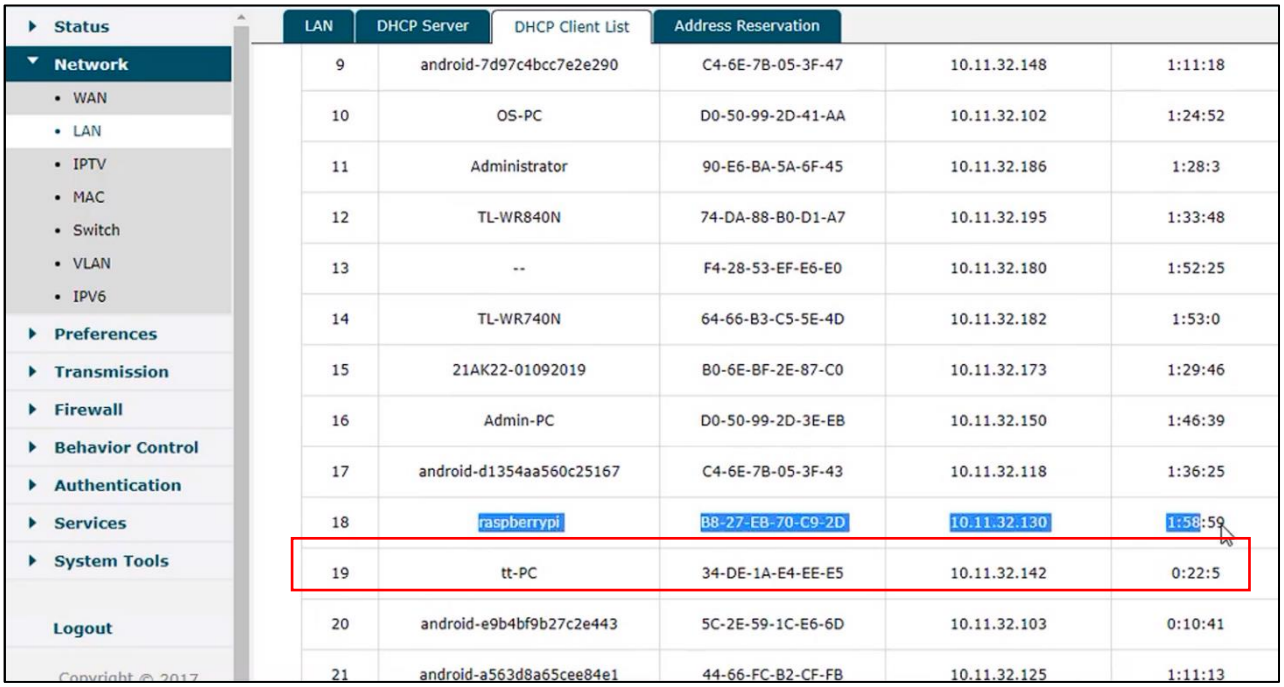

Figure 3.7 – Finding the IP Address of Raspberry Pi

Step 7: Now that you know the IP Address, you can go to your Command Prompt and connect to your Raspberry Pi through an SSH connection. To connect with your RPi, type the command:

ssh pi@10.11.32.130

Where:

ssh – the command for SSH connection
pi – the username used for authentication
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Note: The command varies depending on the configuration of your Raspberry Pi, so it is important that you configure the credentials in RPi Imager beforehand.

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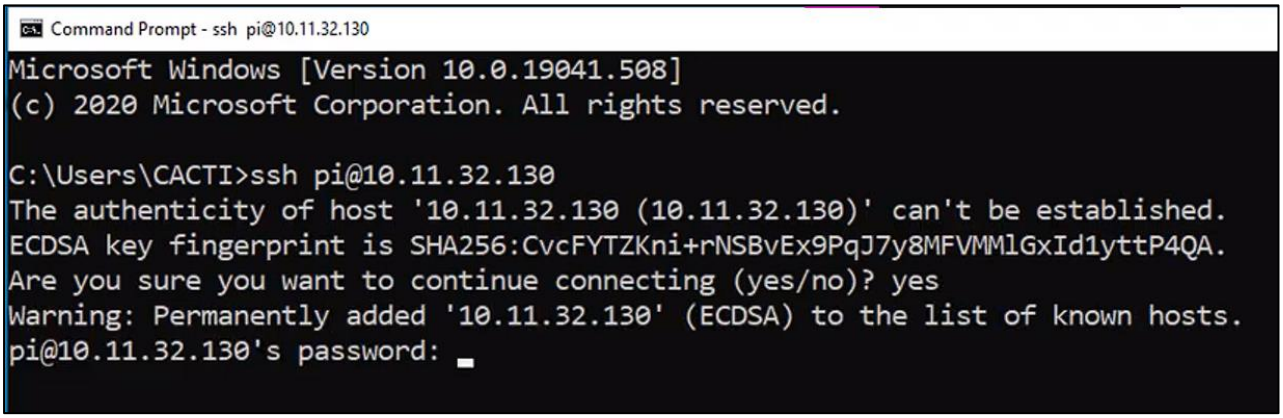

Figure 3.8 – Accessing the RPi with SSH

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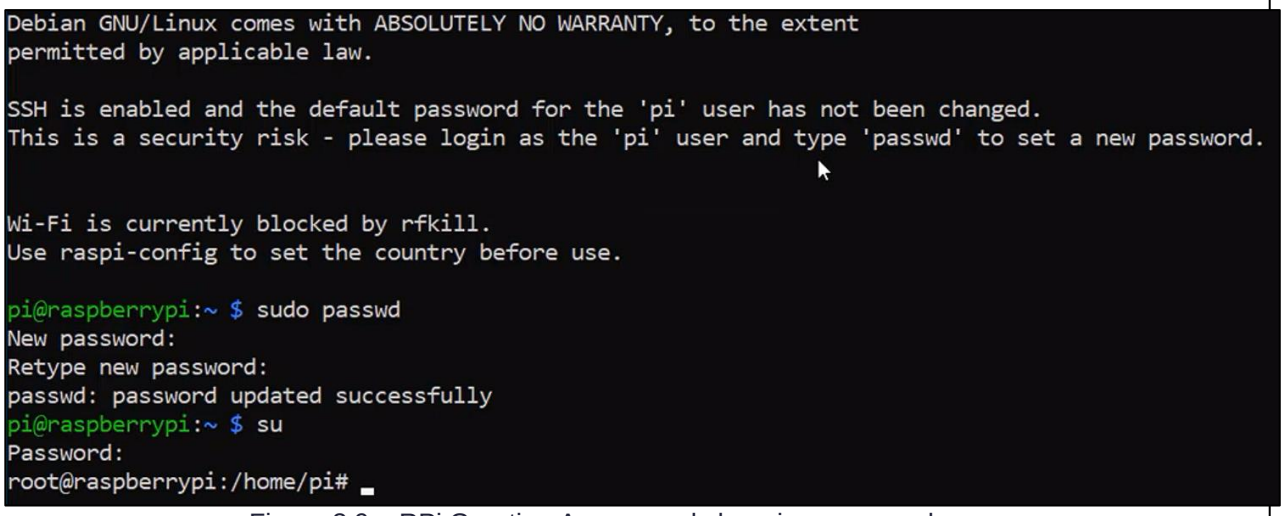

Figure 3.9 – RPi Granting Access and changing password.

Step 9: Update your apt package repository using the commands sudo apt update && sudo apt upgrade (this will take time). After the update, install the cacti monitoring tool using the command sudo apt install cacti -y (this will also take time) (see Figure 3.10).

Figure 3.10.1 – Updating and upgrading apt packages.

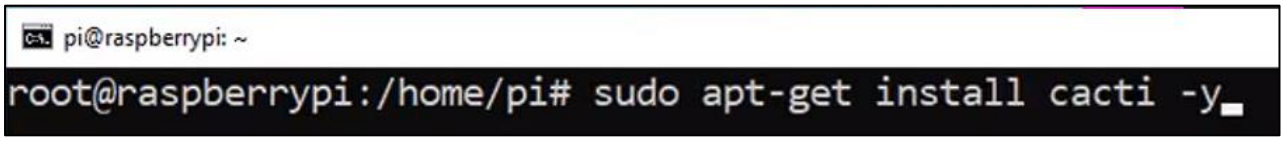

Figure 3.10.2 – apt installation of cacti monitoring tool.

Step 10: The package installation asks for your configurations in the database. You should choose the Yes option here, as shown in Figure 3.11.1.

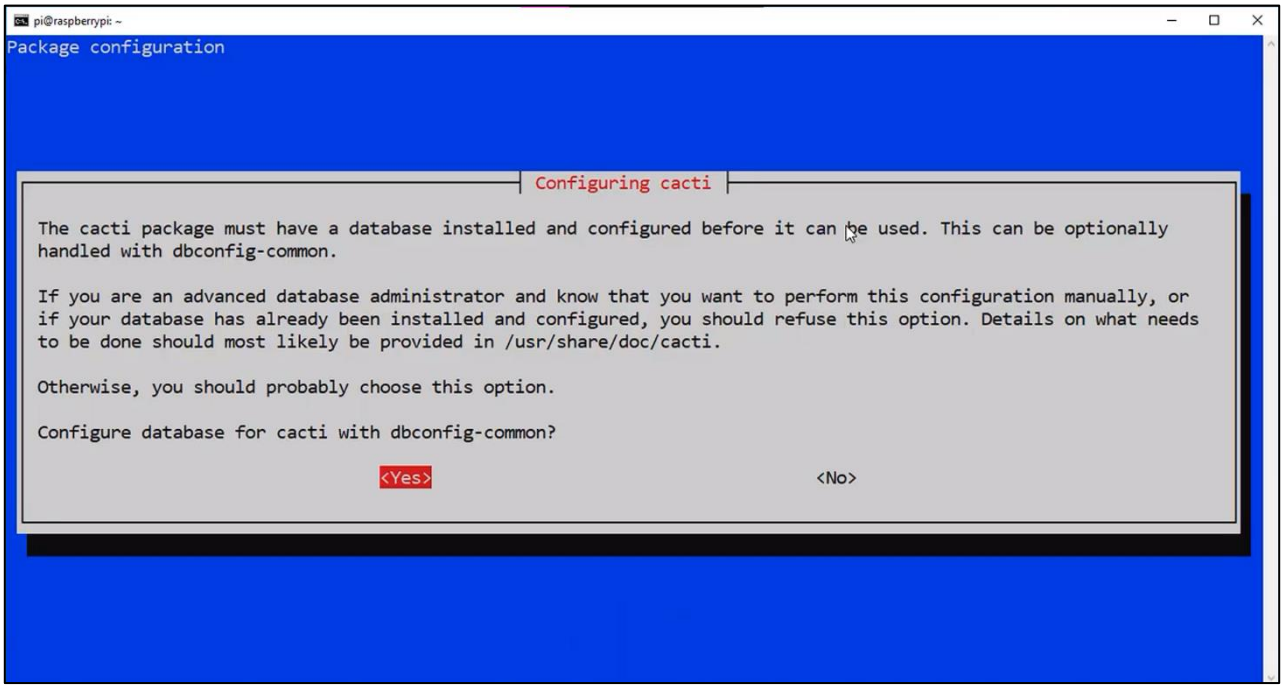

Figure 3.11.1 – configuring cacti database.

Step 11: The package installation will ask you for a password for the MySQL application. Just create a password on your preference, then choose an OK option, as shown in Figure 3.11.2

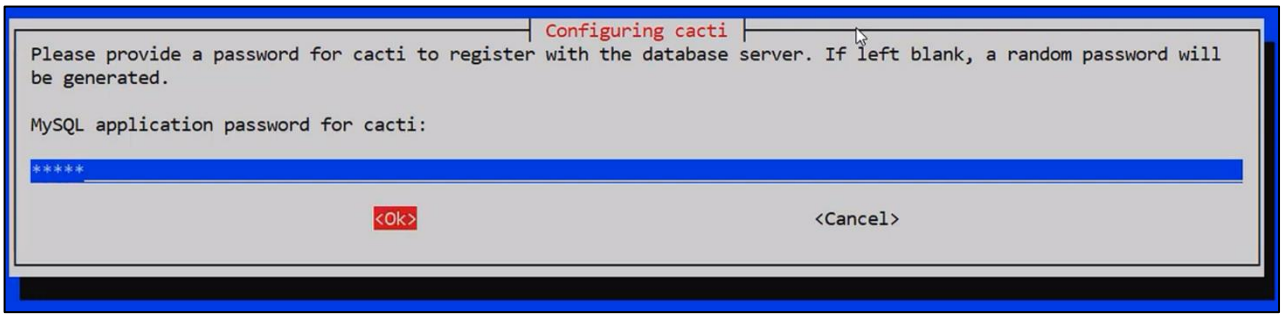

Figure 3.11.2 – configuring MySQL database.

Step 12: Go back to your browser, then type the URL of your webserver. In this case, this will be http://10.11.32.130/cacti (This depends on your hostname). After that, the web service will prompt you to authenticate before granting access. You can use the default credential "admin" as your username and password, as shown in Figure 3.12. Then, click log in.

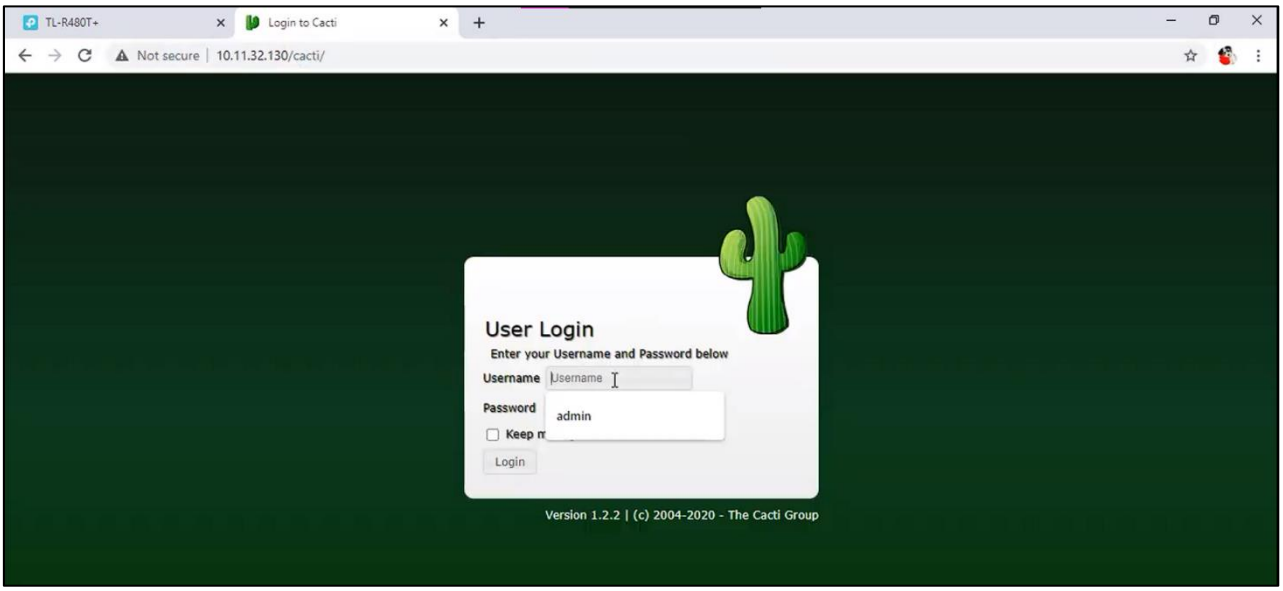

Figure 3.12 – Accessing Cacti Web Server

Step 13: Setting up SNMP on your monitored device involves several steps. Begin by selecting the device you intend to monitor. Then, proceed to configure SNMP by following the instructions provided below. Navigate to the device's settings menu to initiate the process.

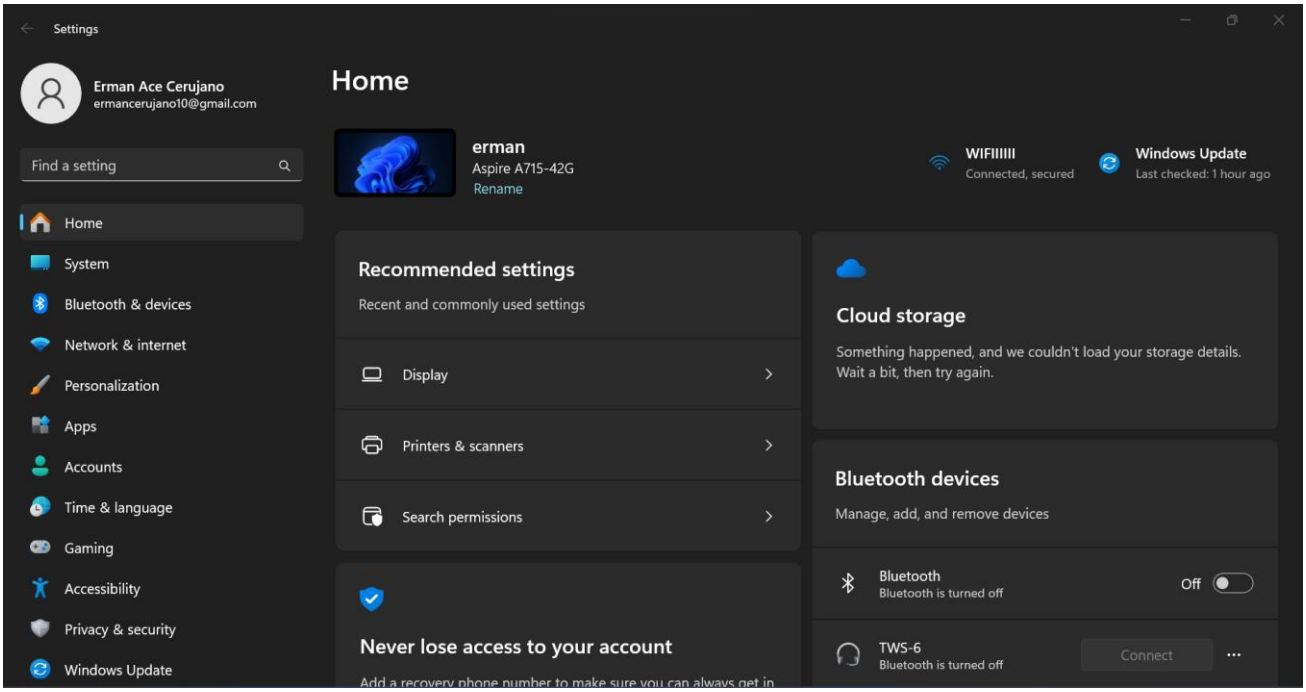

Figure 2-13: Windows Setting

- Search for “Add Optional Feature”

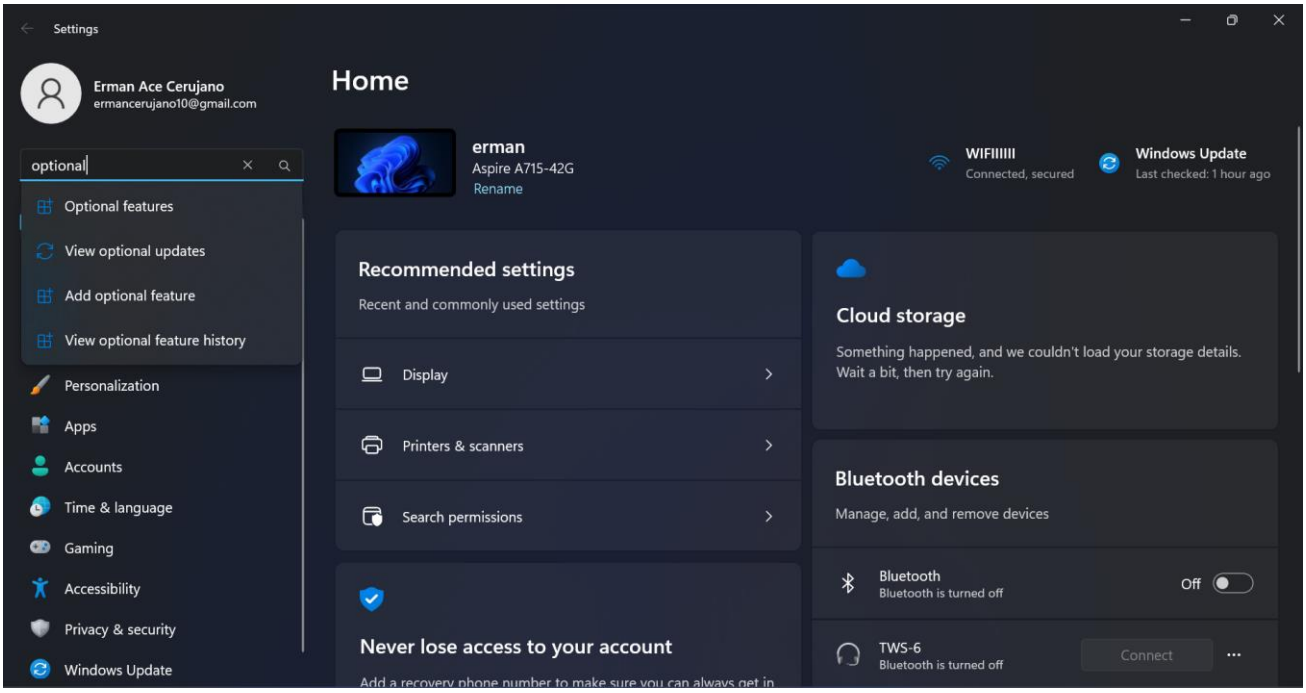

Figure 2-14: Searching for “Add Optional Feature”

- Then click the “Add an optional feature.”

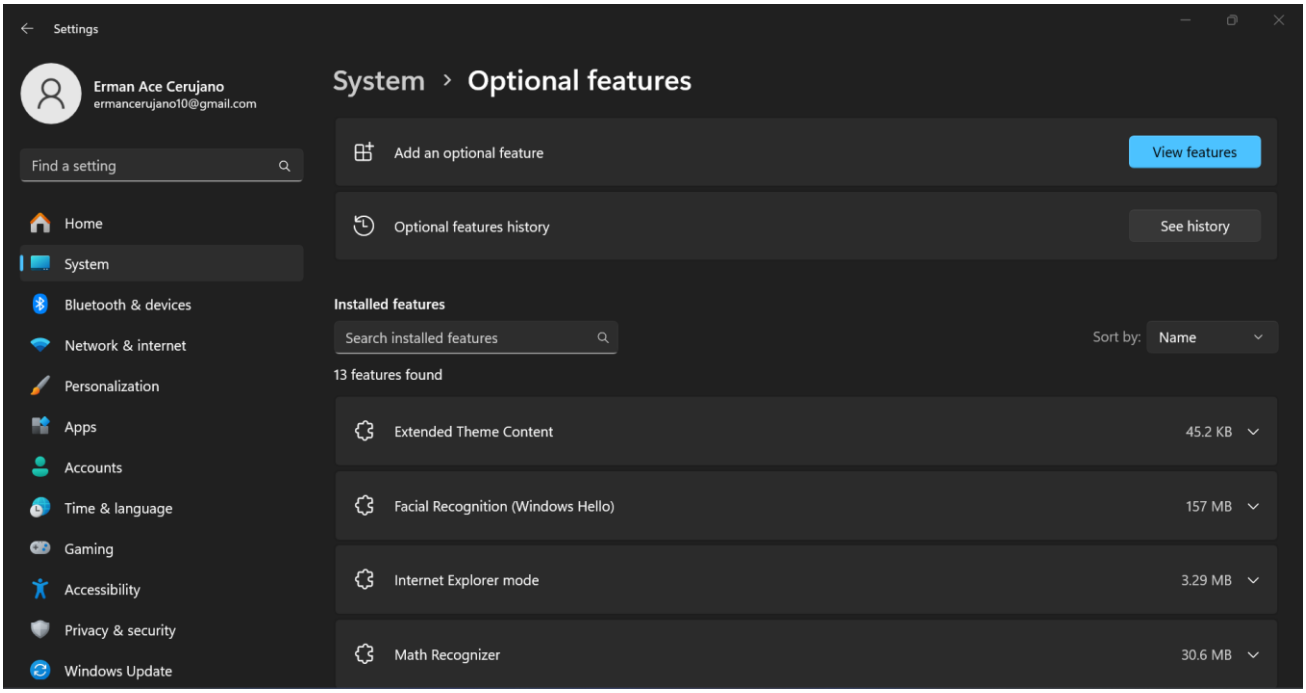

Figure 2-15: Optional Feature Tab

- Search for “SNMP” then click “Next.”

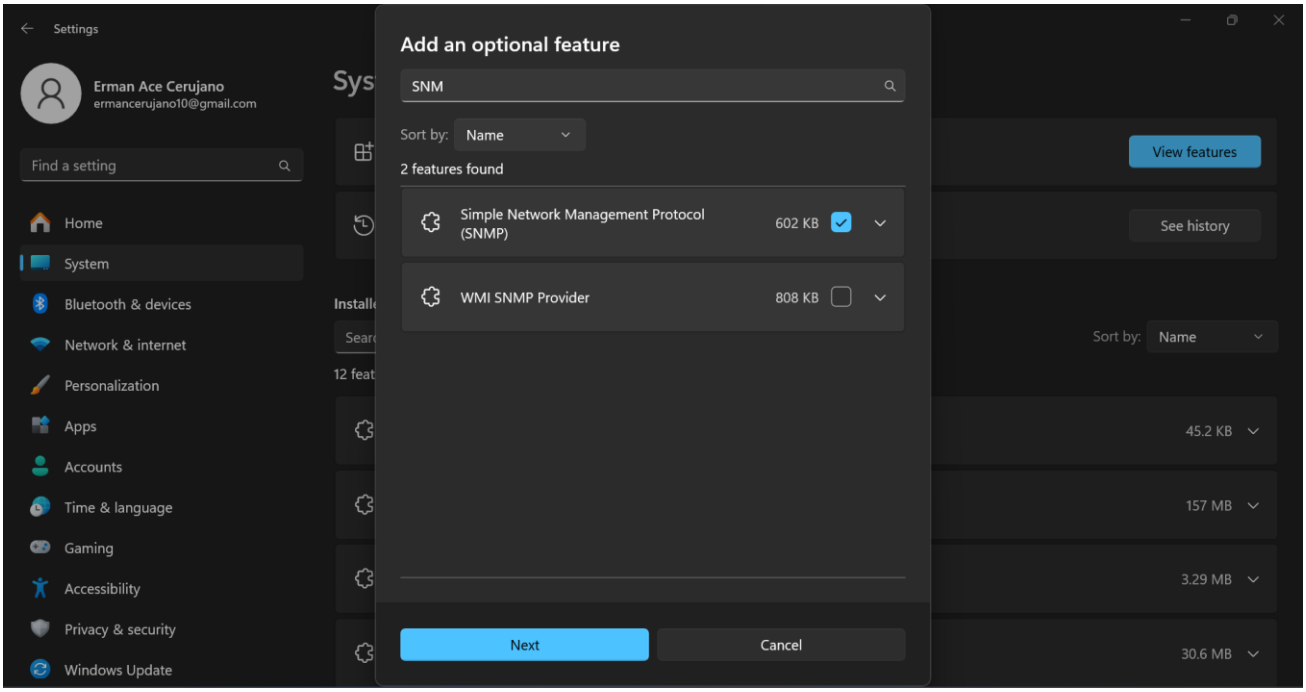

Figure 2-16: Searching for SNMP

- Then click “Install.”

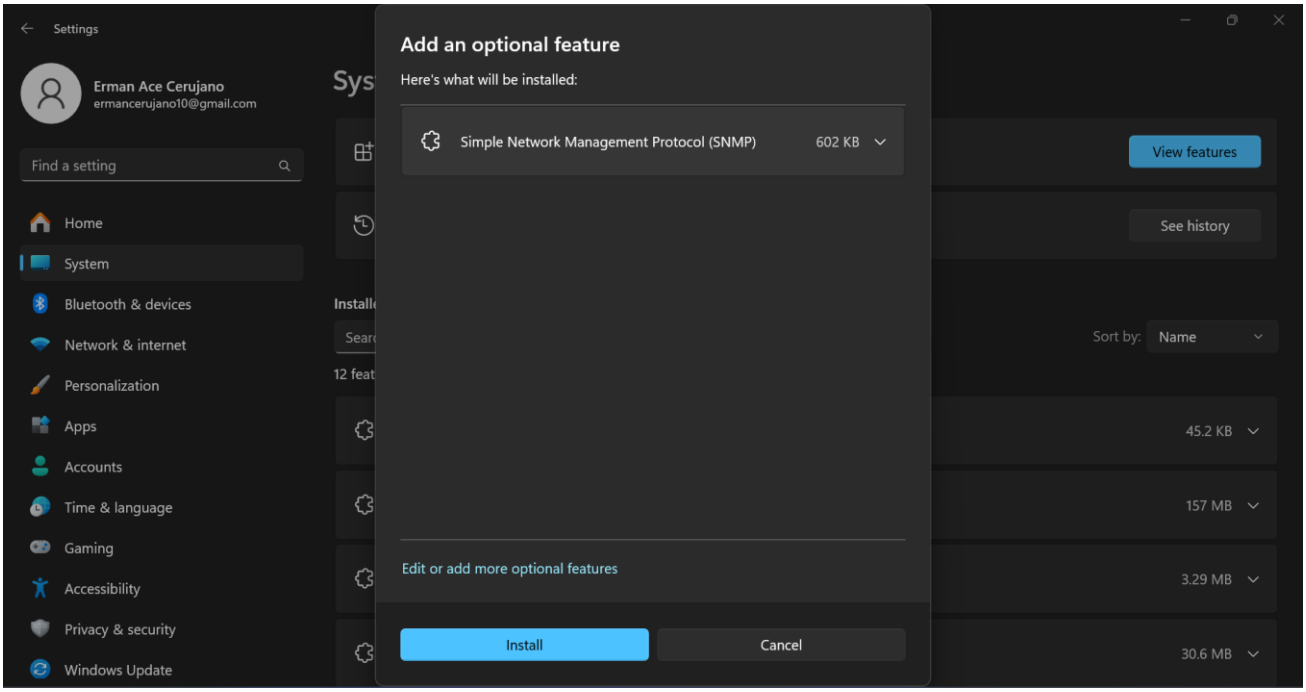

Figure 2-15: Installing SNMP

- Wait for the SNMP to install.

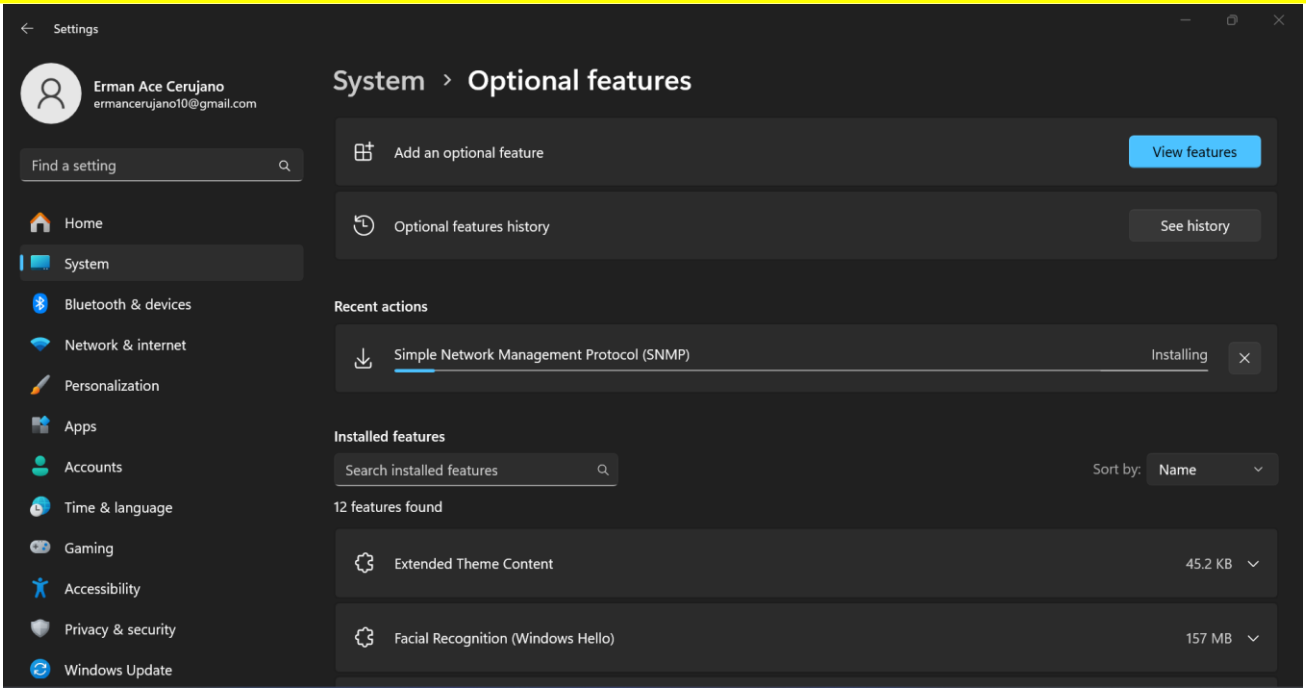

Figure 2-17: Installing SNMP

- You now successfully Install the SNMP into your computer.

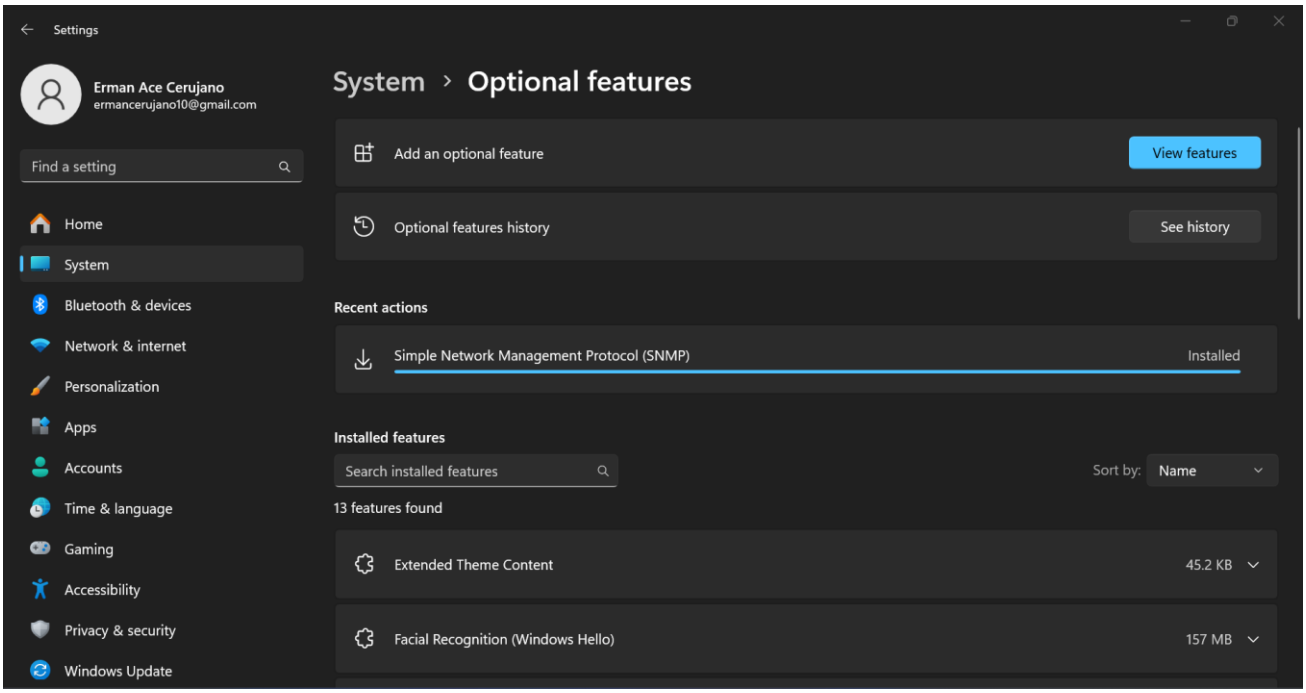

Figure 3-18: Successfully Installed SNMP

Step 14. Before proceeding with monitoring using Cacti, it's essential to configure SNMP on your device. Start by entering the host IP address into the SNMP configuration settings. This step is crucial for ensuring that Cacti can properly recognize and monitor the device.

- Go to “Services” and find “SNMP Service.”

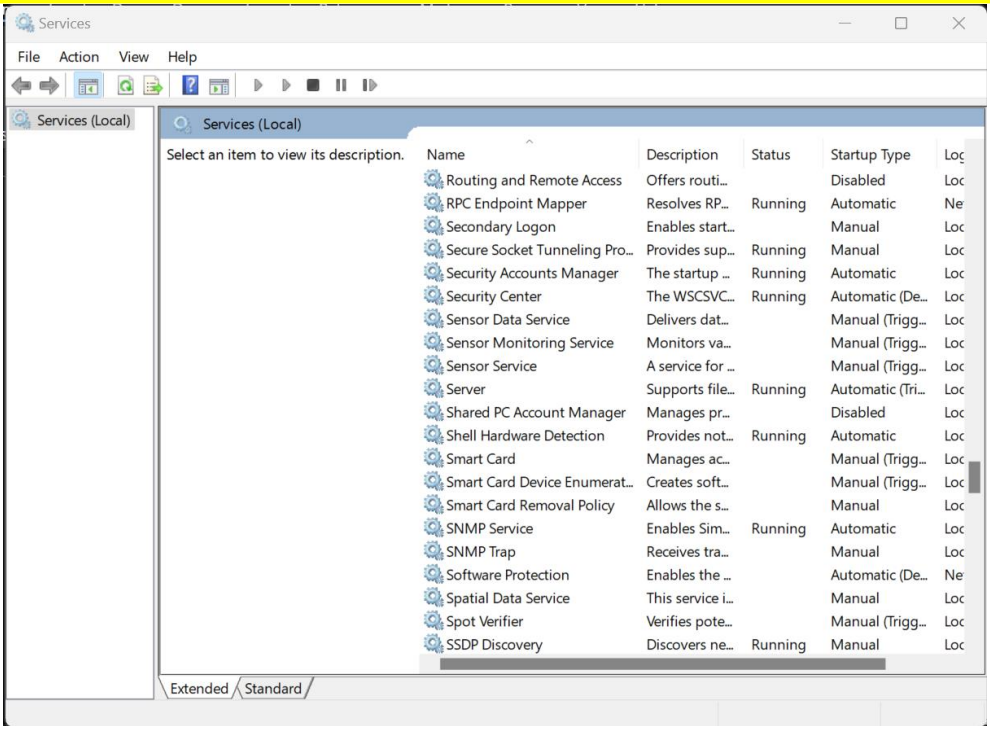

Figure 3-19: Services

- Navigate to the "Agent" section and ensure that all checkboxes are selected. This step ensures that all necessary parameters are enabled for proper functionality.

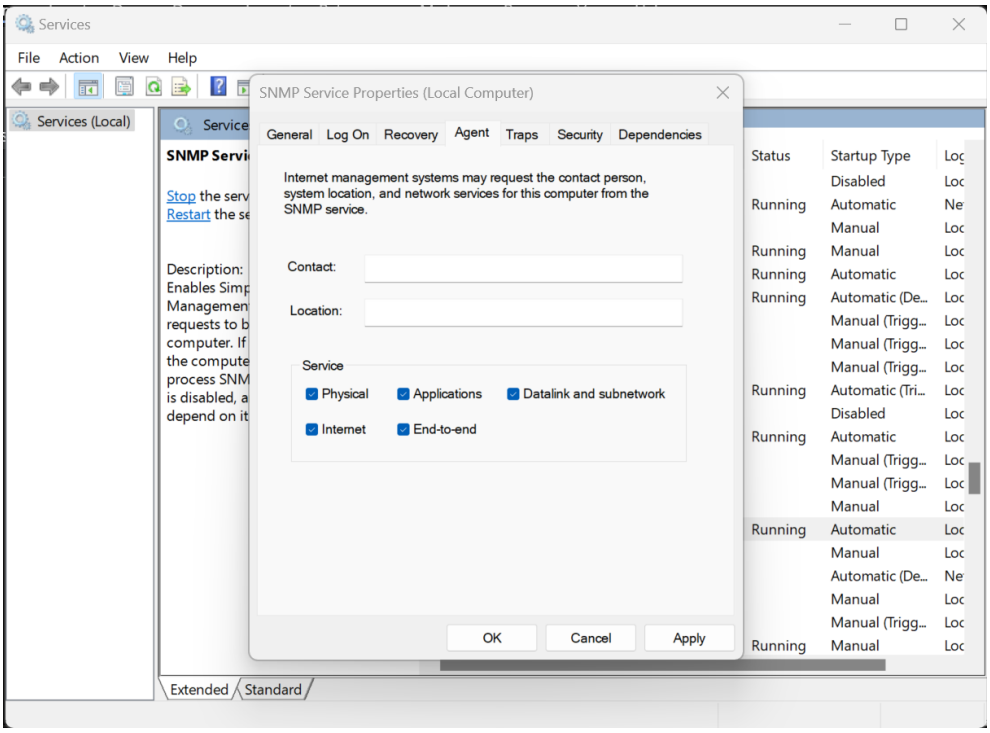

Figure 3-20: Configuring the SNMP Service Properties Agent”

- Go to security then click “Add” in “Accepted Community Names.”

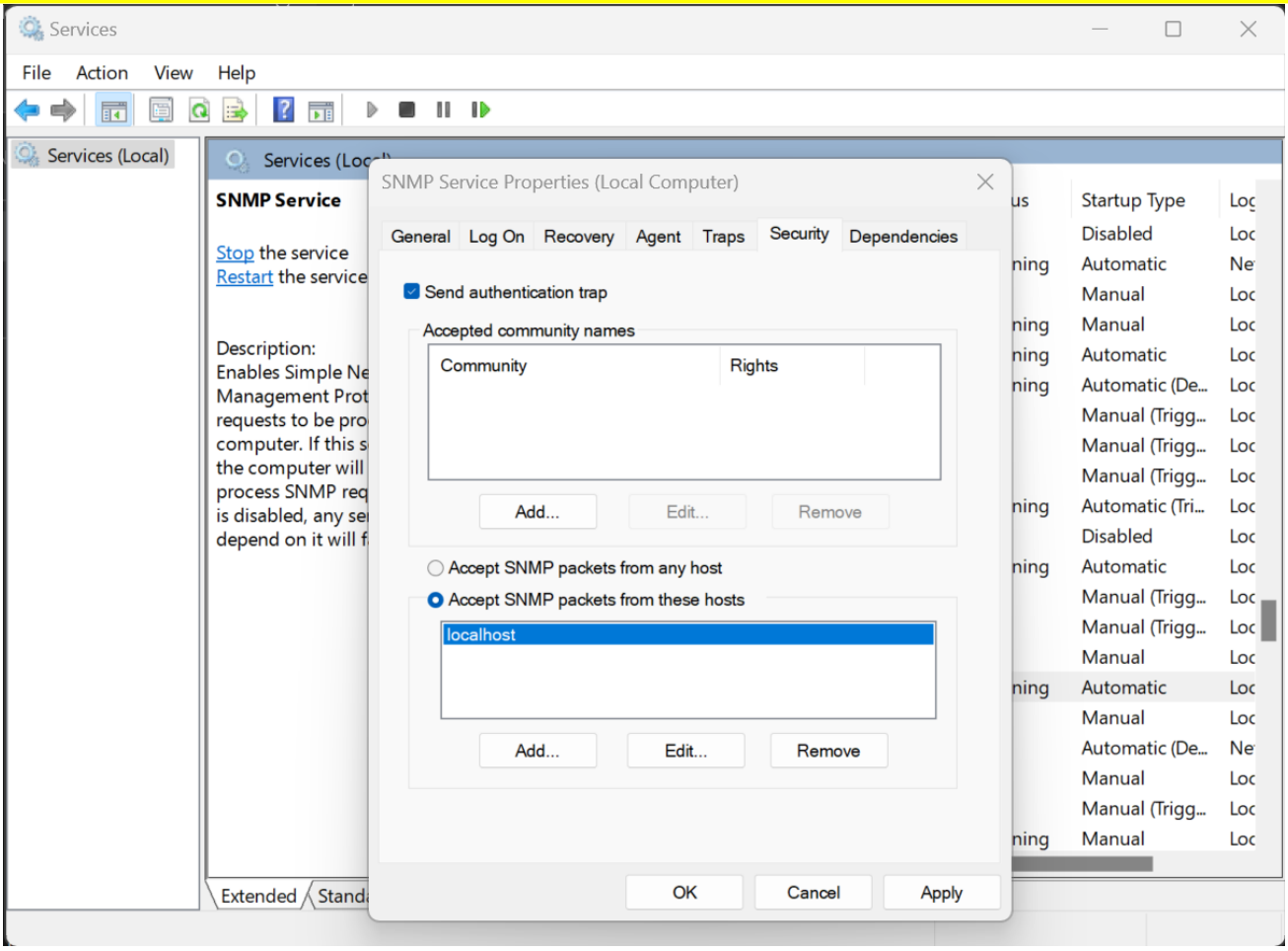

Figure 3-21: Configuring the “SNMP Service Security”

- In “Community Rights” select the “Read Only” and in “Community Name” enter “public” then click the “Add” Button. After that click “Apply” then “OK”

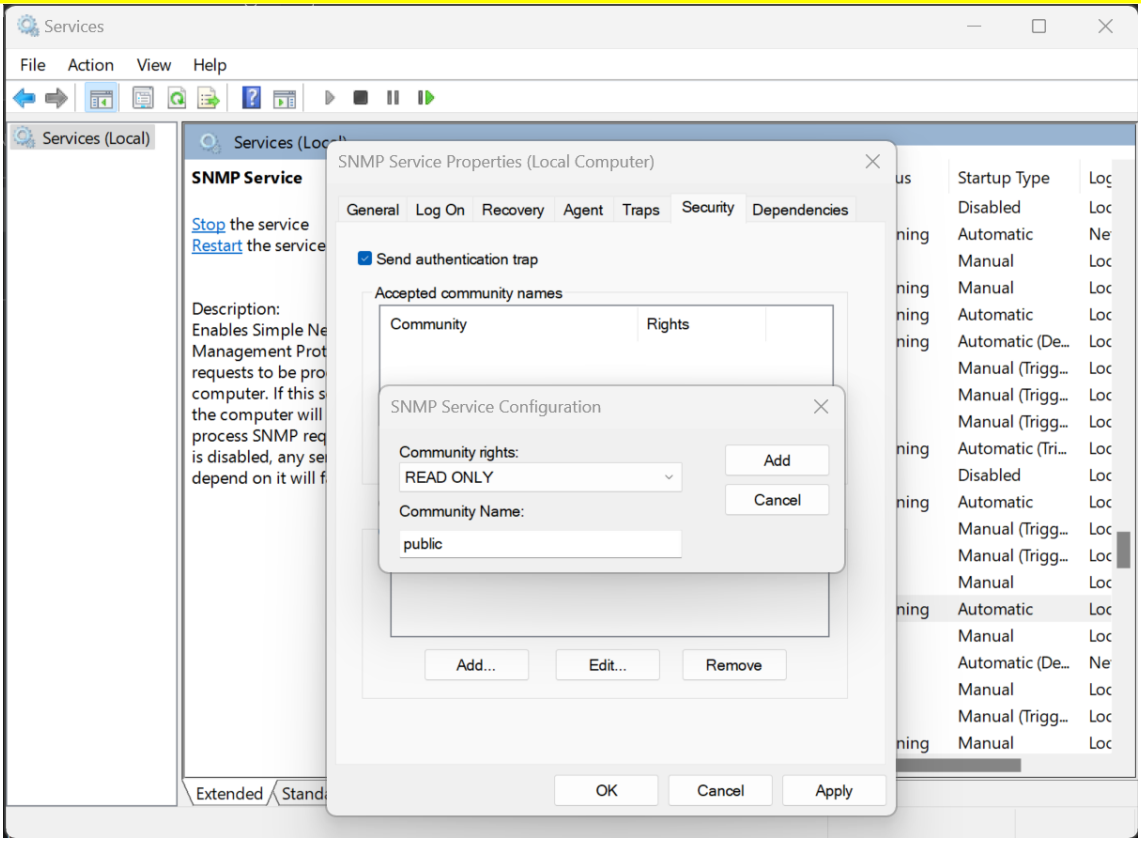

Figure 3-22: Configuring the SNMP Service Security 2

- Next select “Accept SNMP packets from these hosts” then click the “add” button.

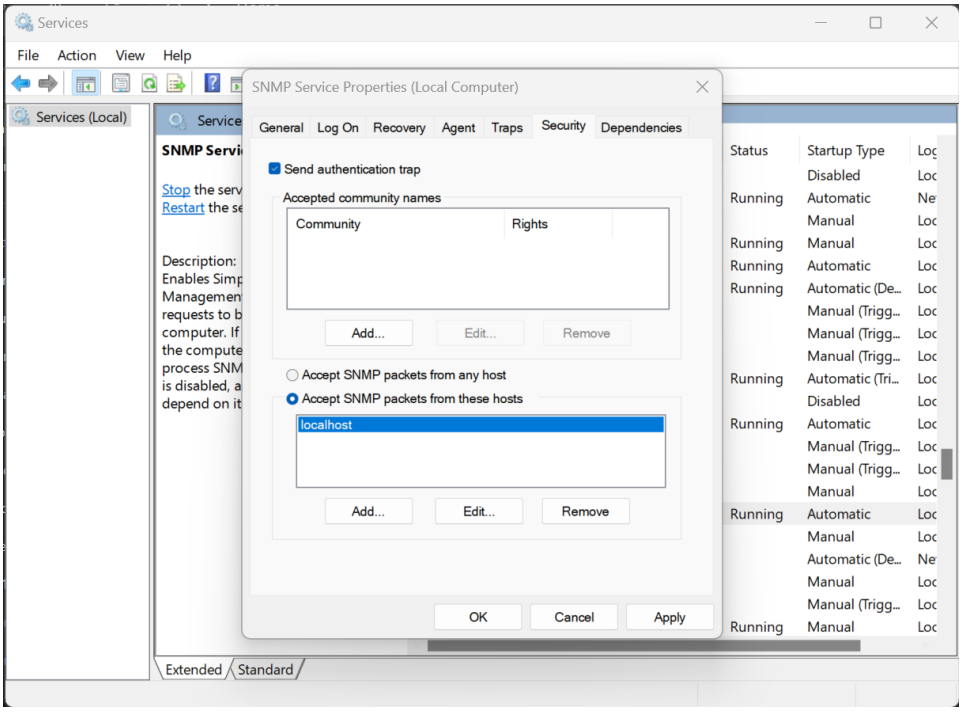

Figure 3-23: Configuring SNMP Service Properties

- Then add the IP address of your RPI then click “Add”

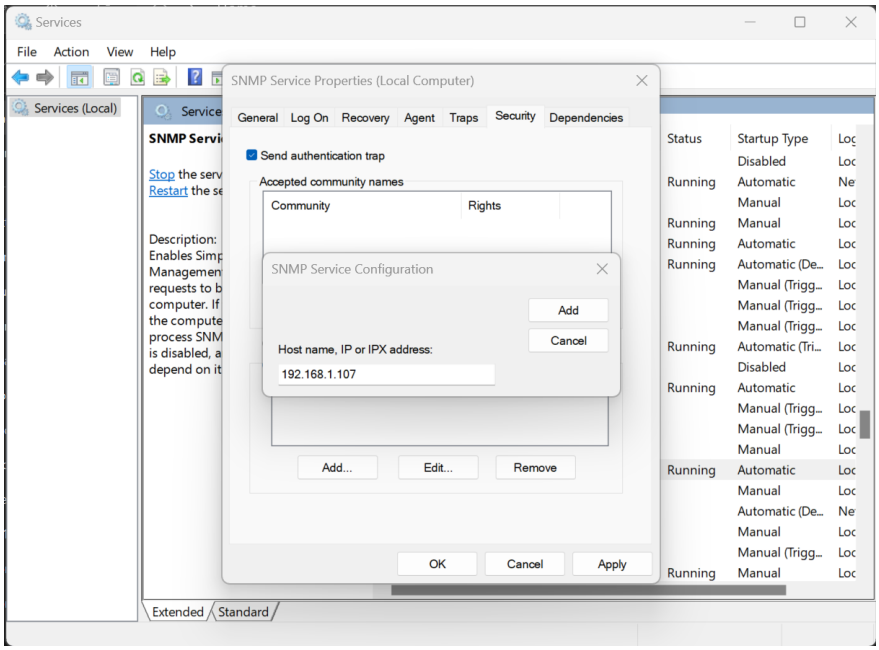

Figure 3-24: Entering the IP of Host.

- Then click “Apply” and “OK”

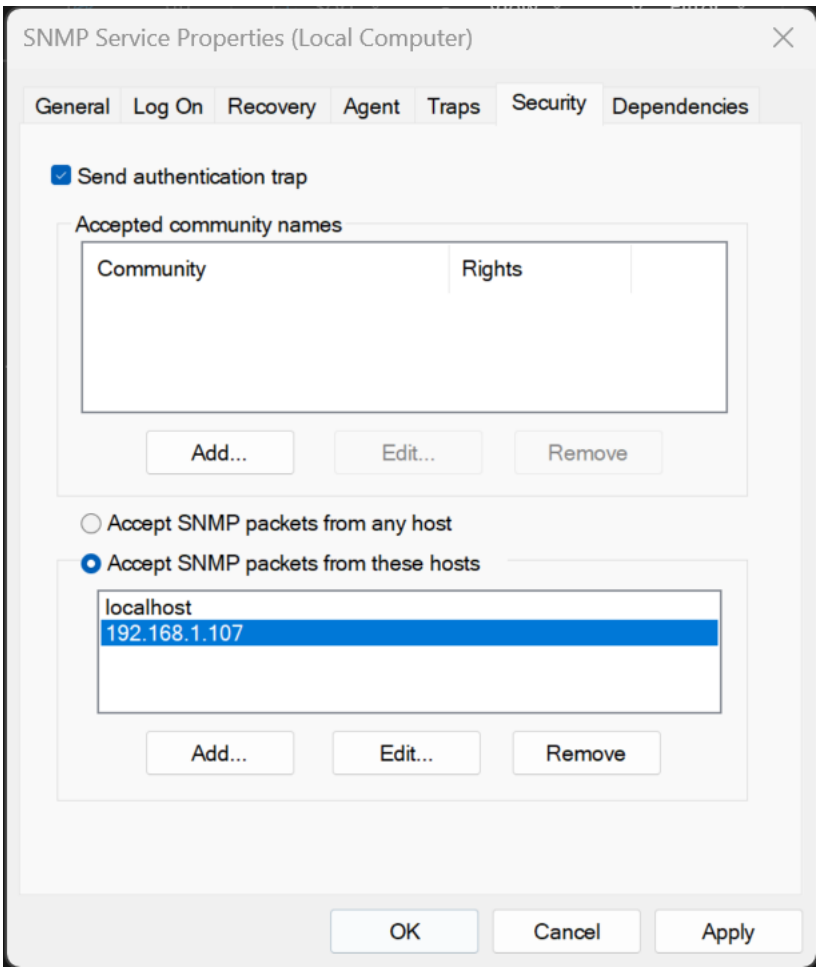

Figure 3-24: Done Configuring the SNMP Service

You have now successfully completed the configuration of SNMP on your computer.

Step 15. Adding your device into the Cacti. Go back to your cacti then go to “Management” then click “Devices” then click the “Add” button.

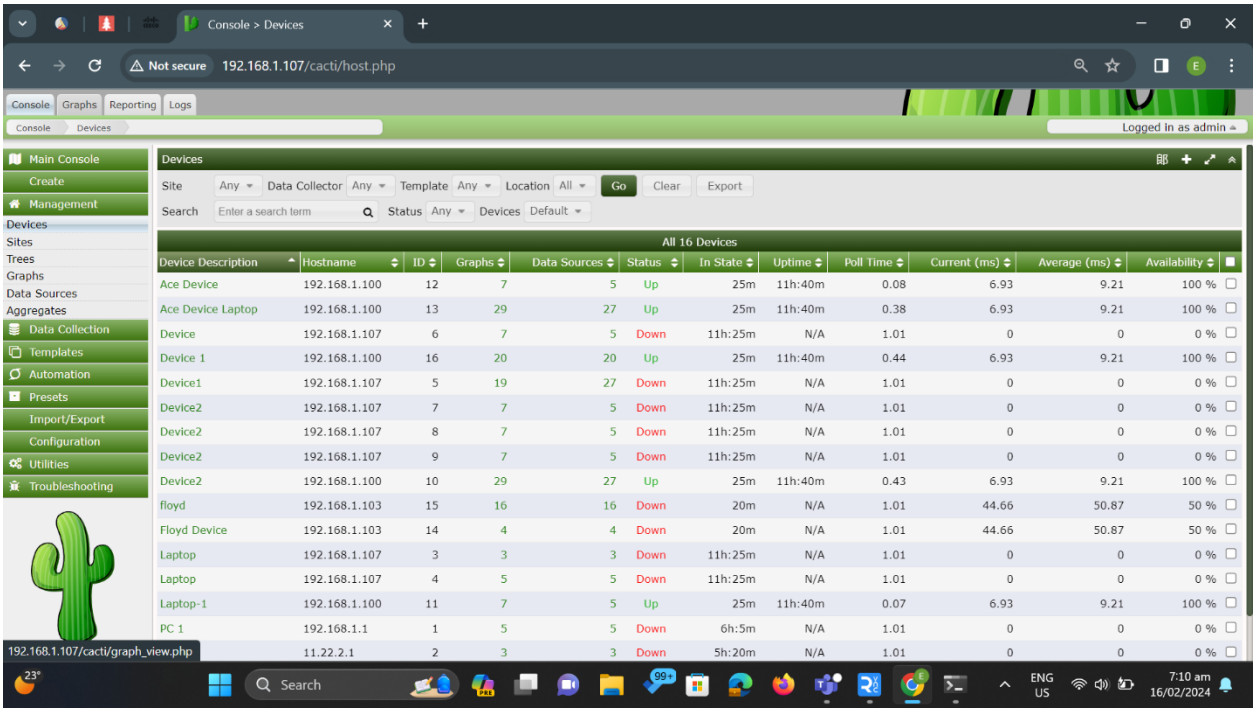

Figure 3-25: Cacti Devices

Step 16. Now, input the necessary details as outlined below:

- For the Description, choose any name that you prefer for the device you intend to monitor.
- Input the IP address of the device you wish to monitor into the Hostname field.
- Select the "Generic SNMP Device" option from the device template.
- Finally, press Enter to proceed.

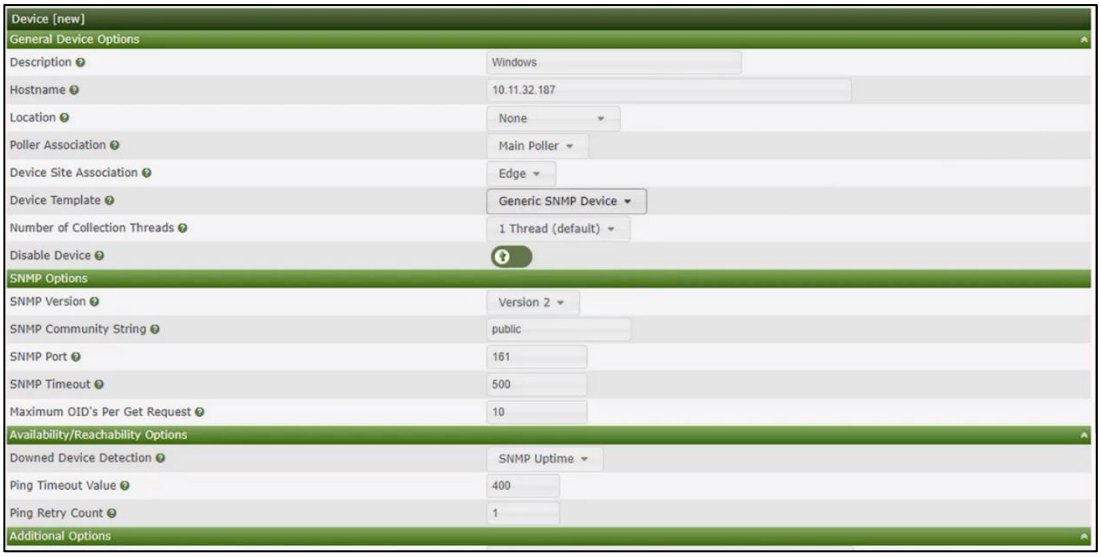

Figure 3-26: Adding Device into your Cacti Devices

Step 17. Creating Graphs. If the SNMP information of your device is working can now be able to create a graph to your device. Click the “Create Graphs for this Device” button.

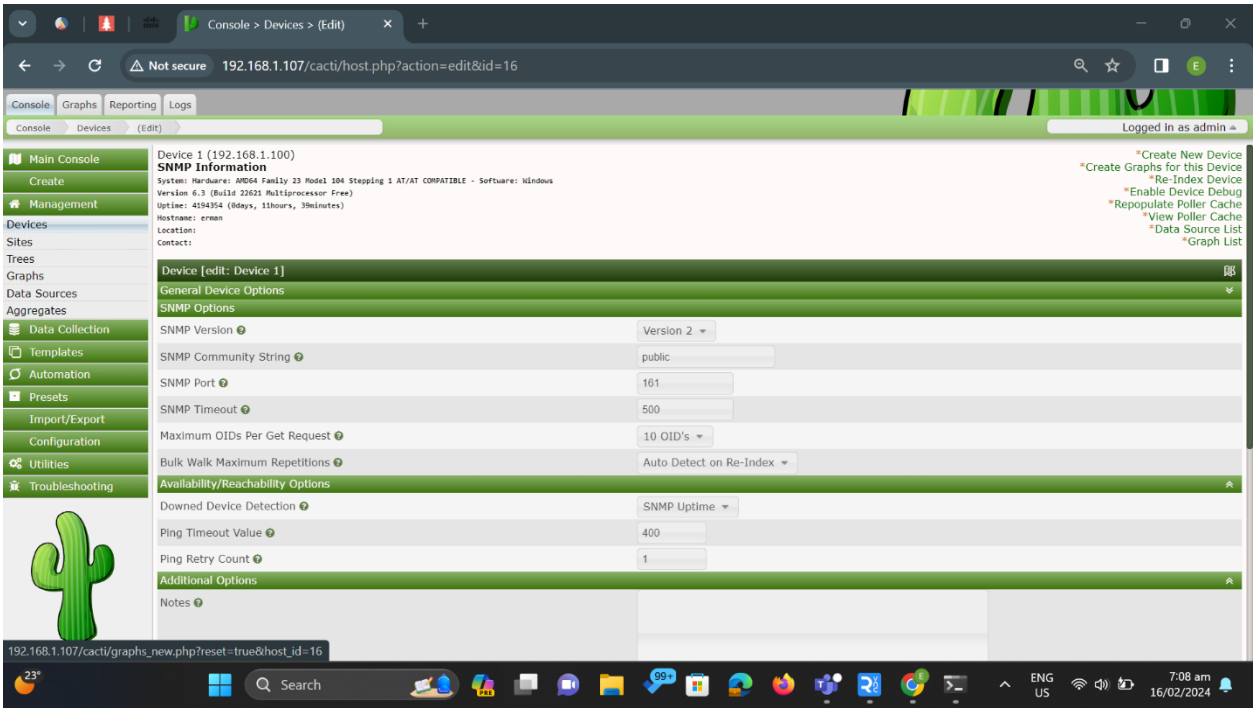

Figure 3-26: Successfully add a device in Cacti Devices

Step 18. Go to the “Data Query [SNMP – Interface Statistics]” and select all that has a “UP” status. After that click “create”

”

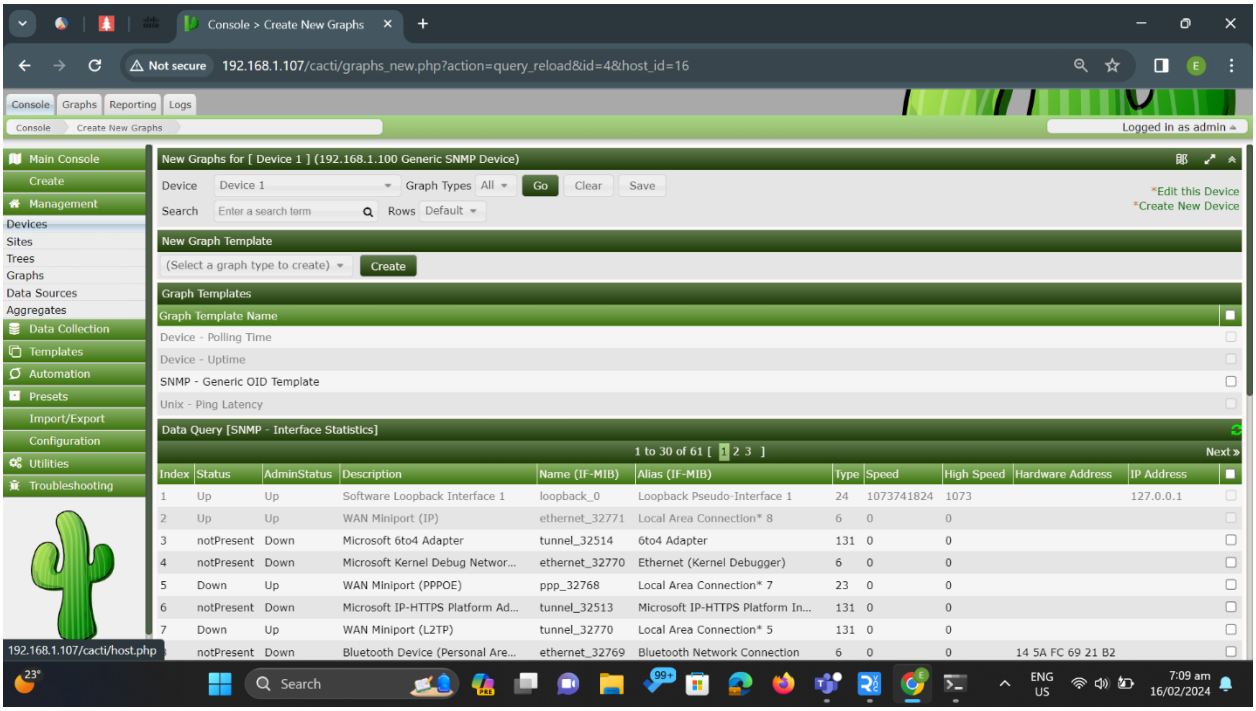

Figure 3-26: Cacti Data Query

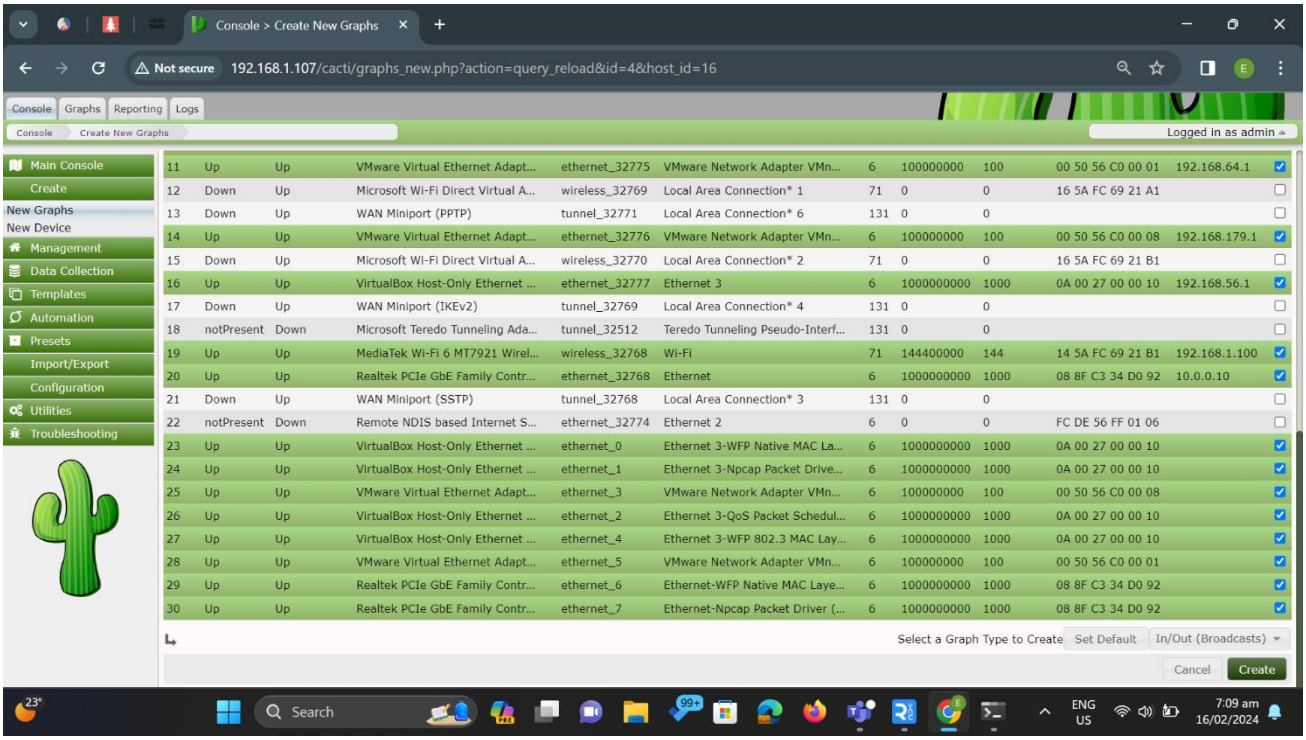

Figure 3-27: Creating Cacti Graph into your Device

Step 19. Go back to your devices. Then select your device, then select the “Place on a Tree (Default Tree) in the “Choose an Action” menu then click “Go.”

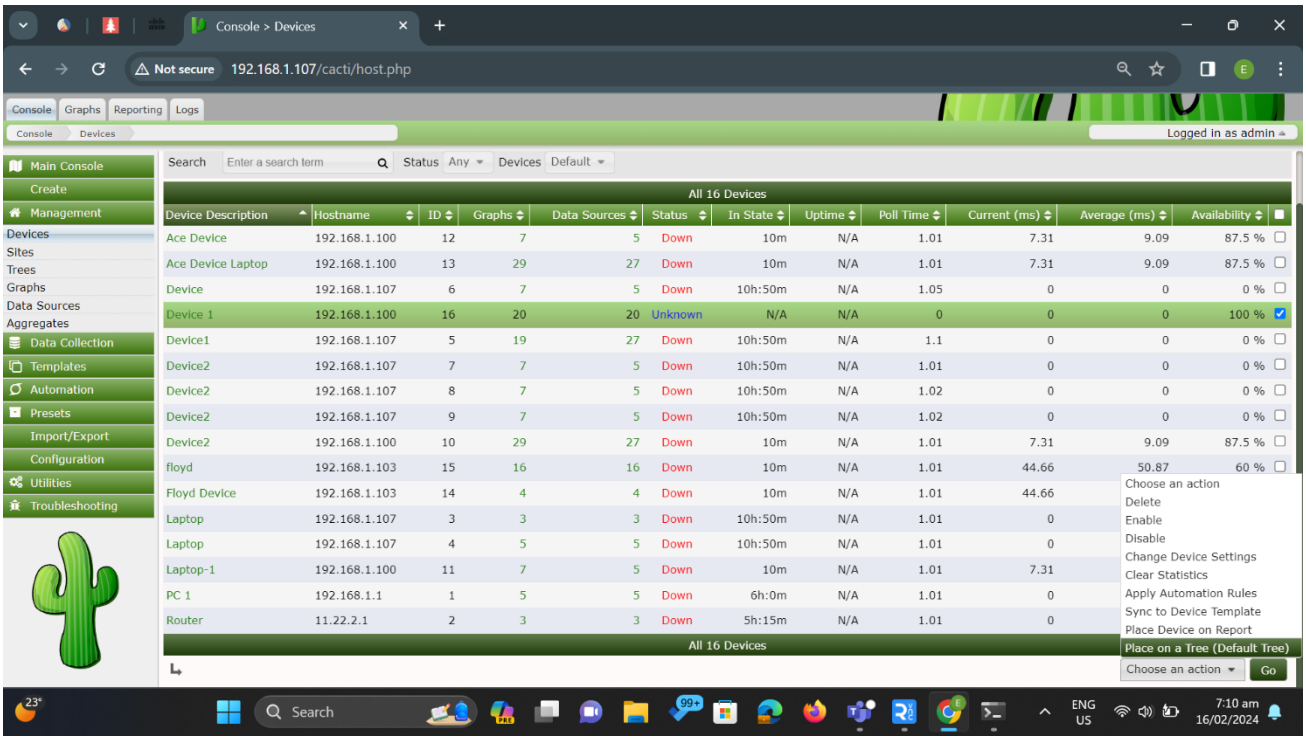

Figure 3-28: Adding the device into tree

Then click “Continue” to place the following Device(s) under the branch selected below.

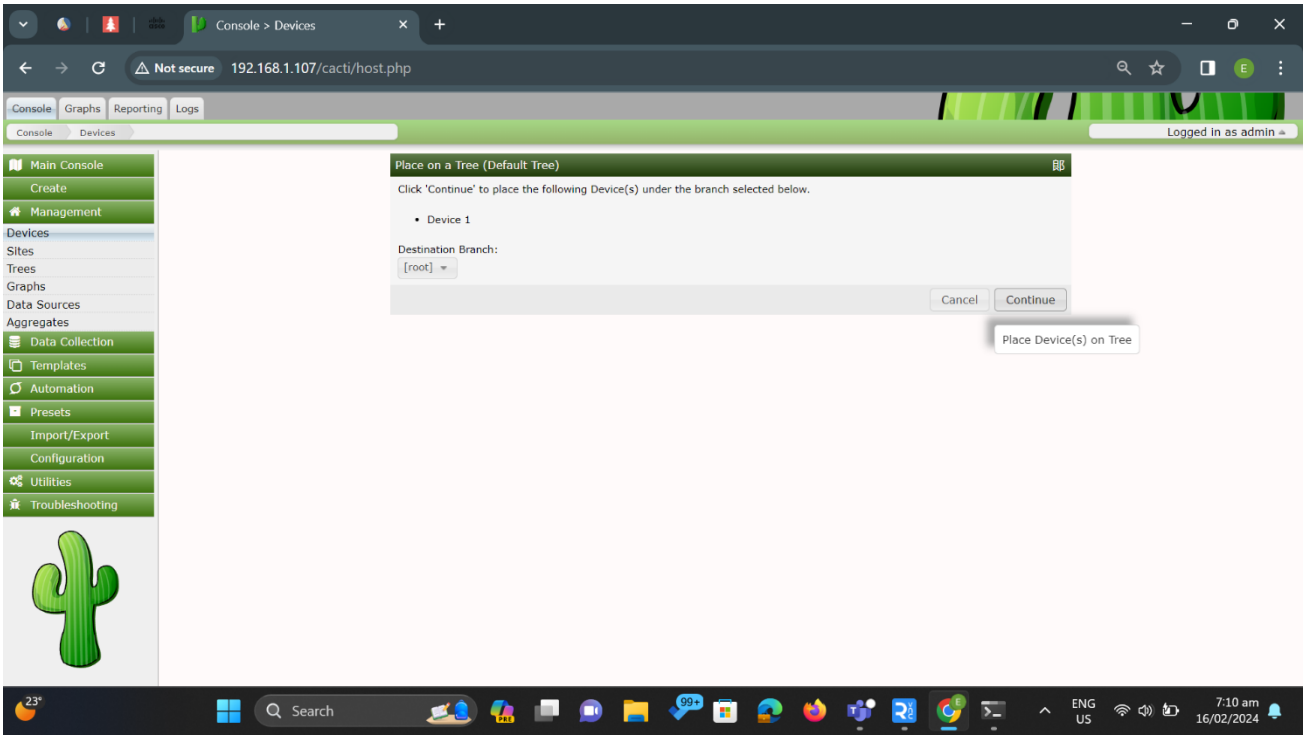

Figure 3-29: Placing your device into tree

Step 20. Creating Graphs. Now that we have successfully added the device to our tree, it's time to create a graph to monitor its performance. To begin, click on the "Graphs" tab.

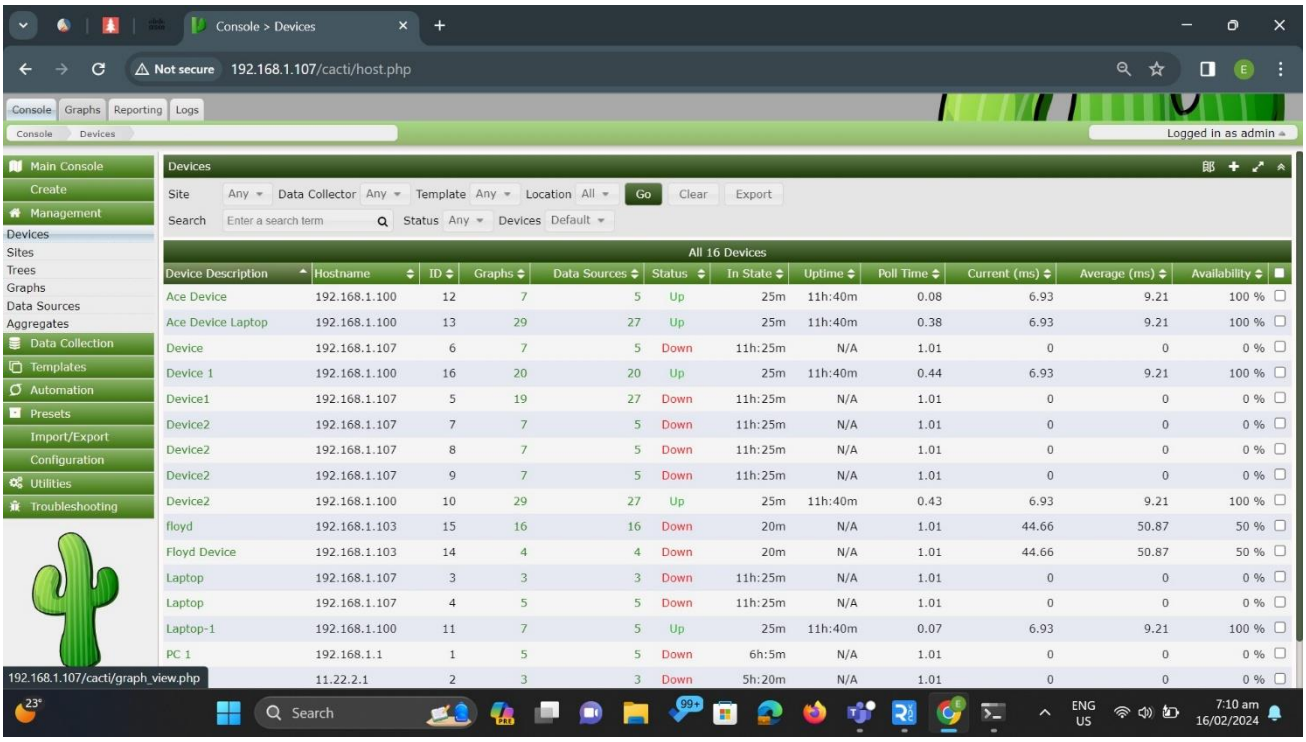

Figure 3-30: Cacti Devices Tab

Then select the device.

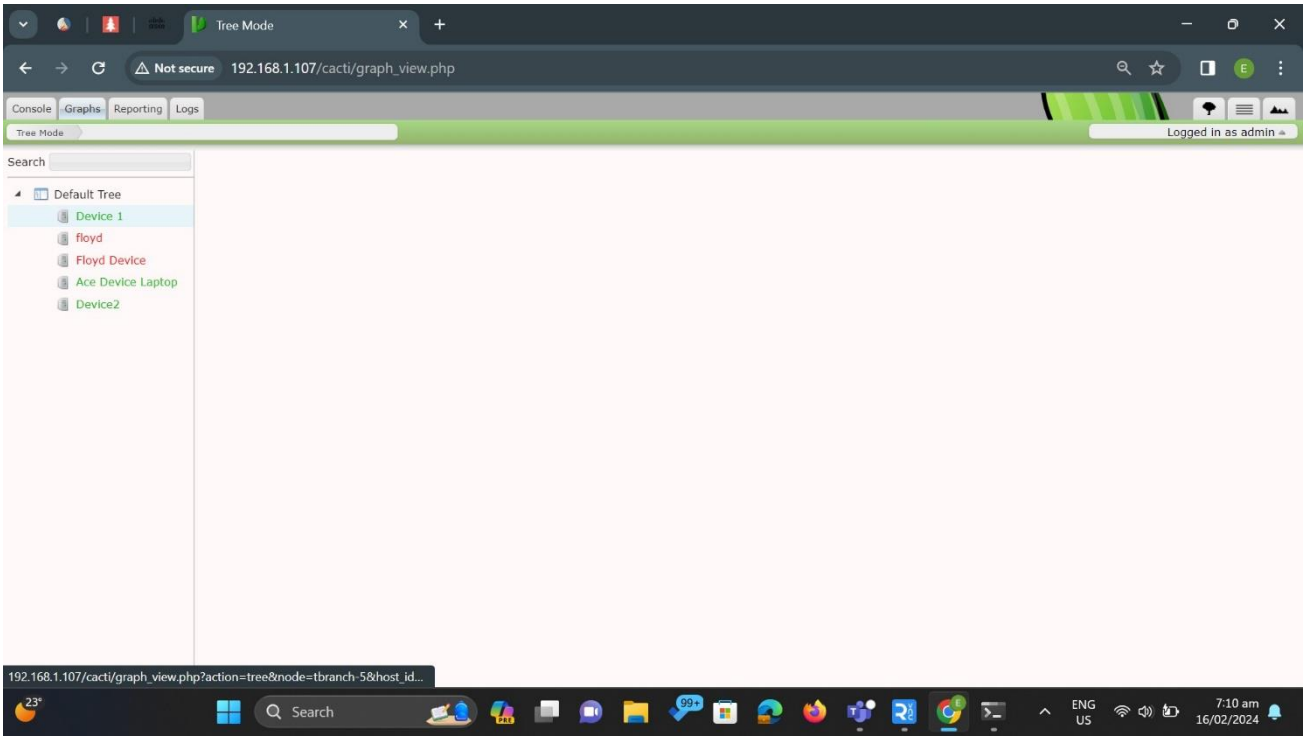

Figure 3-31: Cacti Graphs Tab

You can now monitor the network of the device in a graph form.

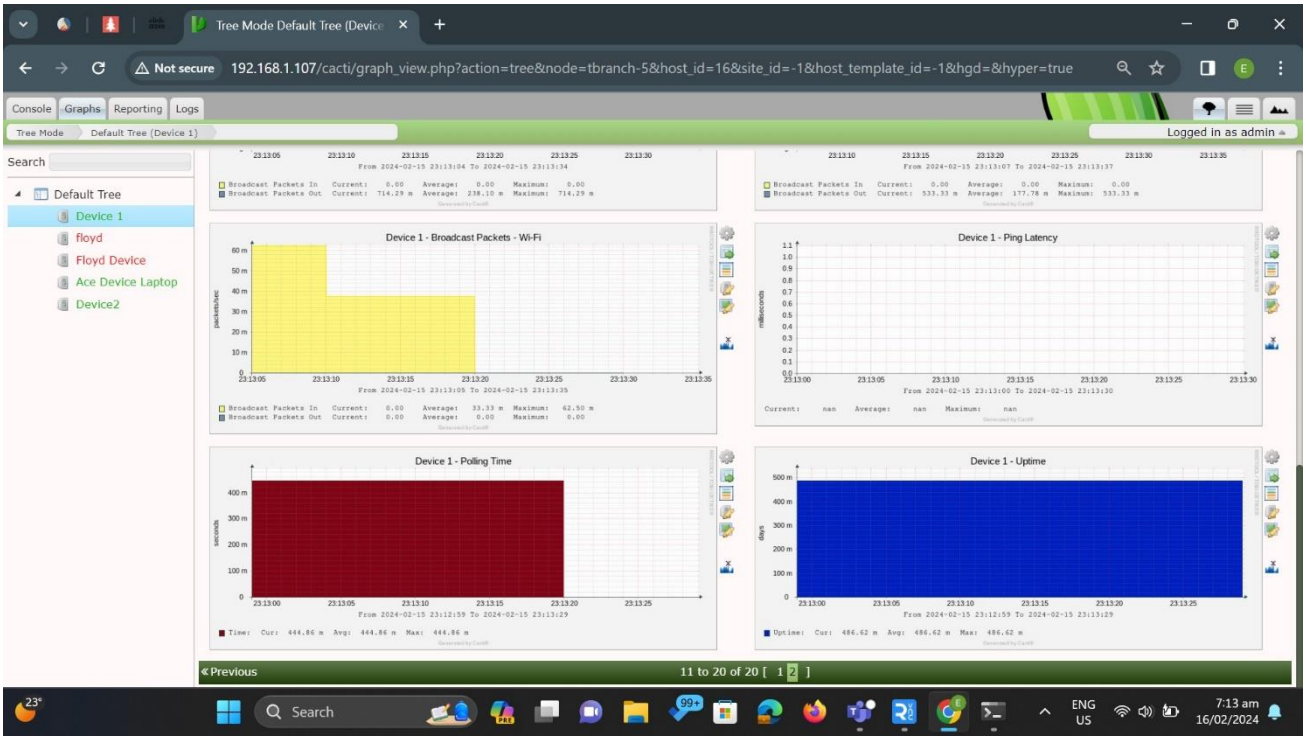

Figure 3-32: Network Monitoring of Device1

SUMMARY / CONCLUSION

In conclusion, leveraging Raspberry Pi for network monitoring offers a cost-effective and versatile solution. By utilizing the compact size and low power consumption of the Raspberry Pi, organizations can deploy monitoring nodes throughout their network infrastructure with ease. This enables real-time monitoring of network performance, traffic analysis, and security surveillance without the need for expensive dedicated hardware.

Furthermore, the flexibility of Raspberry Pi allows for customization and scalability to meet specific monitoring requirements. Whether it's monitoring small-scale local networks or larger enterprise environments, Raspberry Pi-based solutions can be tailored to suit the needs of various organizations. With the abundance of open-source monitoring software available for the Raspberry Pi platform, users have the freedom to choose and configure tools according to their preferences, ensuring efficient network management and optimization.

REFERENCES

NetVN82. (2020, September). How to network monitor using Raspberry PI | Cacti | NETVN. Retrieved November 21, 2023, from https://www.youtube.com/watch?v=zGS38_VTppg

For your additional References that has been used please use the citation tools on the website https://www.scribbr.com/ using APA 7th Edition English, and paste it below.