Empirical Study on Network Configuration Using MicroTik & Cambium of Daffodil Online Ltd (DOL).

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This Report Presented in Partial Fulfillment of the Requirements of the Degree of Bachelor of Science in Electronics and Telecommunication Engineering

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APPROVAL

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DECLARATION

We hereby declare that this project is our own work and effort under the supervision of **Engr. Md. Zahirul Islam, Assistant Professor, Department of Electronics and Telecommunication Engineering, Faculty of Engineering,** Daffodil International University, Dhaka. It has not been submitted anywhere for any award. Where other sources of information have been used, they have been acknowledged.

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ABSTRACT

Network configuration and management is one the key term of now-a-days. In our daily me network connectivity become one of the next basic need of human life. A nationalwide internet service provider (ISP) generally provides network connectivity to the home user. This network connectivity is been managed by a special device named router. In this empirical report two types of router namely MicroTik and Cambium has been studied. Daffodil Online Ltd. (DOL) is one of the pioneer ISP is Bangladesh. In this report the network configuration and management of Daffodil Online using MicroTik and Cambium is been studied and sketch accordingly in order to optimize the network.

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CHAPTER 1
Introduction

1.1 Introduction

Information Technology is working at this time. Many people now use internet technology around the world. Internship is an old practice for students to appreciate the true work, environment and employment challenges. I believe it is time to get a deep look at method of development, working models, deals and industrial behavior. I got the chance to work in Network Operation Center (NOC) and configure a MicroTik router & Cambium network at Daffodil Online Limited. Health Science, Engineering and Accounting these divisions have their own significance as internships prior to graduation. Each enterprise and business today could be closely connected to internet technology and software communication. This is called E-Commerce. The Domain Name System (DNS) is one of the pillars of the Internet, yet most people outside the network probably don't know they're using it every day to do their jobs, check their emails or waste time on their smartphones. I wanted to know about computer network and how it works, how to develop a large-scale network, how to build a profitable network, and how to develop an affordable network and how to reduce network downtimes.

1.2 Motivation

Motivation is a huge power for every man. If you have a low motivational capacity, you're not good in your life. I am currently Electronics and Telecommunication Engineering at Daffodil International University. I understand the importance of collecting practical information that complements learning in textbooks and helps students gain a broader view of the subject. I find that I am completely experienced in the detail of MicroTik & Cambium Networks during the internship. If I know the full environment of a network system & MicroTik, Cambium Network configuration I must be adjust with the system. I have a great time as an internet service provider to serve others, to understand their needs and to offer better service. My ability to read, access and act quickly and intelligently in general remains.

1.3 Internship Objectives

The ultimate goal of my internship program is to train in a competitive job market as a qualified person. So this is very useful in skills development. To make me a competent person, I would like to collect some outstanding qualities. Internship in the applied science is intended to provide work knowledge to the ISP, while the student area is still learning to combine work expertise with educational coaching and to assist the student in the transition from a room to a job. Self-motivated and self-directed to the desire to work.

1.4 Introduction to the Company

Daffodil Online Ltd. is one of the leading national Internet Service Providers (ISP) in Bangladesh. They are the oldest ICT company and more industry-focused, with the customer service as the basis of business principle for a long-term relationship. Since our inception, as we look at the growth over the decade, they are extremely proud of what they have achieved, and even more excited about their prospects for an equally promising future. You may be glad to know that in 2002 they started. Daffodil Online has also created a combination of dedicated IT professionals and a sincere workforce that is a key secret to achieving client satisfaction in corporate standard IT solutions and qualified IT education and training for scholars. They have worked and achieved a reputation in a number of national and international projects. They use the latest technology and equipment and are required to upgrade the service. They have a server and network solution department that provides a highly qualified group of technical experts to provide services and telecommunications solutions.

1.5 Report Layout

In the First Chapter - I described the purpose of internship, internship motivation and company introduction.

In the Second Chapter - I defined my internship approach. And this chapter provides information on the location of the internship in this program. It also discusses how the internships have been performed, what the company, the IT Services provided by DOL and the roles on the networking job market.

In the Third Chapter - I've been describing network design, cabling & network device, common optical fiber connectors, switch, network media converter, router, server.

In the Fourth Chapter - I have described router board, router os, router features, CCR1036-8G-2S+,webfig,connecting to router, static configuration, DHCP configuration, VLAN configuration, bridge configuration, ISP setup with PPPoE Configuration, bandwidth manage in MicroTik.

In the Fifth Chapter - I have described Wi-Fi organizations, Wi-Fi – IEEE standards, channels in 2.4GHz & 5GHz bands, modulation, Cambium cloud-access point portfolio, benefits, home page, wireless configuration, hierarchical navigation, system dashboard, AP dashboard, inventory, alarm page.

In the Sixth Chapter - I've described the Conclusion & the Future Scope. I'm talking about future networking sector scopes and I'm writing a conclusion.

CHAPTER 2
Internship Enterprise

2.1 About the Company

Daffodil Online Limited started the inception in 2002, it has been rendering itself for continuous improvement with update technology. Daffodil online has also made a blend of dedicated IT professionals and sincere workforce which is the significant secretes of attaining client's satisfaction in corporate standard IT solutions and qualified IT education & training to the scholars. They use the latest technology and device and upgrade the service required for them.

Daffodil Online Ltd. is a self-conceit as one of the outstanding national wide Internet Service Provider (ISP) in Bangladesh. They are the oldest company in the ICT field and more experienced for the service, where they are basic business principle is customer's service for long term relationship. Daffodil Online is too much potential administration and engineering team certified and connected with Cisco, Google, Microsoft, MicroTik, Juniper, Red Hat, Oracle etc. DOL activity connected with the world big computing associations with ACM, ACS, PMI, BCS and IEEE. A group concernment as DOL promotes three primary platforms, for example: education, environment, provide training program and services. [1]

2.2 Product and Market Situation

Daffodil Online Ltd. is one of the nation's leading ISPs in Bangladesh. They are the longest-term and most successful ICT firm with long-term customer relationships as the core business ethics. Looking at growth over the past decade, they are extremely satisfied with our achievements and are even more excited about our prospects for an equally promising future. Daffodil Online Ltd also offers a variety of IT and training facilities.

2.2.1 IT Services

- Corporate Internet Services
- Corporate Network Design and Solution
- Create Wi-Fi Zone and Insure Smooth Services
- Security and Threats solution.
- Domain registration and website hosting.

- Website design, development and maintenance.
- Service provider for national internet.
- Co-Location service and Date connectivity provide.
- SMS service in bulk.
- Mail Server, DNS Server facility.
- Other IT related service and support.

2.2.2 Professional Training Services

- Administrator and ISP Setup using MicroTik and Linux.
- MicroTik Certified Network Associate (MTCNA)
- Website development and hosting.
- Red Hat Certified Engineer(RHCE)
- Cambium Networks (CnPilot)
- Cisco Certified Network Associate(CCNA)
- VMware Certified Associate(VCA)
- Red Hat Certified System Administrator(RHCSA)

2.3 Target Group

All consumers and all small and medium-sized firms, including start-ups, are part of the company's customer base. The company plans to concentrate on SOHO customers, as these are the best targets for our new high-speed products and have the greatest growth potential for the company. Web Solutions assumes that these market segments have unique pricing and services requirements and are making consumers more committed and efficient.

2.4 SWOT Analysis

SWOT analyzes are a necessary skill for knowing your potential and your anxiety, so that both the opportunity is available and your face intimidated.

2.4.1 Strengths

- All customers communicate separately from each other via distance. (with at home or the workplace)
- Works with warmth from home support.
- Collecting information. (the asset of the business)
- Online business setup & service provide.

2.4.2 Weaknesses

- Large amount of money required for up gradation business.
- Competitive market for many resellers.
- More pricing tax and service options.
- Sometime service problem face our company.

2.4.3 Opportunities

- Our company use to take up new technologies.
- Free training for professional course.
- Our company is IT skill developing.

2.4.4 Threats

- Some client is leaving the service.
- Sometime fail the system any occurrence.
- Security threats is a big issues in the system.

CHAPTER 3
COMPUTER NETWORK & NETWORKING DEVICES

A collection of PCs and gadgets, such as printers and scanners, linked to an interchange interface, empowers each of the gadgets to connect to each other. Systems may be small or large, linked by wires or cables, via telephone lines or remote communications, for all time. The Web is the biggest system, the overall system collection. In PCs, the organization is an act in which at least two processing devices are connected to share information. A mixture of PC equipment and PC programming is available for processes. In a few different ways, systems can be ordered. The system form is specified as the geographical area in which it operates by one method. Neighborhoods (LANs), for example, reaching regularly across a lonely home, WAN systems reach urban, national or even world-wide communities. The Web is the world largest open WAN.

3.1 Network Design

Network architecture is the preparation process before implementing the IT infrastructure of a client. This includes assessing and understanding how all of the network's components (from routers, switches and servers to desktops, laptops and printers) are connected together and how they can run efficiently. The network will be well designed to enhance operational efficiency. Network construction is usually a role played by network managers, IT managers and other employees.

3.2 Cabling and Network Devices

For LAN / WAN communication many cables and connectors are used. Cables: cable for STP, UTP and optical fiber.

Connectors: FC, RJ-45, ST, SC, LC.

3.3.1 Unshielded Twisted Pair

In the computer and telecommunications industries, Unshielded Twisted Pair (UTP) cables are commonly used as Ethernet cables and telephone wires. The UTP cable is twisted around the conductive system forming one circuit in order to prevent electromagnetic interference (EMI) from eternal sources. Unshielded means no additional protection, such as aluminum foil or mesh, is used to add weight. UTP cables are often grouped with color-coded insulators, the number of which depends on the purpose of the unit.

3.3.2 Shielded twisted pair

Shielded twisted pair are a particular type of copper cable network used in certain business installations. The normal twisted pair of telephone wires has an outer covering or shield; the Shield works as a ground. The Twisted Pair is the ordinary copper wire connecting the telephone company with home and many business computers. Two isolated copper wires are twisted around each other in order to reduce crosstalk or electromagnetic induction between pairs of wire. The two wires are required for each signal on a twisted pair. Because certain telephone sets or desktop locations need many links, sometimes the twisted pair is mounted in two or more pairs. [2]

3.4 UTP Connector

Registered jack-45 (RJ45) refers to the protocol for cable termination that specifies male and female physical connections and the pin assignment of wires and other communication networks of RJ45 cables. Registered jack-45 (RJ45) is a 8-wire connector used in local area network connections. Used as a standard telephone alone, it was used for modems of high speed and other computer networks from then on. A jack-11 recorded (RJ-11) is a six-position, 2-driver phone jack (6P2C) with 4 unused positions. The RJ-11 is widely used for connecting the telephone device to the base unit and the entire telephone to the wall.

Figure 3.1: RJ-45

3.5 Fiber Optic Cable

An optical fiber cable is a cable type with a number of optical fibers which are normally joined together in their individual plastic protective coverings. Optical cables are used for transmitting digital data signals in lights over hundreds of miles at a rate higher than that obtained by electric communications cables. All optic fibers use a hairy transparent silicone core, which is covered by less refractive indexing cover, to prevent light leakage to the environments. A lightweight, high-strength protective material like

Kevlar usually is used because of the very high sensitivity of the optical fiber. Optical fiber cables are widely used.

Two common types of fiber optics are:

- Single-mode fiber (SMF)
- Multi-mode fiber (MMF)

3.5.1 Single-mode fiber

Single-mode fiber is a common type of long distance communication optical fiber. The other is a multimode wire, one is one of two forms of optical fiber. A single fiber is a continuous fiber network for transferring a single mode or light wave. Fiber in single mode has only one communication mode. It has higher bandwidths compared with multi-mode fiber; however, a light source with a narrower spectral range is needed.

3.5.2 Multi-mode fiber

Multimode fiber is a fiber type designed to transport multiple light rays or modes simultaneously with an angle of reflection which is marginally different within the optical fiber core. Multi-mode fiber is used mainly for propagation over shorter distances, because the modes are more likely to spread over longer distances. This effect is called modal dispersion. Single-mode fiber is another popular optical fiber type. Multi-mode networking is also known as optical fiber multi-mode.

3.6 Common Optical Fiber Connectors

3.6.1 SC Fiber Optic Connector

SC is also called a square connector, a subscriber connector. It has been developed by Nippon Telegraph and Telephone. SC's production costs also fallen with ever-increasing popularity on the markets. The SC is a 2.5 mm ferrule snap diameter connector (push-pull coupling) working according to IEC 61754-4 standard. The SC network is now in growing use for single-mode fiber optic cable.

Figure 3.2: SC Fiber Optic Connector

3.6.2 LC Fiber Optic Connector

LC shows the lucent connection. It is a compact push-pull form factor connector that uses a ferrule of 1.25 mm and half the size of the SC. LC is ideal with the combination of small size and latching features for medium density connections, SFP and SFP+ transceivers and XFP transceivers.

Figure 3.3: LC Fiber Optic Connector

3.6.3 FC Fiber Optic Connector

FC is short for Ferrule Connector. FC is used for optical and optical fiber single mode that requires polarization. The FC is the first fiber optic connector to utilize ceramic ferrules, a 2.5 mm ferrule screw connector. However, FC is less common and is mainly replaced with SC and LC because of its loosening vibration and insertion loss.

Figure 3.4: FC Fiber Optic Connector

3.6.4 ST Fiber Optic Connector

ST is a direct tip. Shortly after the FC launch, AT&T created the ST connector. ST Connections are one of the most frequently deployed optical fiber connections in network applications. All short distance and long-line systems are used by ST Connectors. Two versions of the ST connectors are available: ST and ST-II. These are both keyed and spring-loaded. They're push-in and twist types.

Figure 3.5: ST Fiber Optic Connector

3.7 Switch

A switch is a high-speed system for networking, which receives incoming data packets and redirected them to a LAN destination. A LAN switch runs on the OSI Model's data link layer (Layer 2) or network layer and can accept all sorts of packet protocols as such. In essence, switches are a simple local area network's traffic cops. Switches are like hubs, but more intelligent. A hub mainly links all nodes in network communication to any computer trying to communicate at all times, leading to multiple collisions. On the other hand, a switch generates an electronic tunnel for a second division between the source and destination ports which no other traffic can reach. The switches are similar to routers, but the router can move the packet to different networks, while the switch is contained on the same network on a node-to-node communication basis.

Figure 3.6 : Cisco Switch

3.7.1 Managed switches

Managed and non-managed switches differ greatly from control. The Managed Switch allows to configure and track the network by changing each port on the switch to any configuration need. It also provides greater control over how and who has access to the data via the network. Managed switches generally provide a Simple Network administration Protocol to monitor switch status and individual switch ports and provide statistics like traffic flow and network errors and port state.

3.7.2 Unmanaged switches

Unmanaged switches use ports to decide whether or not to use half-duplex or full-duplex mode parameters such as data rate. Similarly, there is no VLAN (Virtual LAN) definition in unmanaged switch systems. Therefore, both tools are part of the same broadcast domain. Nonetheless, unmanaged switches retain a Media Access Control

(MAC) address list. This table keeps track of dynamically learned MAC addresses and the corresponding switch port on which the MAC address was located. Including a MAC address table ensures that unmanaged switches provide a different, per-port collision domain. This is a key differentiator between an uncontrolled Ethernet switch and an Ethernet node.

3.8 Network Media Converter

A media converter is an efficient and flexible device designed for the implementation and optimization of fiber connectors in any kind of network, in the form of network hardware. A transceiver which converts the electrical signal used in copper unshielded twisted pair (UTP) network cabling to light waves used for fiber optic cabling is the most widely used type of media converter. Fiber optic communication is important if the distance between the two network devices is greater than the copper cable's transmission distance. Using a media converter to convert copper to fiber, two network devices with copper ports can be connected over long distances using a fiber optic cable.

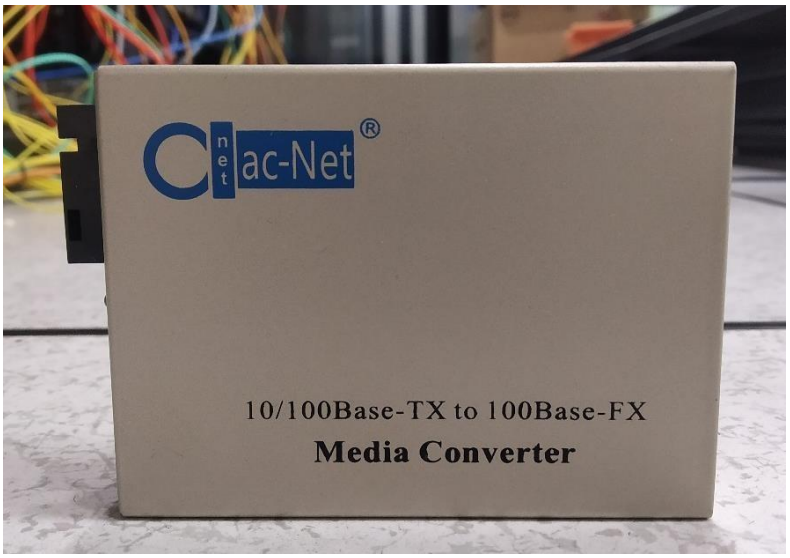


Figure 3.7: Media Converter

3.9 Router

Router is an OSI reference model system network layer (layer 3), meaning multiple computer networks can be connected via wired or wireless connections. Network router can receive, analyze, perform traffic management functions and pass data packets to their destination node from one network. The router is a device that processes the packet routing information to forward packets between networks. To connect two or more

logically separate networks, routers use a logical and physical address. We do this by separating a large network into segments of logical networks or subnetworks. Each of these subnetworks has a logical address. It allows networks to be independent but still have access to each other. Data is distributed in packets or blocks of data each packet has a logical network address in addition to having a physical network address. Network router with tools to help determine the best path for a given transmission from the available paths. They consist of a combination of software and hardware. The router contains the CPU, the digital memory, and the I/O interface, using the network path to transfer data packets. Routers that represent the direction of the network to many networks, for example. Electronic networks, telephone networks & networks transport. Routers can run either a control plane or a forwarding plane in two ways. The router sends accurate data packets to its specific location in a control plane. On the other hand, the plane router routing does not remember sending or receiving packet information.

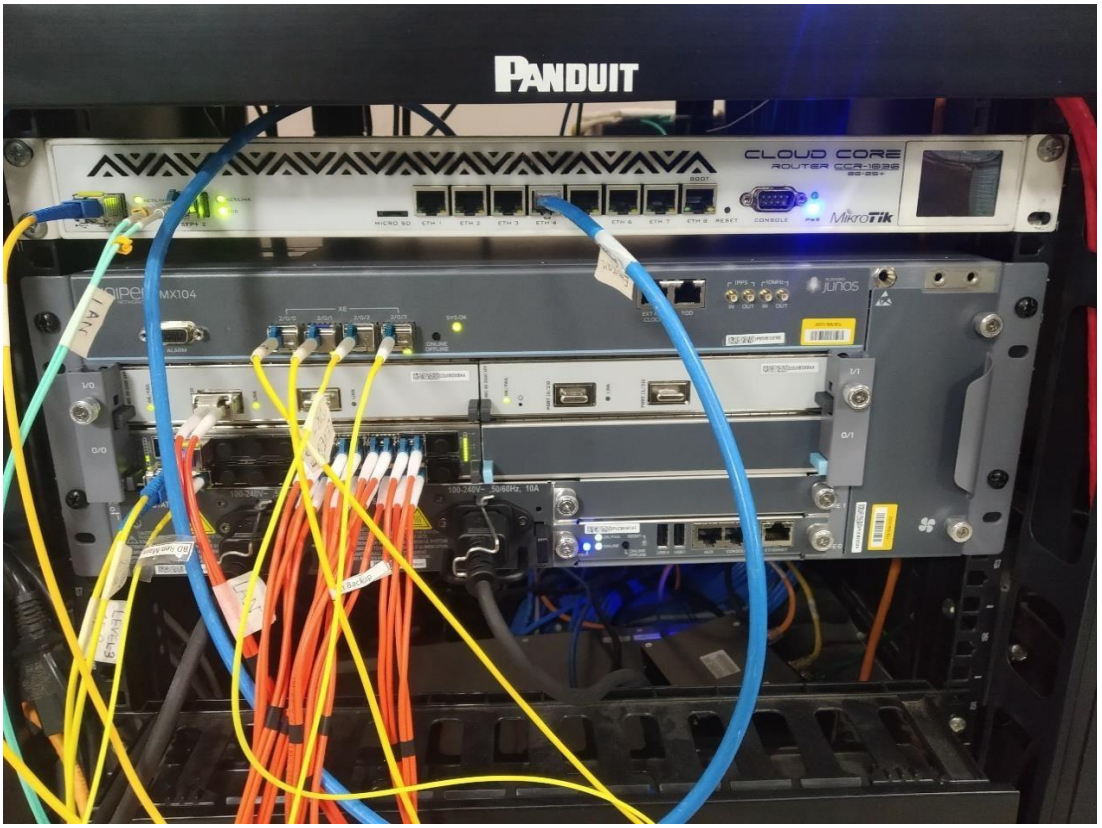


Figure 3.8: MicroTik & Juniper Router

3.10 Server

The server is a network resource management computer, system or software. Servers are often called dedicated because they do little more than their server functions. A

variety of servers are available such as print servers, file servers, network servers and database servers. By definition, computers are called servers because they share resources with client machines. Nearly every personal computer can be used as a network server. Nevertheless, machines dedicated to the software/hardware device typically have features and settings for that task only. For example, high-performance Ram, faster processors and several high-capacity hard disks may be present on dedicated servers. Dedicated servers are also able to be linked by multiple networks, other servers and redundant power supplies. The features and configurations of this communication are important as many client machines and programs rely on them to work efficiently, correctly and reliably. The ability to update software without restarting or rebooting.

- Improved storage capacity to back-up sensitive data frequently.
- Progressive networking efficiency.
- Automatic transmission of data between devices.
- High resource memory and data protection.

Server machines often have multiple operating systems not normally found on individual computers. Many operating systems have identical interfaces and are available in both server and customer versions. However, the difference between the client / server operating system was blurred by improving the reliability of both computer hardware and operating systems.

Figure 3.9: DNS Server

CHAPTER 4

Network Administration with MicroTik

MicroTik was founded in 1996 in Latvia to develop wireless ISP systems and router systems. In most countries around the world, MicroTik is now offering internet hardware and software. In 1997 we developed the Router OS software system with our industry experience in the use of standard PC hardware and complete routing systems, providing a comprehensive reliability, control and flexibility of all data and routing interfaces.

4.1 Router Board

Router Board is a MicroTik hardware platform, a line of routers running Router OS. Numerous solutions for the router board provide a variety of device scenarios, from wireless connections and managed network switches to quality of service devices (QoS). Ethernet (PoE) can essentially operate all router board models with an external power sources connector. Wireless models have a mini PCI / mini PCIe slot for radio modules, and most models also have a serial port control connector.

4.2 Router OS

Router OS is a network operating system based on Linux for the deployment of board routers in MicroTik Router. The system can be used on a wireless access system as a captive portal. The Router OS can be configured via a serial port, a telnet, a Secure Shell (SSH), a web interface (WebFig) or a software application (WinBox) providing a Graphical User interface. The API enables the development of specialized monitoring and management applications. The OS is distributed free of charge, but with an expanded number of functions, many license rates are available to purchase.

4.3 Router Features

Router OS supports many Internet service provider applications. For example

- It can be used like a router
- Offers OSPF, BGP, Multiprotocol Label Switching, Open Flow, et c.
- Can be used as a bridge or switch.
- implement PPPoE Client-Server
- Delivers VPN-Virtual Network Private.
- Provides rules for firewall
- Provide service to DHCP servers
- Provide the hotspot system based on Wi-Fi and captive portals

- The management of bandwidth is very easy
- Easy interface with GUI
- Simple management
- Both IPv4 and IPv6 are supported

4.4 CCR1036-8G-2S+

The fastest MicroTik router is getting even better now – the new CCR1036-8G-2S+ now has two SFP+ ports for 10 G interface support. The 36-core Tierra CPU, like other CCR1046 model, is equally efficient and can now have 10 gigabits. This system is supplied in a 1U rack mount case with a double SFP+ port, a serial console cable, eight Gigabit Ethernet port and a USB port. There are 2 SODIMM slots in the CCR1036-8G-2S+, the regular shipment is 4 GB of RAM, but there is no memory limit for router OS (the router supports and uses 16 GB or more).The EM model with 16 GB of RAM is also available now! [3]

Figure 4.1: CCR1036-8G-2S+ Router

4.5 Web Fig

Web Fig is a Router OS web-based application that enables to track, set up and fix the router. It is designed as a WinBox replacement, both with identical configurations and almost all of Router OS features are available to them.

Figure 4.2: Web Fig

WebFig can be run from the home page of the router that the IP address of the browser can be entered. Choose the webFig from the list of available icons as illustrated in the screenshot if home page is successfully loaded. After clicking on the webFig icon, you will be prompted for a login prompt. Enter and click connect in the login information.

4.6 WinBox

WinBox is a small device that enables quick and easy control of MicroTik Router OS. There are no sections of WinBox in the manual that are as close as possible to the console function to mirror all WinBox interface functions. WinBox loader from https:/www.MicroTik.com/download is available. Double-click WinBox.exe and the window loader pops up when WinBox.exe is downloaded.

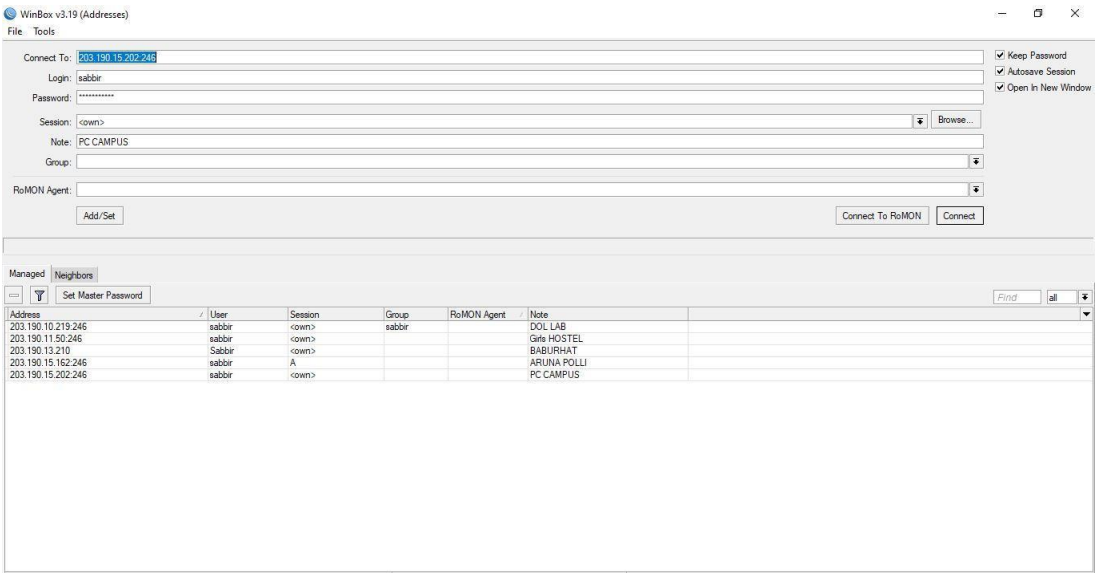


Figure 4.3: WinBox

Specify username and password (if any) and press the Connection button, to connect to the router in the IP or MAC address of the router.

4.7 Static Configuration:

Static routing requires routing decisions in the routing table, which can only be updated manually by admin. In those situations where the route choice is limited or only one default route is available, static routes are normally implemented. Static routing can also be used if you just have few route setup devices and no future route change is needed.

Step 1: WinBox open: IP > Address 192.168.0.1/24 > Interface = ether1 >

IP > Address 172.16.0.1/24 > Interface = ether4 >

Apply > OK

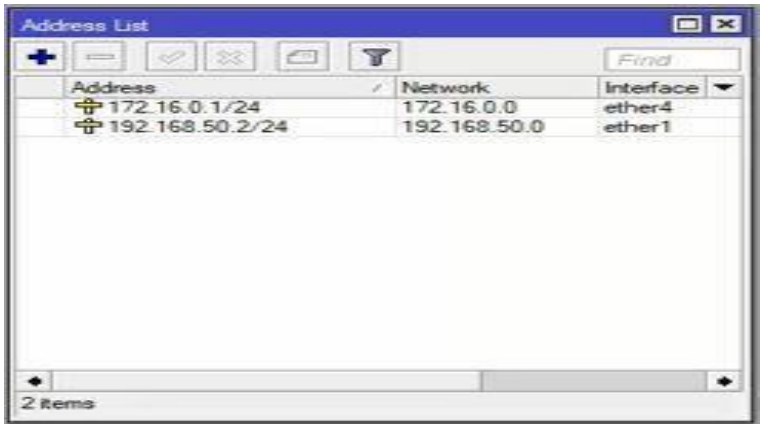


Figure 4.4: Add Network Address & select Interface

Step 2: IP > Routes > = 192.168.50.1) > Apply > OK

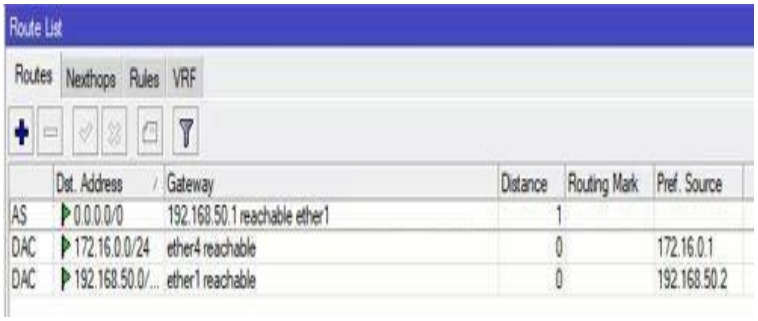


Figure 4.5: Add Route

Step 3: IP > Firewall > NAT> + action > masquerade> Apply >ok

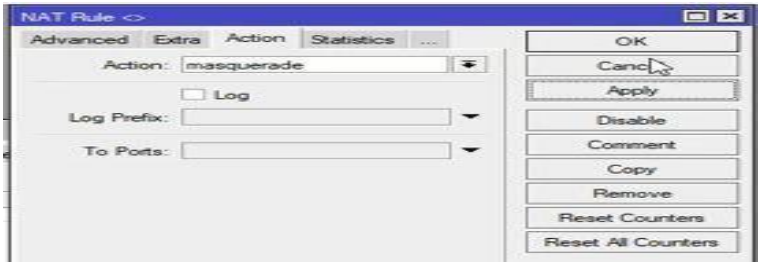


Figure 4.6: Set Firewall

Step 4 : IP > DNS > DNS Settings > servers= 203.190.10.252

= 230.190.10.253

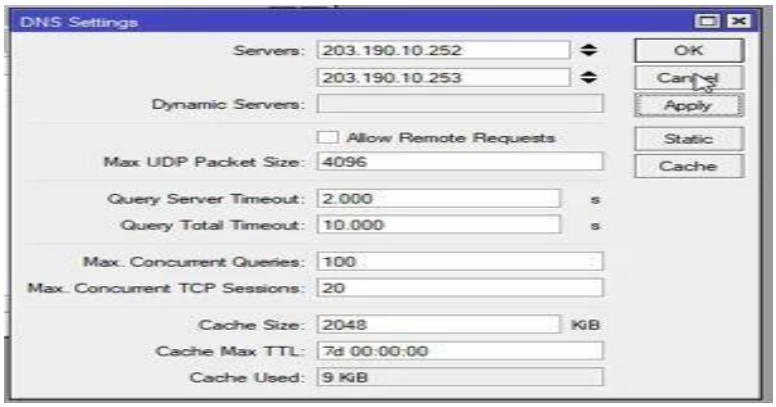


Figure 4.7: Add DNS

4.8 DHCP configuration:

DHCP is the network management protocol used to dynamically assign the IP address to any device or node on the network, to allow it to communicate via IP. The DHCP protocol is a network management protocol. On small local networks, as well as on large enterprise networks, DHCP will run.

Step 1: Go to IP > DHCP Server tab. The window of the DHCP server will appear.

Step 2: Click the DHCP Setup button and select the interface (ether2) in the DHCP Server window, then click the Next.

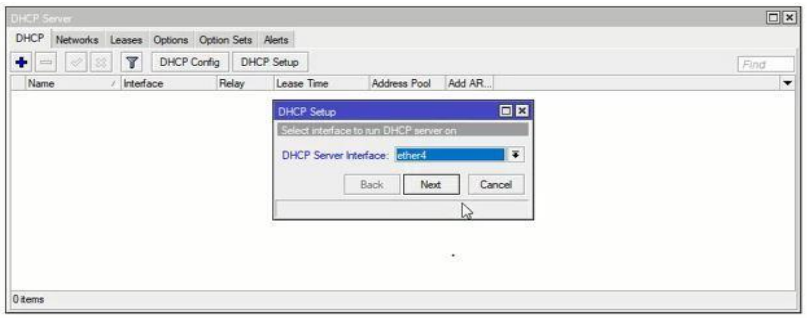


Figure 4.8: Select DHCP Server Interface

Step 3: Now, in the DHCP Address space input field, given the LAN network block (172.16.0.1), then click Next. The DHCP client / LAN user will receive the IP from this network.

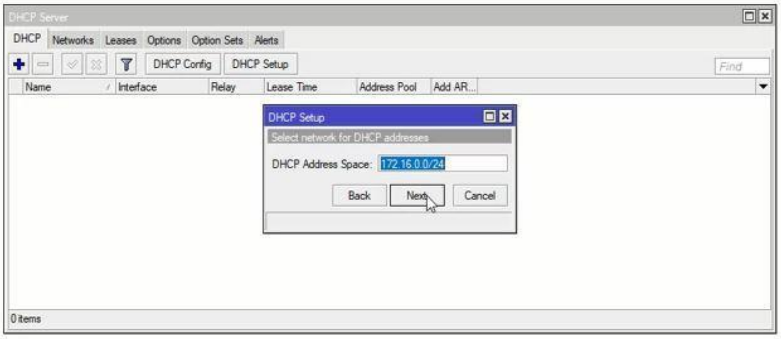


Figure 4.9: Select Network Block

Step 4: Select a gateway for the given DHCP network input box in the Gateway, then click Next.

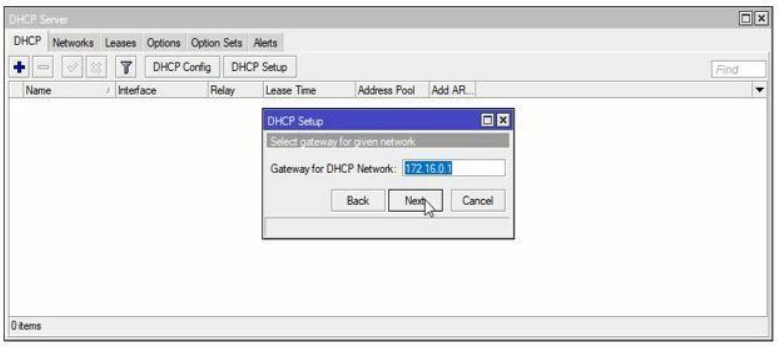
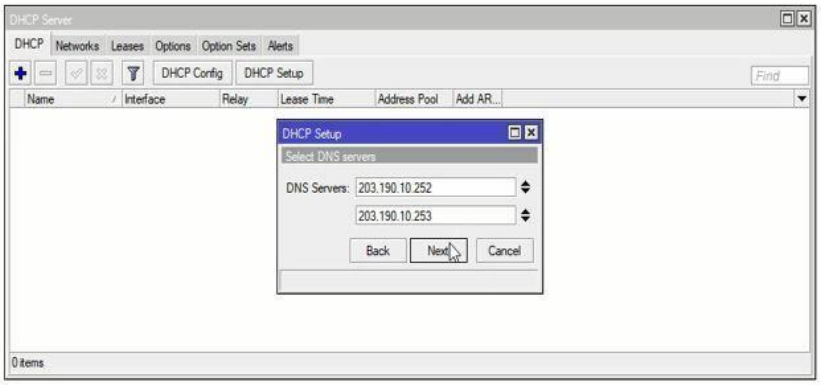


Figure 4.10: Select Gateway

Step 5: Provides the IP range from which the IP address of DHCP client / LAN user will be entered and clicks the next button.

Step 6: Give DNS server IP and click next button.



Select 4.11: Select DNS Server

Step 7: Now enter the IP lease time and click the Next button.

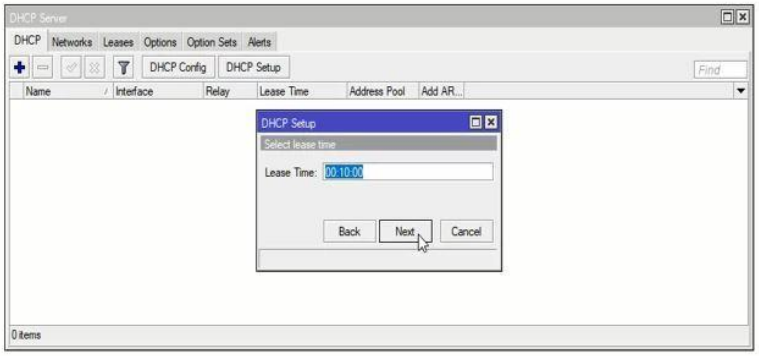


Figure 4.12: Set Lease Time

Step 8: DHCP configuration is now complete and a successful message will be displayed.

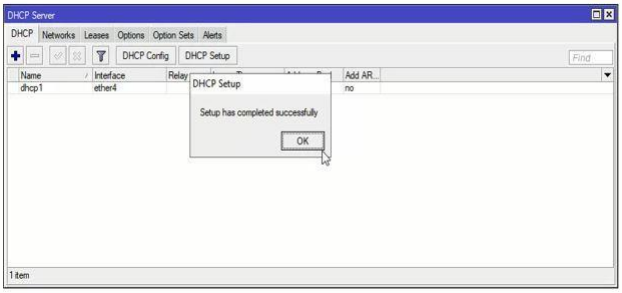


Figure 4.13: DHCP Setup complete

Now link to the network any IP device (desktop, laptop, mobile etc.). A MicroTik DHCP server IP is automatically allocated for this device. Click Leases to see the DHCP client's IP lease status.

4.9 VLAN Configuration

A VLAN is a logical group of workstations, servers and network devices which, despite the local distribution, appear to be on the same LAN.VLAN is a logical topology which divides a single broadcast domain into several broadcast domains. VLAN is a layer 2 method. So, a manageable switch is required to manage VLAN in network and a router is required to route and control inter-VLAN. VLAN increases the security and stability of the network as well as IT capacity.

Step 1: Interfaces > VLAN

N.B: click + icon and open the dialog box set name, select interface and input VLAN id. VLAN Range 1 to 4094 limit.

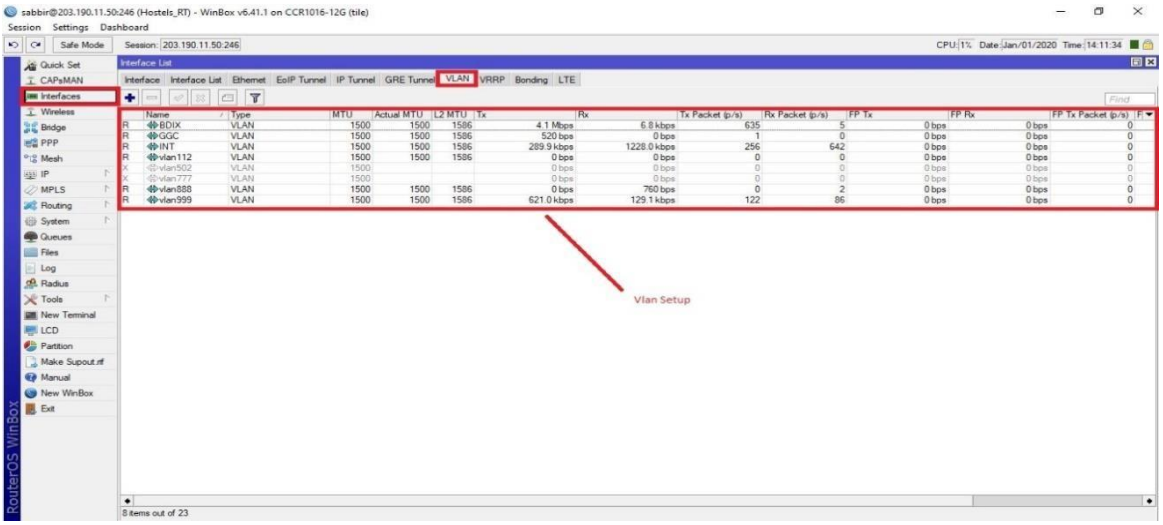


Figure 4.14: Set the multiple VLAN id same interface and different interface.

Step 2: Set name (VLAN999) in Name input box .Set VLAN ID (999) in VLAN ID input box and choose physical interface (ether10-Girls.Then click on Apply and OK button.

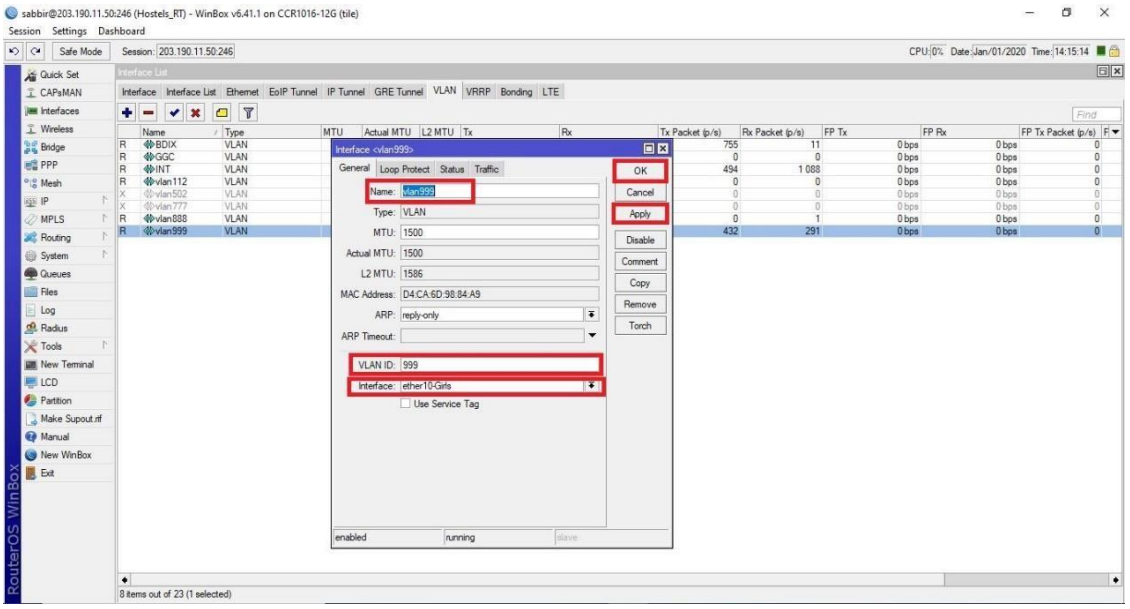


Figure 4.15: Set Name , VLAN ID & choose Interface

4.10 Bridge configuration

In the logical interface MicroTik Bridge integrates multiple physical interfaces. MicroTik Bridge turns layer 3 ports into layer 2 ports and connects them to a logical port layer 3. So, in the same broadcast domain, all bridge ports as well as the logical

layer 3 port are kept. Now, any service such as PPPoE or DHCP can be accessed from any bridged MicroTik port.

Step 1: From the left menu bar, click on the Bridge menu.

Figure 4.16: Select Bridge

Step 2: Click on this Bridge tab then click on (+).

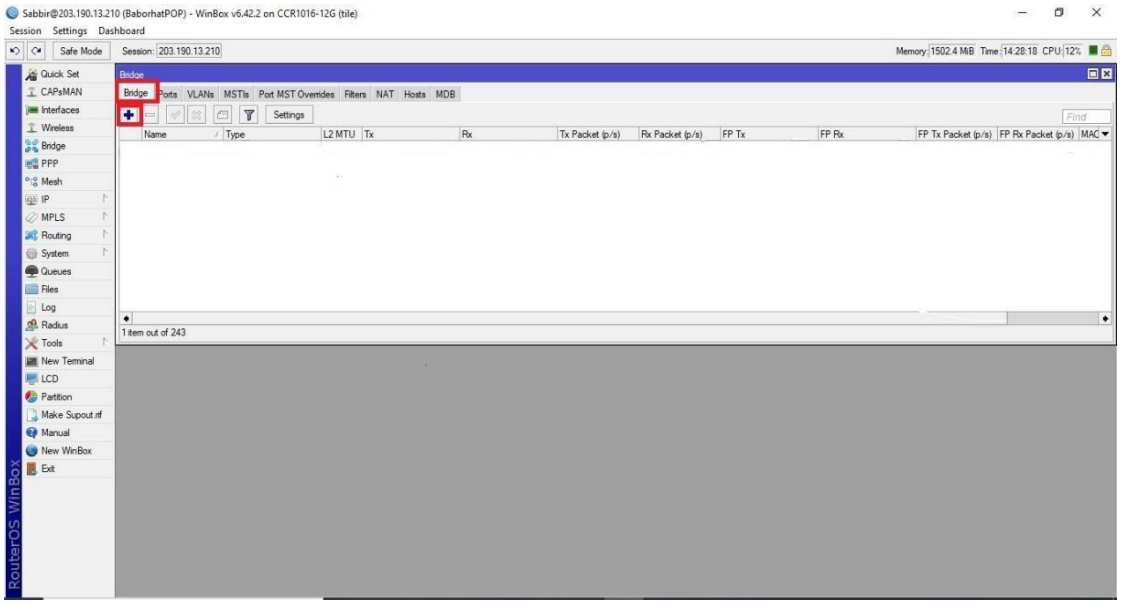


Figure 4.17: Click Bridge plus sign

Step 3: Give bridge interface name (bridge1).Click Apply and OK.

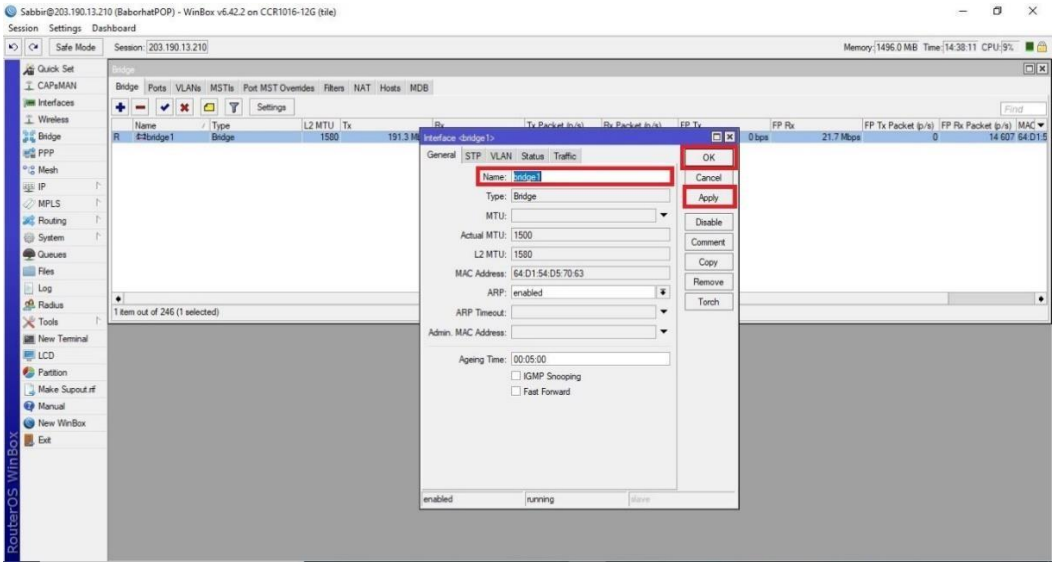


Figure 4.18: Add Bridge Name

Step 4: Now go to Ports then click on (+).

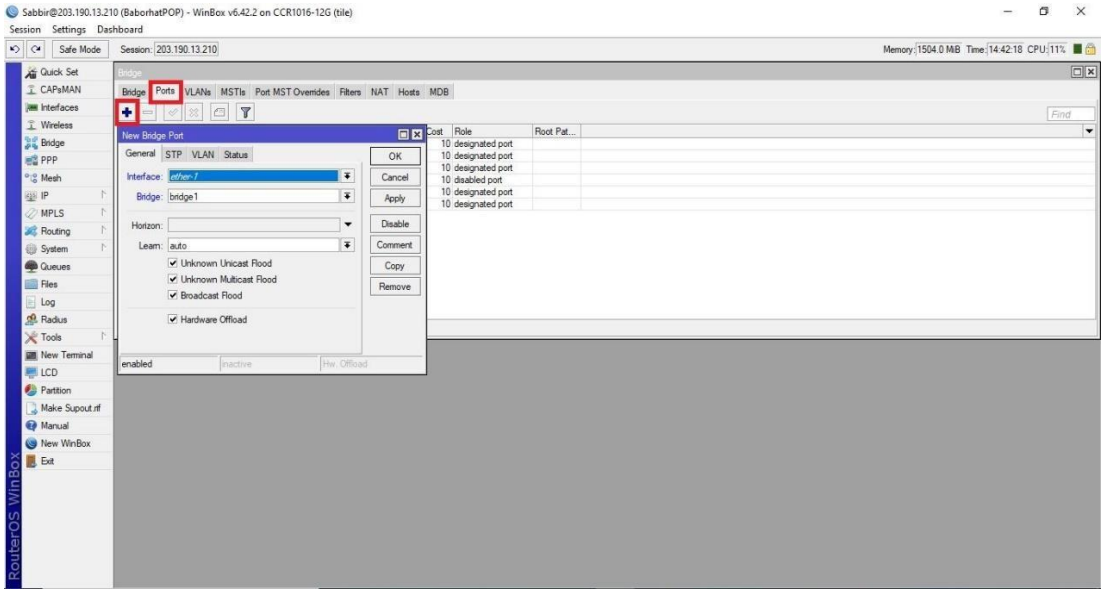


Figure 4.19: Add Port

Step 5: Choose physical interface (ether11) from dropdown menu.

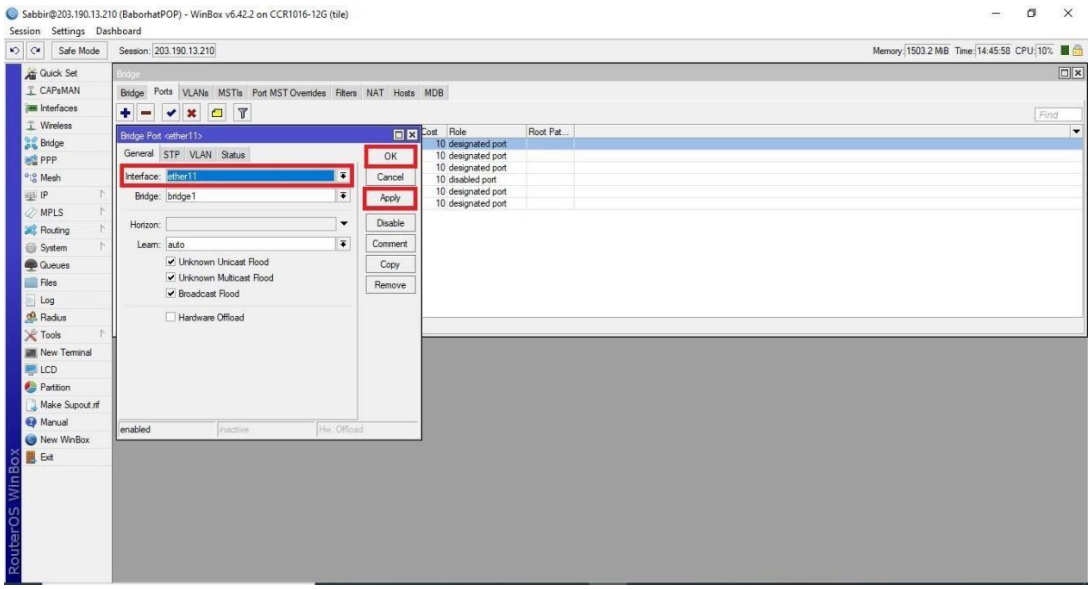


Figure 4.20: Select Interface & bridge

4.11 ISP Setup with PPPoE Configuration

PPPoE (point-to-point protocol over Ethernet) is the popular services in the MicroTik router. PPPoE is a Point-to-Point (PPP) standard extension. Point-to-point protocol over Ethernet (PPPoE) protocol refers to the method of connecting multiple devices to an Ethernet LAN (local area network) like computers, laptops, smartphones, etc. Typically used in a building or office as its main purpose, PPPoE allows users to share a typical Digital Subscriber Line (DSL), wireless connection, or even internet cable modem connection. The PPP (point-to-point protocol) in PPPoE is commonly used in dial-up connections. The main purpose of PPPoE was to manage data that was transmitted over Ethernet networks. In general, various packages are available for any ISP business depending on the bandwidth. Maintaining customer bandwidth with the MicroTik Queues service is always easier, but bandwidth with the PPPoE service can also be maintained.

Step 1: IP > Pool menu and click (+). It's going to show a new IP pool window. Place the name: PPPoE-1M and Addresses: 155.55.81.0/24 click the Apply and OK button in the IP Pool tab.

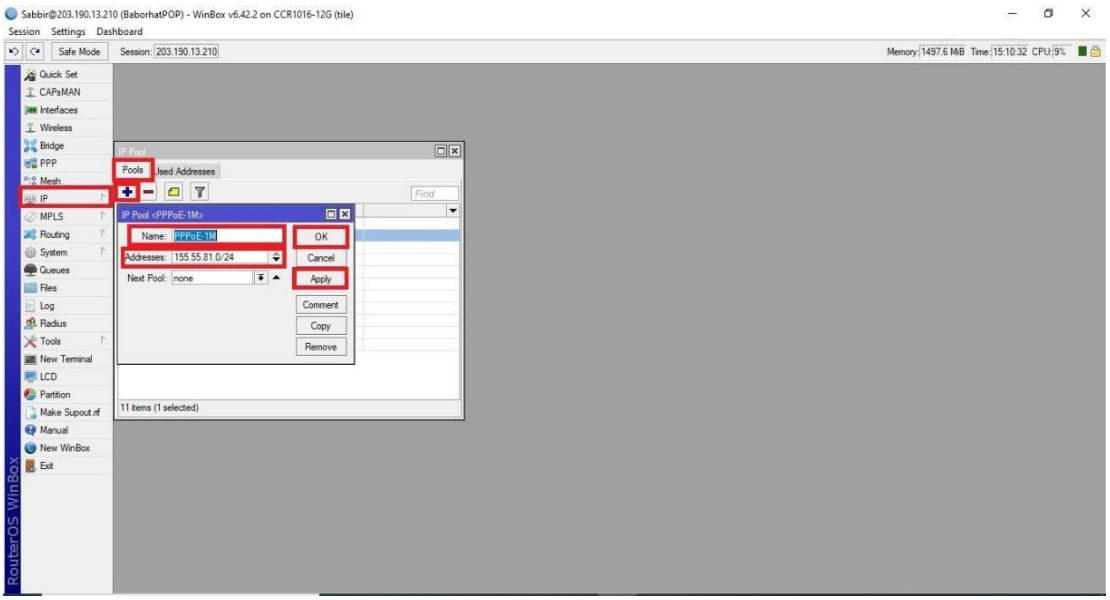


Figure 4.21: Create IP Pool

Build another two new IP pools PPPoE-2M and PPPoE-5M in the same way. The range of address will be 155.55.82.0/24 and 155.55.85.0/24 respectively.

Figure 4.22: Create 2 another IP Pool

Configuration of the IP pool has been completed. Now we'll go our next step PPPoE server configuration in MicroTik Router.

Now we're going to configure the PPPoE server in the MicroTik router.

Step 2: From the left menu, click on the PPP tab. Choose PPPoE Servers.

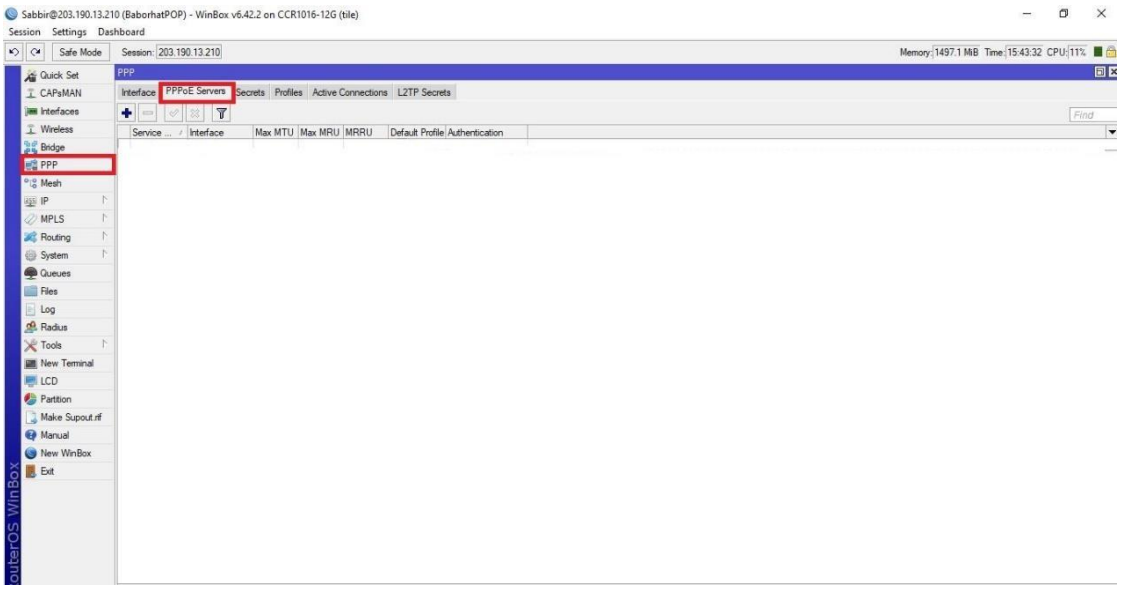


Figure 4.23: PPPoE Server

Now click the PPPoE Servers tab & Click on add new (+) button. In this window, enter the name of PPPoE server (PPPoE server) in the Service Name box. Now choose the LAN (bridge 1) interface where the PPPoE server is built from the drop down menu of Interface.

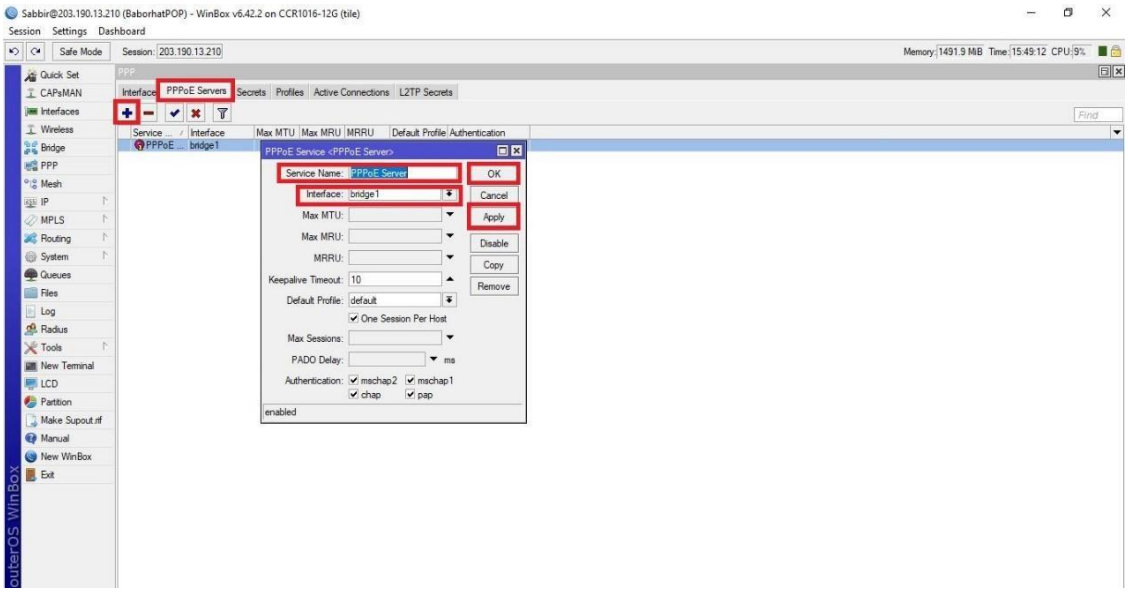


Figure 4.24: Create PPPoE Server

The PPPoE server configuration has been completed in the MicroTik router. Now we're going to create profiles from where our clients get their IP address.

We will create profiles that the clients will use to get IP addresses. Follow the steps in the MicroTik router to create a PPP profile.

Step 3: Click on the Profiles tab to open the PPP window.

Put the profile name (Profile-1 MB) in the New PPP Profile Window.

Create two more profiles for 2Mbps connection and 5Mbps connection. Put PPPoE GATEWAY in this case as a local address and select the Remote Addresses PPPoE-1 M and PPPoE-1M.

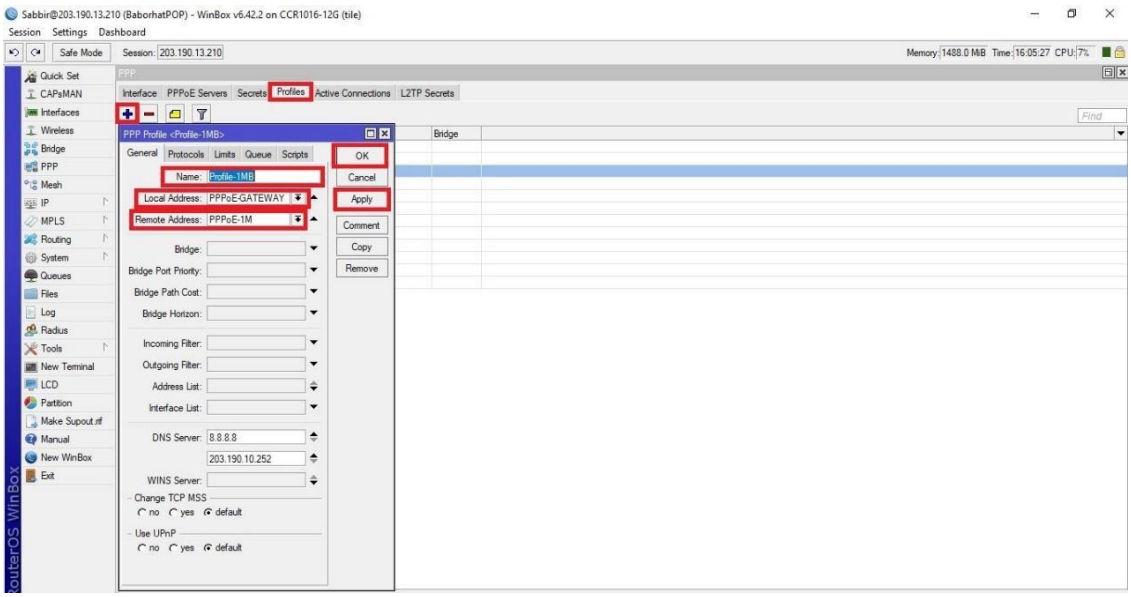


Figure 4.25 : Create PPP Profile

Configuration of the PPP profile has been completed. Now create a user secret (username and password) and connect to the PPPoE server with this secret.

Step 4: Now create the client's secret will be connected to the network.

Click PPP window and press on Secrets (+).

Put the username (alamin@dol.com) and put password (alamin321).

Now choose Service (pppoe) then choose profile (Profile-1MB).

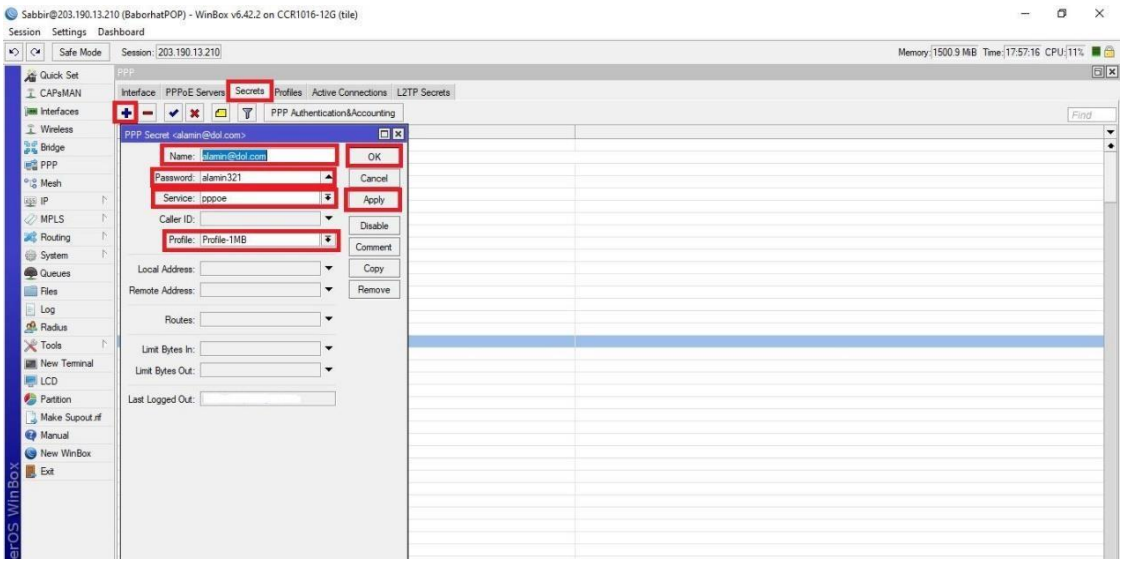


Figure 4.26: Create Secrets

Configuration of PPP secret has been completed. All steps have been completed to set up a PPPoE service in the MicroTik router.

4.12 Bandwidth Manage in MicroTik

Bandwidth describes the overall data transfer capability of a network or internet connection. It measures how much data can be sent over a particular link in a given amount of time.

Bandwidth management is the process by which traffic on a network connection is measured and controlled.it Measured in bit per second (bps) .One of the most popular MicroTik Router services is bandwidth management. It Manage fair share of bandwidth for customers. MicroTik routers now use Most of them offices to handle their user bandwidth, MicroTik router is so beneficial for better bandwidth management.

Process: Queues > simple Queues.

Quality of Service (QoS) means the router will monitor network traffic and shape it. Simple queues are the simplest way to reduce the data rate for specific IP addresses and/or subnets. Can set limit, prioritize, idle and busy bandwidth usage, and more. Given name & Target also type upload and download speed.

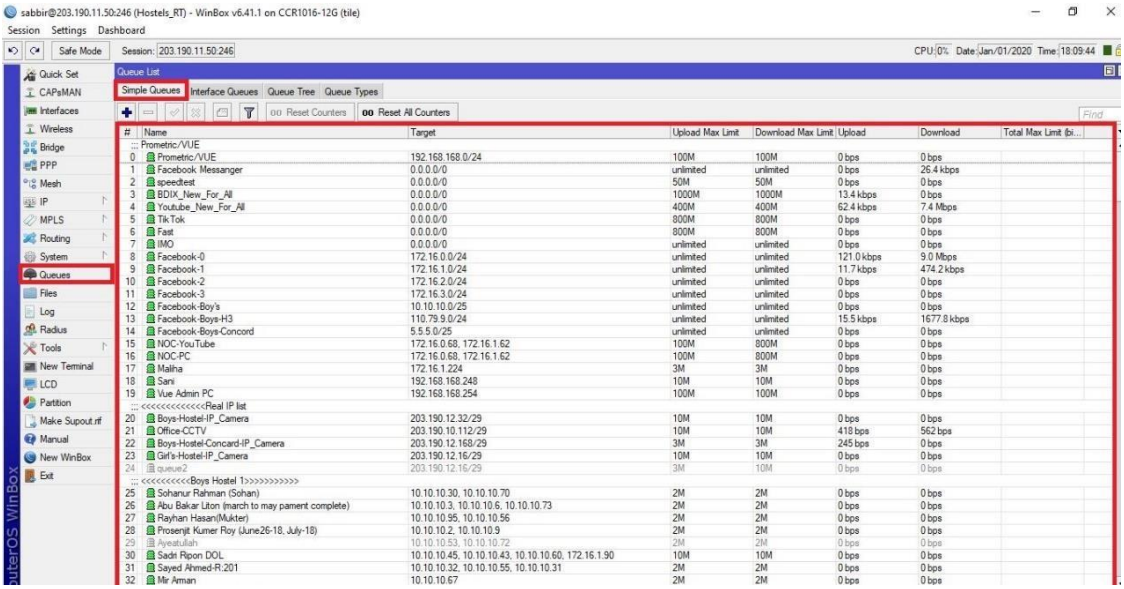


Figure 4.27: Limit the bandwidth in queues.

Chapter 5

Wi-Fi Fundamentals & Cambium Networks Configuration

5.1 Wi-Fi Organizations

Wi-Fi Alliance: The Wi-Fi Alliance global non-profit organization dedicated to the use of various wireless devices by different manufacturers and certified according to IEEE 802.11 standards. The aim of the Wi-Fi Alliance is to create a single, global standard for high-speed wireless local area networking. Around 300 companies were part of the alliance in 2011. In March 2000 the organization launched the Wi-Fi CERTIFIED program.. It provides a well-known mark of quality and interoperability, guaranteeing the highest quality and user experience for approved Wi-Fi devices. So far, the Wi-Fi Alliance has accredited over 10,000 to encourage widespread usage of Wi-Fi products and services in the new and perched markets. [4]

Figure 5.1: Wi-Fi Alliance

The mission of the Wi-Fi Alliance is:

- Growth of the Wi-Fi industry in different market segments and geographies
- Develop market-friendly programs
- Support to industry standards and specifications
- Optimum user experience with certification products enabled by Wi-Fi

The Wi-Fi Alliance certifies interoperability standards compliant products but does not submit to the Wi-Fi Alliance any 802.11 compliant device due to certification costs. The Wi-Fi Alliance has a mark that manufacturers can use in a wireless local network system based on the IEEE 802.11 standard to use brand-certified products.

5.2 Wi-Fi - IEEE Standards

The 802.11 standard has many WLAN specifications. This identifies a wireless network over - the-air system and one base station or two wireless customers.

802.11 - Applies to wireless LANs and provides 1 or 2 Mbps of direct sequence spreading (DSSS) transmission within a 2.4 GHz band. Applies to frequency hopping spread spectrum (FHSS).

802.11a - The 802.11 extension to wireless LAN, with 5GHz band up to 54 Mbps. 802.11a uses a Multiplexing Encoding System instead of FHSS or DSSS for orthogonal divisions.

802.11b -The expansion to 802.11 is also known as 802.11 High Rate which Wi-Fi and provides 11 Mbps (with a fallback to 5.5, 2 and 1 Mbps) in the 2.4 GHz band. Only DSS uses 802.11b. In 1999, 802.11b had approved the original standard 802.11, allowing Ethernet-like wireless features.

802.11 g - Apply for short distance transmission up to 54-Mbps in 2.4 GHz bands and is used for wireless LANs.

802.11n - In incorporating multiple-input multiple-outputs (MIMO), 802.11n builds on previous 802.11 standards. More data can be obtained by multiplexing spatial systems and by increasing spatial diversity by means of coding schemes, alamouti coding. The actual speed would be 100 Mbit / s and up to 4-5 times as fast as 802.11 g (even 250 Mbit / s at the PHY level).

802.11ac—802.11ac extends to current 802.11 protocols with the protocol 802.11n in a three-stream (three-stream) configuration to provide a data rate of 433Mbps for each space medium, or 1.3Gbps for each other. The 802.11ac standard currently works in 5 GHz and supports broader channels (80MHz and 160MHz) as well as straightforward technology, with design that helps to accelerate wireless speeds. [5]

5.3 Channels in 2.4GHz and 5GHz bands

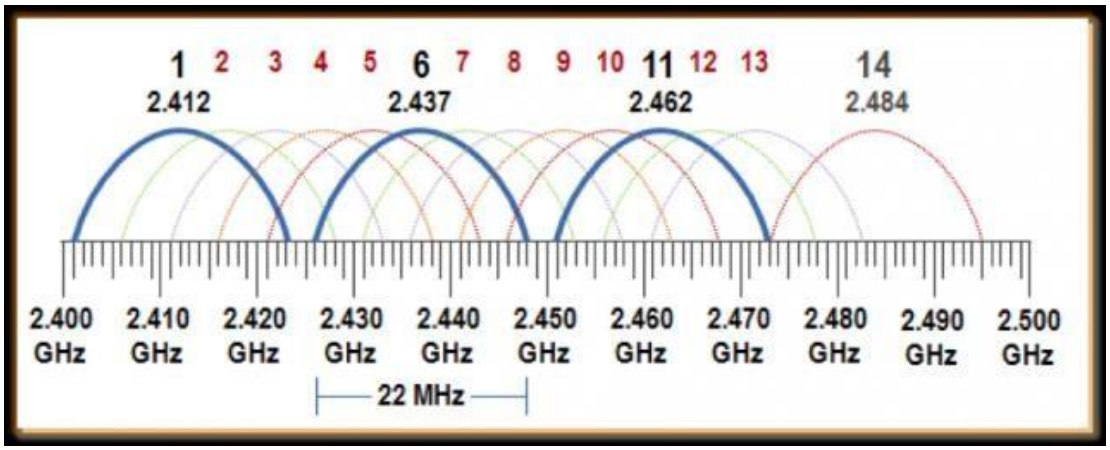


Figure 5.2: Channels range

- 14 worldwide channels (not everywhere available)
- Central frequency channels are separated by 5 MHz
- 20-22 MHz wide Wi-Fi signals

5.4 Modulation

Modulation is primarily used in telecommunications technologies involving electrical signals to transmit data. It is called the basis of data communication because electric and optical signals are used as information transmitters. Modulation can be achieved by changing the regular waveform or the carrier. The amplitude, frequency and phase are included in the process.

5.5 radio frequency behavior

- **Absorption**: This occurs when a signal is absorbed by a material as the signal travels through it. Different materials absorb RF signals to different degrees.
- **Reflection:** This occurs when a signal hits a smooth object that is larger than a wave and rebounds in a different direction. Think about pointing a torch to a mirror, and how the light will reflect at a different angle depending on how you direct it to the mirror. Materials such as glass or metal are notoriously bad for causing Wi-Fi signal problems because of this.
- **Scattering:** This is quite similar to reflection, but involves multiple reflections. This happens when the RF signal reaches an irregular surface and is mirrored in multiple directions. Similar to the example of light and mirror in the past, an image that points the light to a mirror ball, and how the light is spread through several, weaker beams.

- **Diffraction:** This is when the RF signal is bent around the obstruction, resulti ng in the "RF shadow" of the degraded signal. This can be caused by somethin g like a small hill or a house in the way of a signal.[6]

5.6 Cambium Cloud-Managed Wi-Fi

5.6.1 Indoor Wi-Fi Access Point Portfolio

E400: The cnPilot e400 with a full rating and a capacity of 256 users and up to 16 SSIDs provides network adaptability to increasing demand dynamics with advanced features such as airtime equality, automatic channel scanning (ACS) and high customer device speeds with band steering. Acceptable Enterprise grade High density 802.11ac Indoor access points for schools, indoor public areas, centers, hotels and resorts (Hospitality), coffee shops, multi-dwelling devices (MDUs). [7]

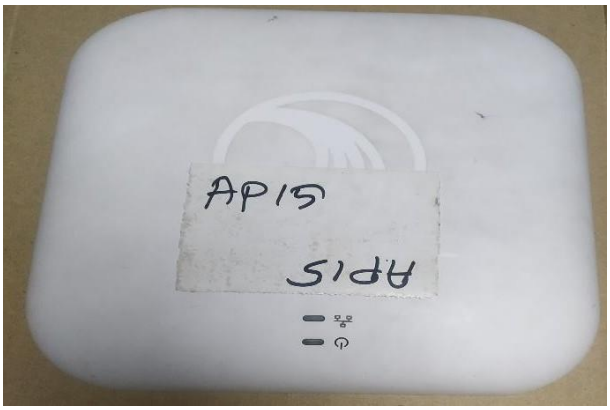


Figure 5.3: cnPilot e400 device

R201: Cambium cnPilot R201 networks offers an all - in solution for one networking. The Gateway cnPilot R201 provides a single connection to the Subscriber Module (SM) for Wi-Fi, telephony and poe. Completely PMP 450- and ePMP-compliant, cnPilot R201 enables more resources and increased revenues to be delivered.

Figure 5.4:cnPilot R201 device

5.6.2 Outdoor Wi-Fi Access Point Portfolio

ePMP1000: The Integrated Radio ePMP 1000 can be set up as a Subscriber Unit, an unsynced Access Point or as a Backhaul radio. This radio works as a customer (slave), in PMP and PTP deploys for ePMP GPS Synchronized Radio and is a synchronized solution for GPS. The network offers high volumes in both 5 GHz and 2.4 GHz.

Performance and reliable customer broadband interactions, including VoIP, video and data services. The ePMP 1000 is the most powerful networking solution to meet the world's underserved and unconnected. [8]

Figure 5.5: ePMP 1000 Integrated Radio

E500: cnPilot e500 APs have two gigabit Ethernet ports and an AUX port capability which enables the outdoor implementation of another radio backhaul, security camera or any other additional equipment, with additional energy. The 802.11ac e500 is the essential workhorse for today's demanding high-density outdoor Wi-Fi networks with its support of up to 256 competitive client associations, 16 SSIDs, WPA-2 encryption, Dynamic VLANs, DFS, access lists (ACL) and zero touch provisioning.

Figure 5.6: cnPilot e500 Enterprise Outdoor

5.7 cnMaestro Wi-Fi Controller

5.7.1 Overall Objectives:

At the end of this session, participants should be able to:

- Create a cnMaestro account and add administrators
- Claim and onboard devices and place them in a network
- Monitor Cambium equipment
- Configure devices with AP Groups and WLANs
- Investigate and acknowledge issues using alarms
- Bulk update device software
- Troubleshoot common deployment issues.

5.7.2 Benefits

Quick to Get Started

– Create your Cloud account and embed your devices

– No servers to manage, setup, update

Access from Anywhere With a Standard Web Browser

– No VPN or Java web client requirement

Scalable

– supports up to 10,000 devices for person cnMaestro account

–Customers can have multiple accounts

– Allow use of the cloud for 100,000 devices

Rich Feature Set

– For Wireless Networks

– End-to-end Cambium network management.

5.8 Home Page

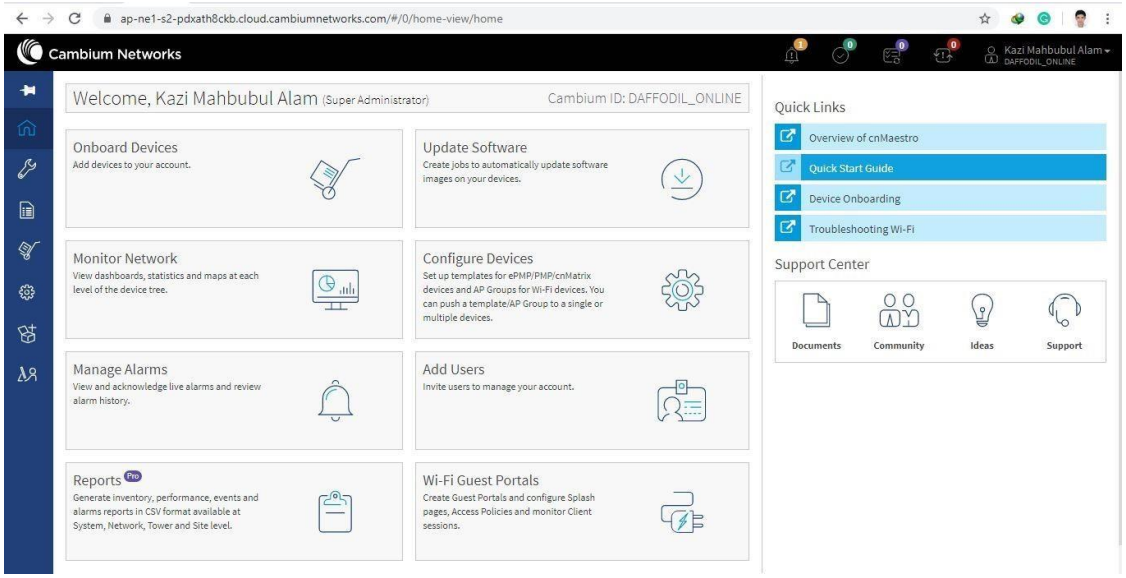


Figure 5.7: cnMaestro Home Page

5.9 Wireless Configuration

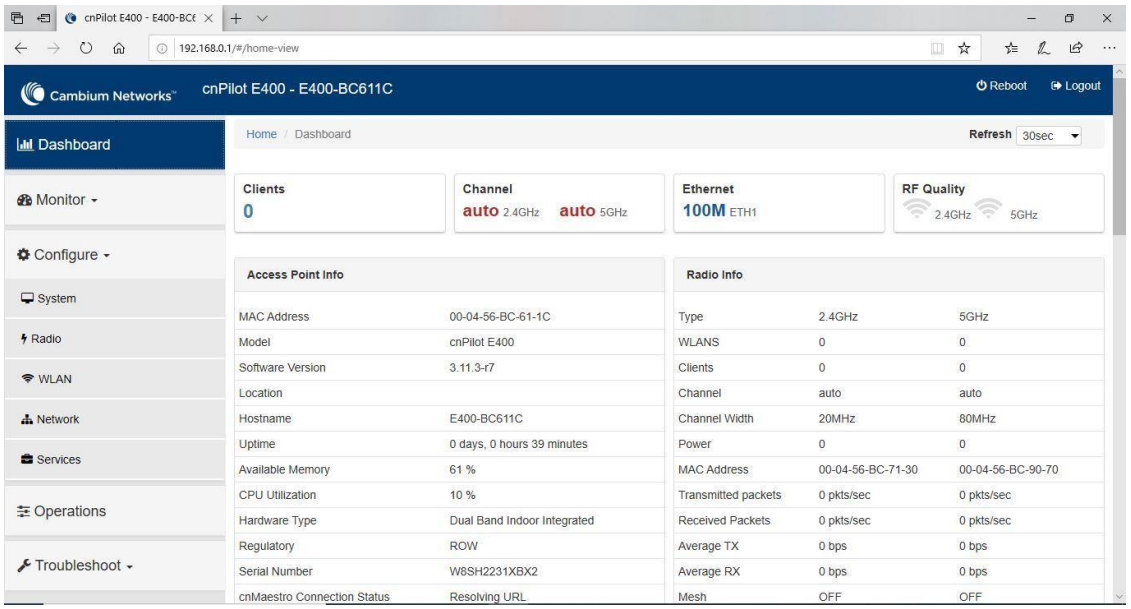


Figure 5.8: cnPilot E400 dashboard

5.9.1 System Configuration

Go to System > Name: Md. Sabbir Ahamed

Location : Bangladesh

Placement : Indoor

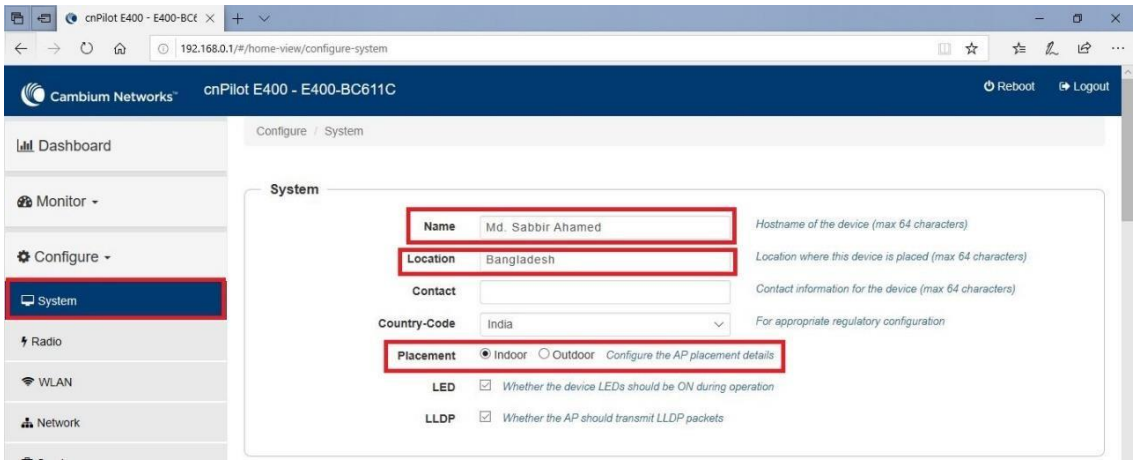


Figure 5.9: cnPilot E400 System setup

5.9.2 System – Management

Go to System > Management. Then given Admin Password.

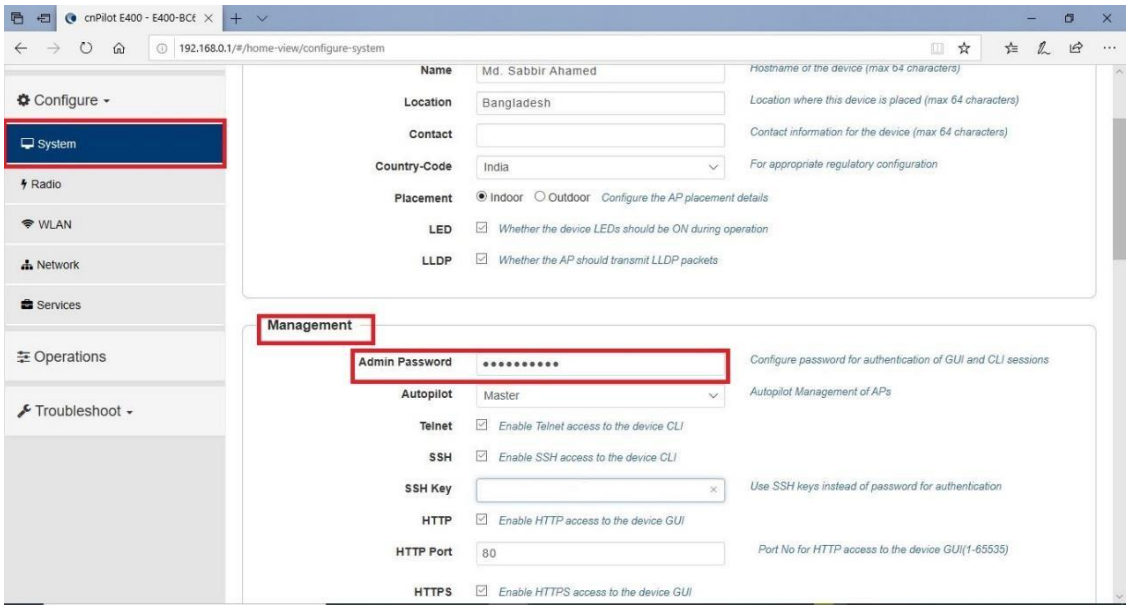


Figure 5.10: cnPilot E400 management setup

Go to System > cnMaestro. Then given cnMaestro URL.

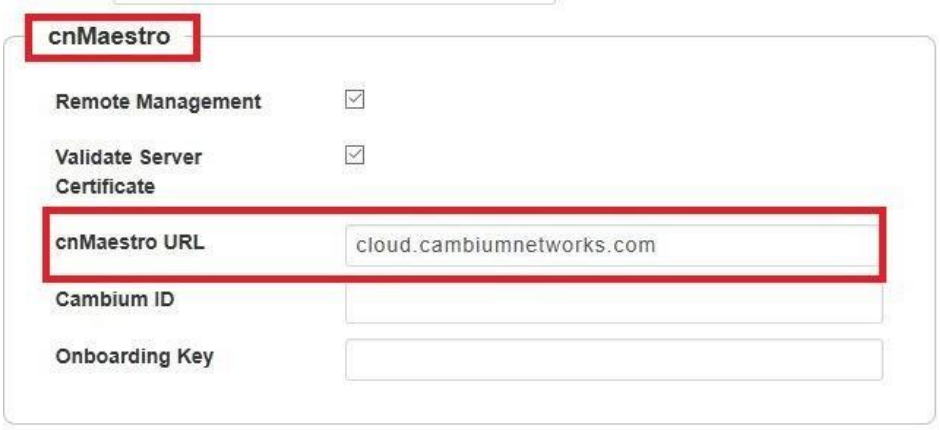


Figure 5.11: cnPilot E400 cnMaestro cloud setup

5.9.3 System – NTP

Can be set as IP or full server name.

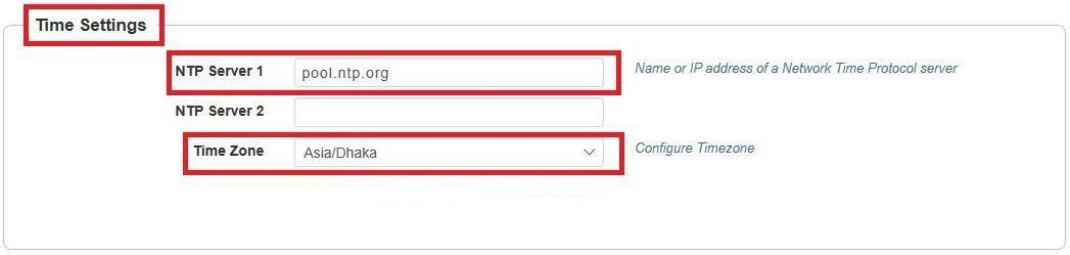


Figure 5.12: cnPilot E400 NTP setup

5.9.4 WLAN Configuration

Go to Wlan then add WLAN. Then given SSID, VLAN, security, radios, max client.

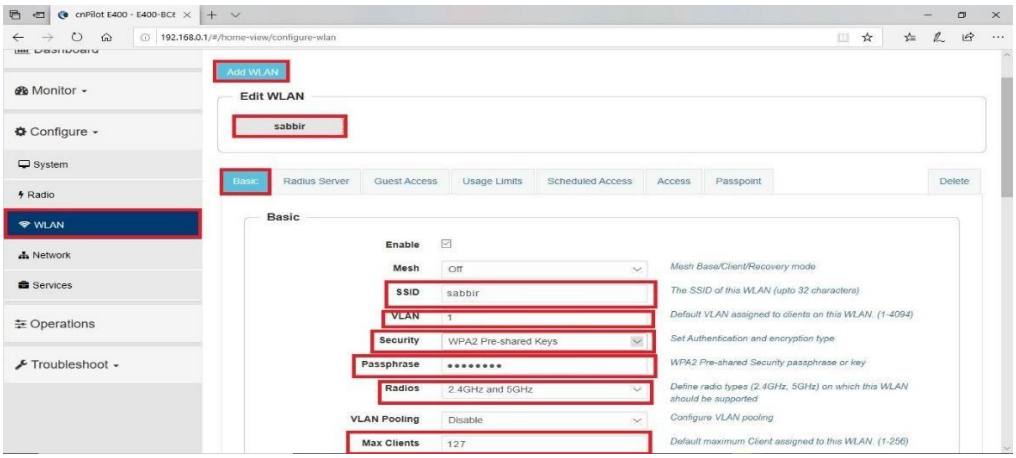


Figure 5.13: cnPilot E400 add WLAN

5.9.5 WLAN - Rate Limi

Go to WLAN > Usage Limits.

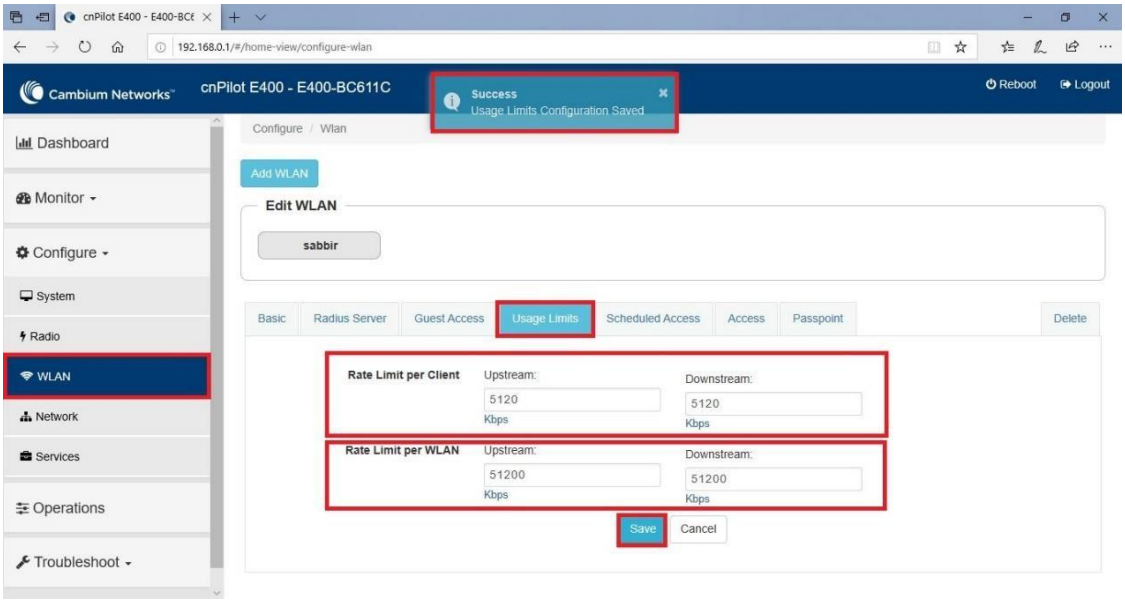


Figure 5.14: cnPilot E400 usage Limits setup

5.9.6 WLAN – Scheduled Access

Go to WLAN > Schedule Access.

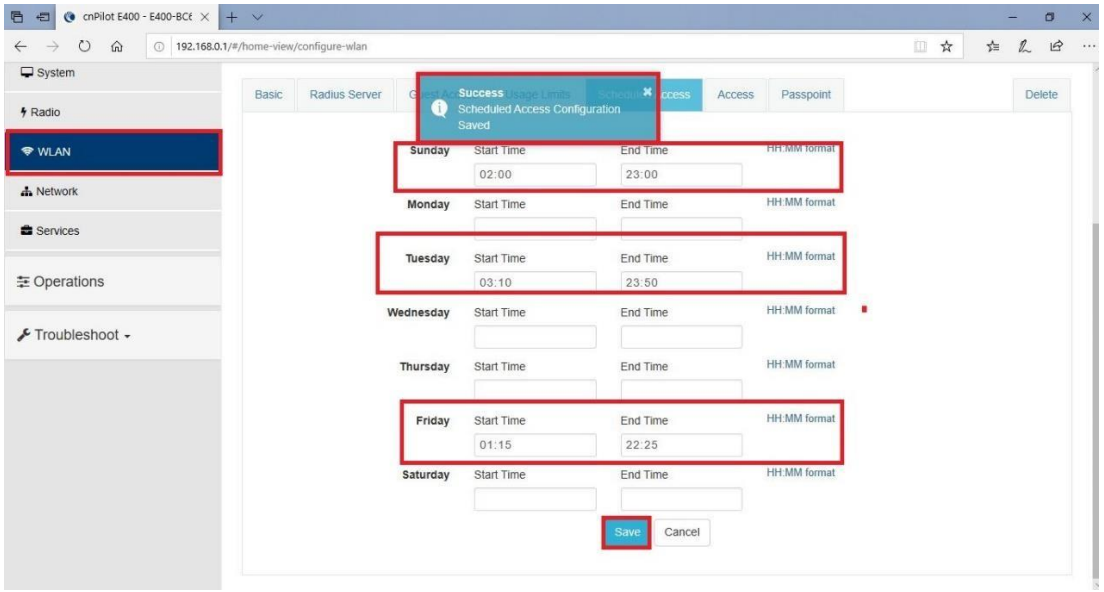


Figure 5.15: cnPilot E400 Schedule setup

5.9.7 LAN Configuration

Go to Network > Vlan .Then given IP address. Select Static IP. Given Default Gateway, DNS server. Then click save.

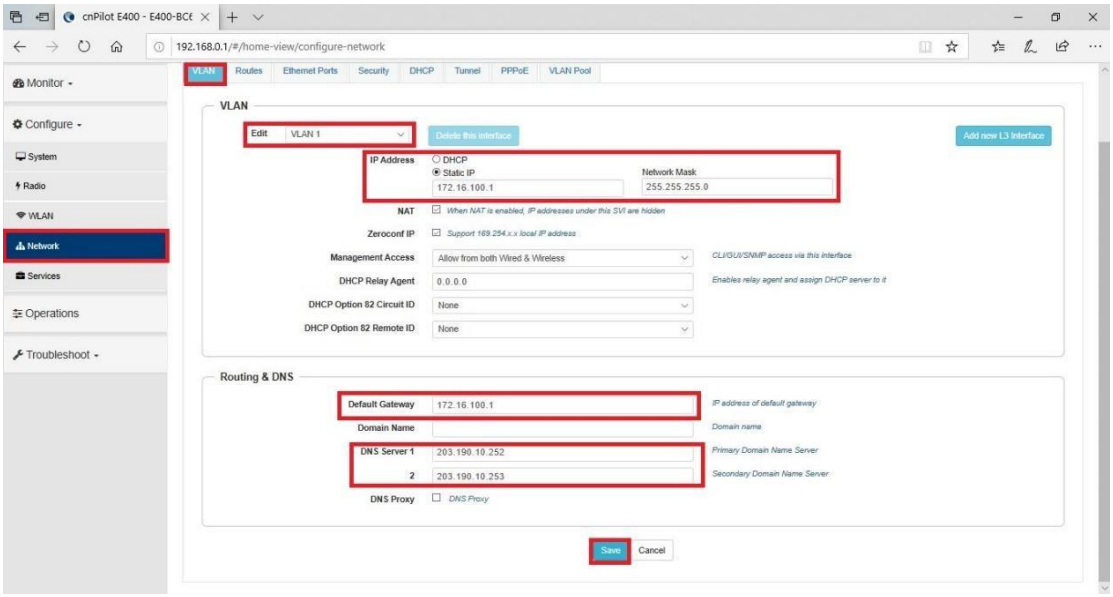


Figure 5.16: cnPilot E400 VLAN setup

Go to Network > DHCP. Select pool 1.Given Address Range, Default Router, DNS Address, Network, Lease. Click save.

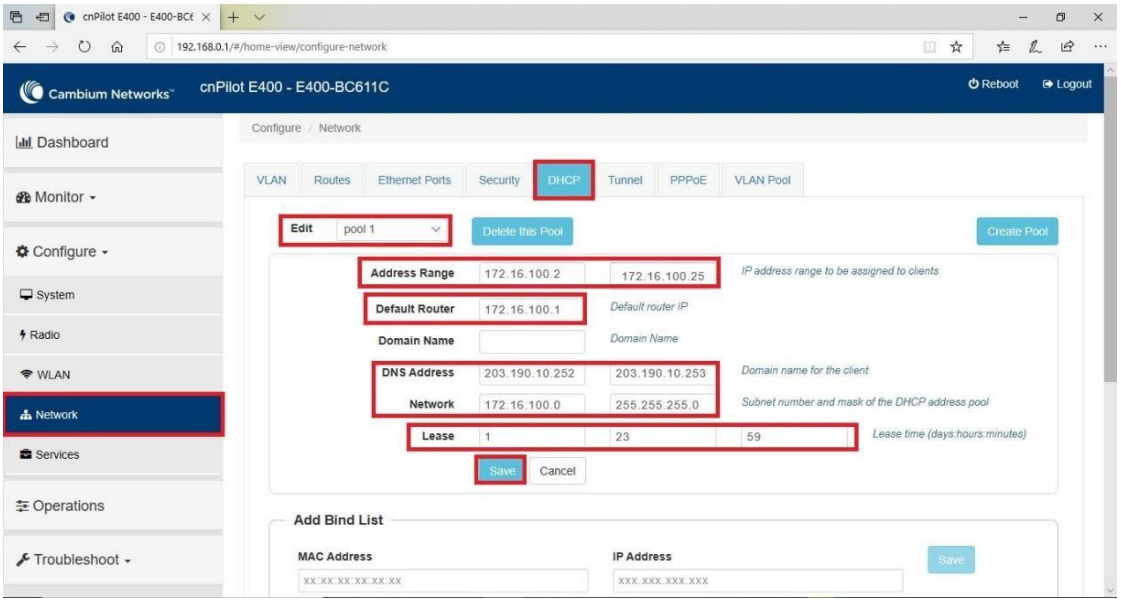


Figure 5.17: cnPilot E400 DHCP setup

5.10 Hierarchical Navigation

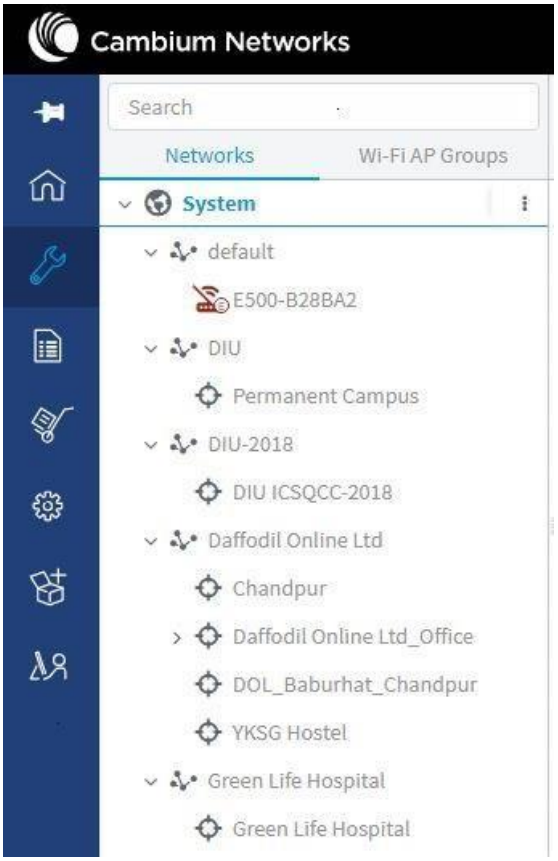


Figure 5.18: Hierarchical Navigation

5.11 OnboardDevicesUsingMSN

–Select Onboard Devices from Home or Navigate to Onboard

–Select “Claim Device”

–Enter MSN E500 Device

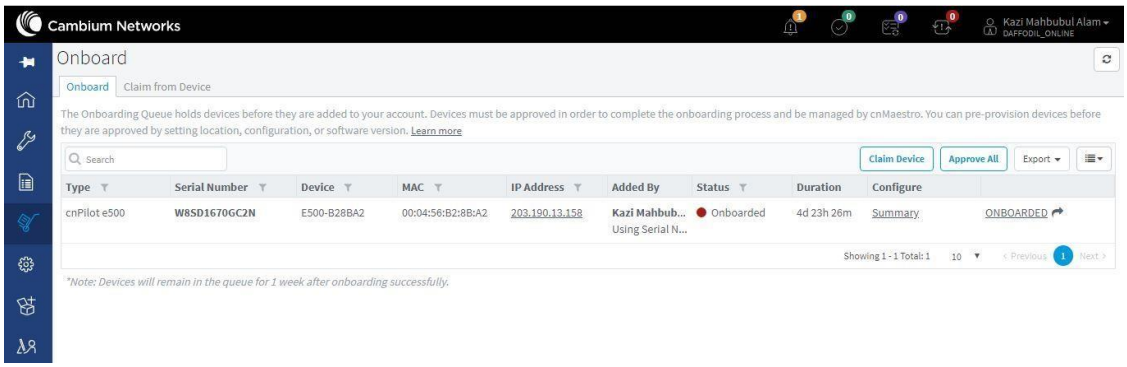


Figure 5.19: onboard device

5.12 System Dashboard

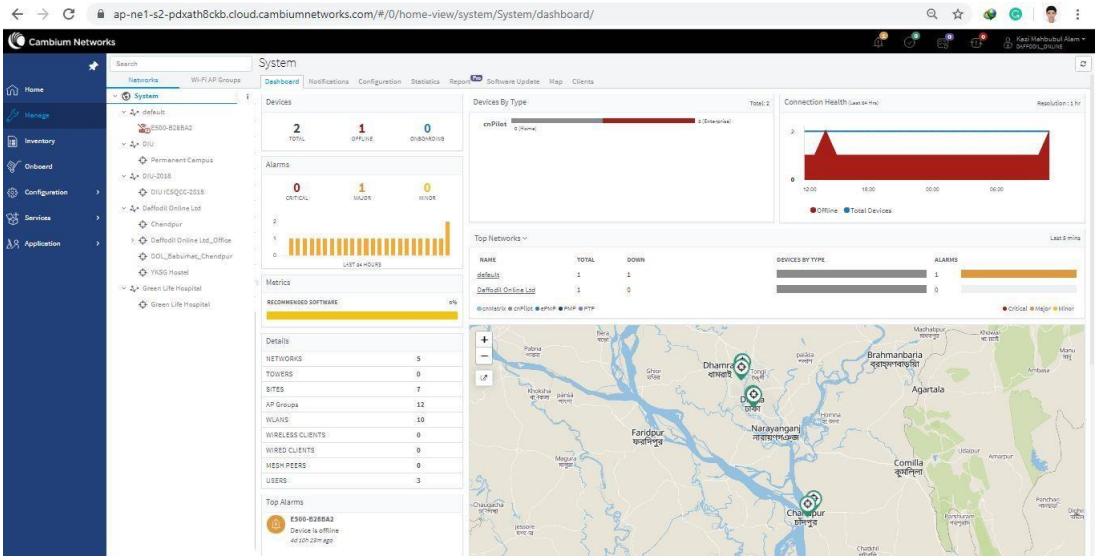


Figure 5.20: system dashboard

5.13 AP Dashboard

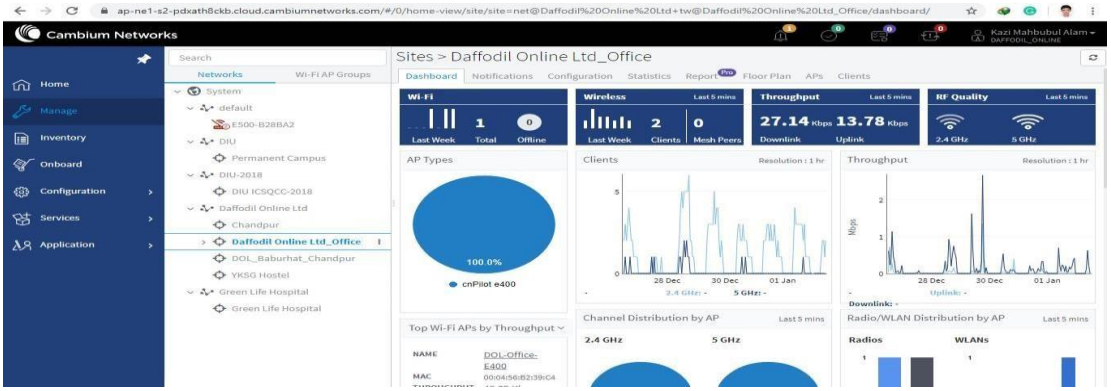


Figure 5.21: AP Dashboard

5.14 Inventory

- Column Groups Change Column Display

- Wireless LAN View Uses AP Table Instead

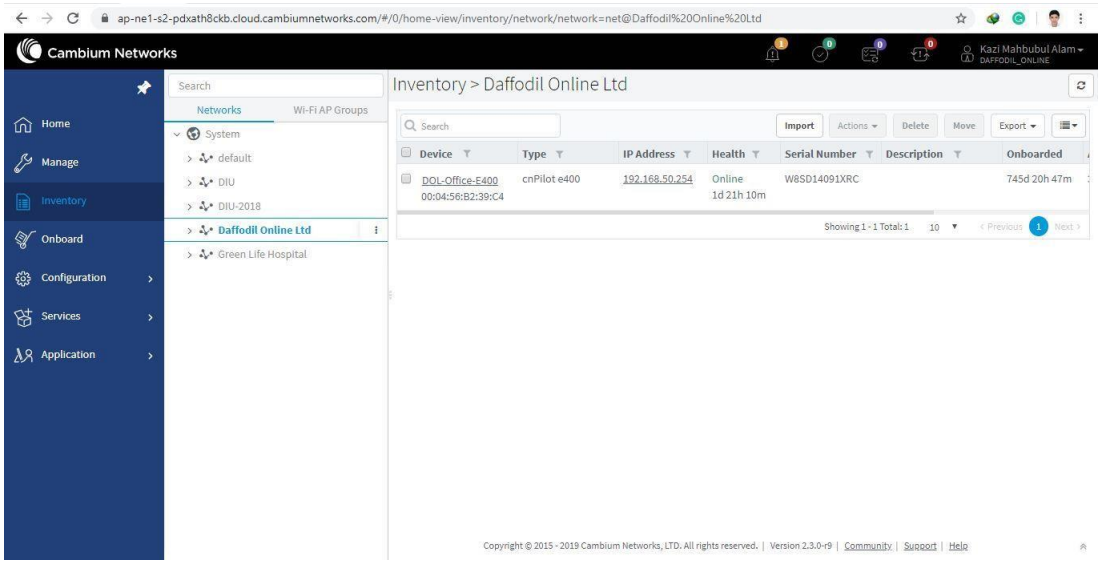


Figure 5.22: Inventory

5.15 Alarm Page

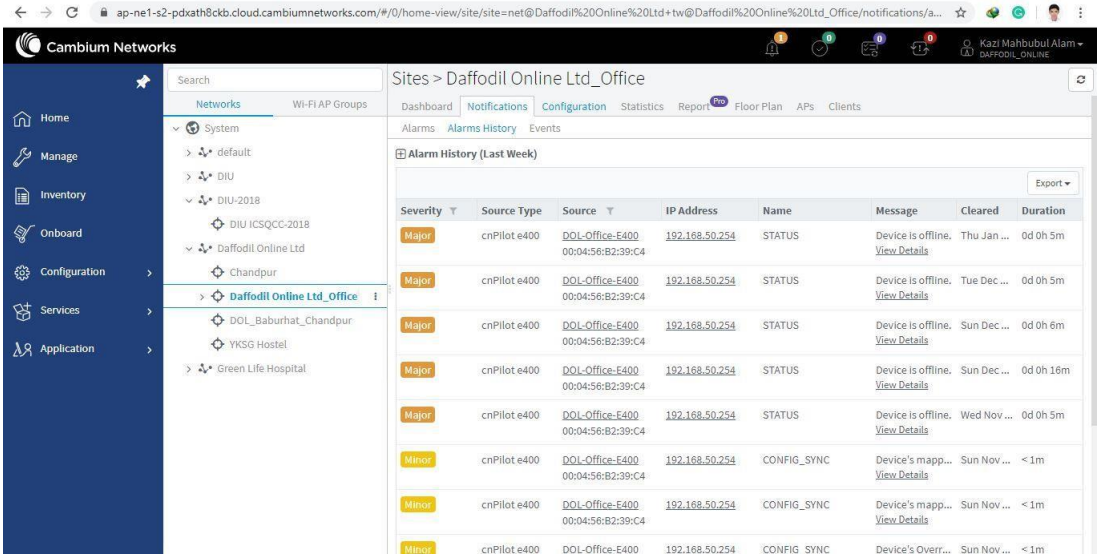


Figure 5.23: Alarm Page

CHAPTER 6

Conclusion and Future Career

6.1 Discussion and Conclusion

The internship was a fantastic and enjoyable experience. I have seen the future, and I can help myself by networking with many people to confirm this. During this internship, I found that self-motivation and the ability to manage time are one of the most important skills. I was eight hours a day when I first started, and 6 days a week I would sit in the office, and I didn't think that was the case. Once I knew I didn't break what I was having to do with my overlap, so I organized the work of my day. I had to learn how to motivate myself for many hours during this internship and office time management. I still want to use a service that has made a number of recommendations and opinions. This line of work I'm enjoying. I continue to work hard for my job and I look forward to getting to know new people and the industry. It was a fantastic experience and I think the other intern got much out of it!

6.2 Scope for Further Career

There are career opportunities in various networking areas. In addition to the MicroTik & Cambium networks platform, the career opportunities in networking include many different fields such as: CISCO, AWS, JNCP, F5-CTS.

As the technology advances and flourishes, networks are increasingly interconnected. Therefore, there appears to be no fast disappearing need for a network specialist. A person must live up to the latest technological trends. He needs to keep up to date constantly. This helps him to gain in-depth knowledge that helps to solve various problems in turn. Communication is also a critical factor in the way people deal with all employees in the company by network engineers.

References

[1] https://www.daffodilnet.com/about-us.php

[2] https://searchnetworking.techtarget.com/definition/shielded-twisted-pair

[3] https://MicroTik.com/product/CCR1036-8G-2Splus

[4] https://www.techopedia.com/definition/536/wi-fi-alliance

[5] https://www.tutorialspoint.com/wi-fi/wifi_ieee_standards.htm

[6] https://blog.ct-networks.io/what-is-rf-behaviour-8e520c3ad3e5

[7] https://www.cambiumnetworks.com/products/wifi/cnpilot-e400/

[8] https://www.cambiumnetworks.com/products/epmp/integrated-radio/