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

BY

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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

This Project titled "Empirical Study on Network Configuration Using MicroTik & Cambium of Daffodil Online Ltd.(DOL)" submitted by Md. Sabbir Ahamed, ID: 161-19-1843 & Sanjeeda Akter Ranasha, ID: 161-19-1858 to the Department of Electronics and Telecommunication Engineering (ETE), Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Electronics and Telecommunication Engineering and approved as to its style and contents. The presentation was held on January 2020.

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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, 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 everincreasing 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.

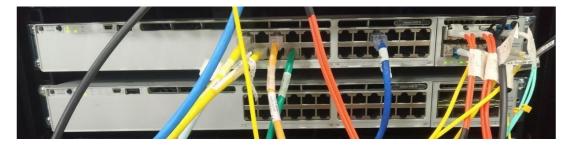


Figure 3.6 : Cisco Switch

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 fullduplex 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.

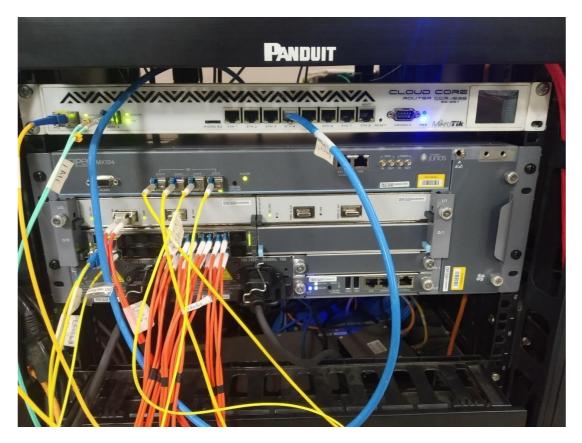


Figure 3.8: MicroTik & Juniper Router

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.

Doutor	OS v6.38.1		Mikrotik
Router	US V6.38.1		
'ou have con Idministrator		ministrative access only. If this device is no	ot in your possession, please contact your local network
WebFig I	Login:		
Login: s	sayeed	Login	
Password:	- 140 -		
	8		
Winbox	Telnet Graphs I	icense Help	

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.

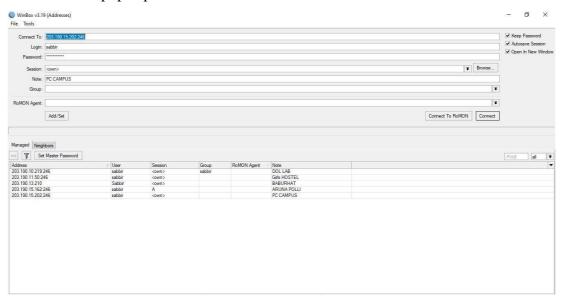


Figure 4.3: WinBox

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

	T		Find
Address	/ Networ		Interface
P 172.16.0.1/24	172.16	0.0.	ether4
192.168.50.2/24	192.16	8.50.0	ether1

Figure 4.4: Add Network Address & select Interface

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

Route L	ist					
Routes	Nexthops	Rules	VRF			
•			7			
	Dst. Address	1	Gateway	Distance	Routing Mark	Pref. Source
AS	0.0.0.0/0		192.168.50.1 reachable ether1		1	1000000000
DAC	▶ 172.16.0.	0/24	ether4 reachable	1)	172.16.0.1
DAC	▶ 192.168.5	50.0/	ether1 reachable)	192.168.50.2

Figure 4.5: Add Route

 $\label{eq:step 3: IP > Firewall > NAT > + action > masquerade > Apply > ok$

Advanced Extr	ra Action	Statistics			OK
Action:	masquerade			-	Canc
I	Log				Apply
Log Prefix:				-	Disable
To Ports:			1	-	Comment
				· · · ·	Сору
					Remove
					Reset Counters
					Reset All Counters

Figure 4.6: Set Firewall

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

= 230.190.10.253

DNS Settings			
Servers:	203.190.10.252	•	OK
	203.190.10.253	•	Cantel
Dynamic Servers:			Apply
	Allow Remote Request	s	Static
Max UDP Packet Size:	4096		Cache
Query Server Timeout:	2.000	5	
Query Total Timeout:	10.000	s	
Max. Concurrent Queries:	100		
Max. Concurrent TCP Sessions:	20		
Cache Size:	2048	КВ	
Cache Max TTL:	7d 00:00:00		
Cache Used:	9 KiB		

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.

DHCP Server					
DHCP Netwo	irks Leases Options	Option Sets	Alerts		
+ = <	😹 🍸 DHCP	Config DH	CP Setup		Find
Name	/ Interface	Relay	Lease Time	Address Pool Add AR	-
			DHCP Setup		
			Select interfac	e to run DHCP server on	
			DHCP Server	Interface: ether4	
			1	Back Next Cancel	
				Dack Ivex Cancel	
				13	
				8.53	
0 items					

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.

DHCP Server			
	DHCP Setup		Find
Name / Interface		in a second s	
0 items			

Figure 4.9: Select Network Block

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

DHCP Server					
DHCP Network	s Leases Options	Option Sets	Alerts		
+ - 🖉	🐹 🍸 DHCP C	Config DHC	CP Setup		Find
Name	/ Interface	Relay	Lease Time	Address Pool Add AR	*
			DHCP Setup		
				y for prven network: HCP Network: 172.15.0.1 Back Nett	
0 items					

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.

7	DHCP Config DHC	P Setup	Find
Name / Interfa	ce Relay	Lease Time Address Pool Add AR	
		DHCP Setup	
		Select DNS servers	
		DNS Servers: 203.190.10.252	
		203.190.10.253	
		Back Next Cancel	

Select 4.11: Select DNS Server

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

DECP Server DHCP Networks	L	Ortina Cata			
+ - 08	a second second			laure I	Find
			DHCP Setup Select lease time Lease Time: 00:10:00 Back Next	Cancel	
0 items					

Figure 4.12: Set Lease Time

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

DHCP Server			
DHCP Network	s Leases Options Option Sets Alerts		
+ - 0	🛛 🍸 DHCP Config DHCP Setup		Find
Name	/ Interface Relay DHCP Setur	Add AR	· · · · · · · · · · · · · · · · · · ·
dhcp1	ether4 DHCP Setup	P no	
1 item			

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.

C# Safe Mode	Session: 203.190.11	50:246								CPU: 1% Date	Jan/01/2020 Time	14:11:34
Quick Set	Interface List											6
I CAPEMAN	Interface Interface I	List Ethemet EoIP	Tunnel IP Tunnel	GRE Tunnel	VLAN VRRP	Bonding LTE						
im interfaces	+ - 2 22	07										Find
1 Wireless	Name	/ Type	MTU Act	ual MTU	2 MTU Tx	Rx	Tx Pack	ket (p./s) Rx Pac	ket (p/s) FP Tx	FP Rx	FP Tx F	acket (p/s) F
Bridge	R 49BDIX	VLAN	1500	1500	1586	4.1 Mbps	6.8 kbps	635	5	0 bps	0 bps	0
PPP	R & GGC R & INT	VLAN VLAN	1500	1500	1586 1586	520 bps 289.9 kbps	0 bps 1228.0 kbps	256	0 642	0 bps 0 bps	0 bps 0 bps	0
°12 Mesh	R 🚸vlan112	VLAN	1500	1500	1586	0 bps	0 bps	0	0	Obpe	0 bps	0
IP P	X <8-vlan502	VLAN	1500			0 bps	0 bps	0	0	0 bps	0 bps	0
Ø MPLS ►	X @vlan777 R @vlan888	VLAN	1500	1500	1586	0 bps 0 bps	0 bps 760 bps	0	2	0 bps	0 bps 0 bps	0
Routing	R 🚸 vlan 999	VLAN	1500	1500	1586	621.0 kbps	129.1 kbps	122	86	0 bps	0 bps	Ő
El System				and a second		>						
Gueues												
Files												
Log												
							•					
Radius							Vlan Setup					
Tools 🖹												
interminal →												
Tools F New Terminal												
Tools F Mew Terminal LCD Partition												
Tools Tools New Terminal LCD Partition Make Support of												
Tools New Terminal LCD Partition Make Support of Manual												
Tools New Terminal LCD Partition Make Supout of Manual New WinBox												
Tools New Terminal LCD Partition Make Support of Manual												
Tools New Terminal LCD Partition Make Supout of Manual New WinBox												
Tools New Terminal LCD Partition Make Supout of Manual New WinBox												
Tools New Terminal LCD Partition Make Supout of Manual New WinBox												
Tools New Terminal LCD Partition Make Supout of Manual New WinBox												
Tools New Terminal LCD Partition Make Supout of Manual New WinBox												

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.

0	Safe Mode	Session: 203.190.1	1.50:246								CPU:0% Date	Jan/01/2020 Time: 1	14:15:14 🔳 👸
24	Quick Set	Interface List											6 ×
	CAPsMAN	Interface Interface	List Ethemet EoIP	Tunnel IP Tunnel GRE 1	Funnel VLAN VRRP Bondi	ng LTE							
)	Interfaces	+ *	: 🗖 🍸										Find
î	Wireless	Name	/ Type	MTU Actual M	TU L2 MTU Tx	Rx	Tx Packet (p		Rx Packet (p/s)	FP Tx	FP Rx		icket (p/s) F 🔻
	Bridge	R &BDIX R &GGC	VLAN VLAN	Interface <vlan9< td=""><td>99></td><td></td><td></td><td>755</td><td></td><td>0</td><td>0 bps 0 bps</td><td>0 bps 0 bps</td><td>0</td></vlan9<>	99>			755		0	0 bps 0 bps	0 bps 0 bps	0
102	PPP	R WINT	VLAN	General Loop	Protect Status Traffic		ок	494	1 0		0 bps	0 bps	0
010	Mesh	R @vlan112 X @vlan502	VLAN VLAN	Name	vlan999		Cancel	0		0	0 bps 0 bps	0 bps 0 bps	0
朢		X Wvlan777	VLAN	Type:	A REAL PROPERTY AND ADDRESS OF			0		0	0 bps	0 bps	0
0		R ∰vlan888 R ∰vlan999	VLAN VLAN			L	Apply	0 432		1	0 bps 0 bps	0 bps 0 bps	0
24	Routing 1	n wyvian 555	VLAN	MTU:			Disable	432	6	21	U Dps	0 bps	U
	System 1			Actual MTU:			Comment						
-	Queues			L2 MTU:	1586		Сору						
	Files			MAC Address:	D4 CA 6D 98 84 A9		Remove						
1.000	Log			ARP:	reply-only	• F							
-	Radius			ARP Timeout:		L	Torch						
	Tools 1			-									
	New Terminal			VLAN ID:	999								
	LCD			Interface:	ether10-Girls	¥.							
	Partition				Use Service Tag								
	Make Supout.nf												
	Manual												
	New WinBox												
	Ext												
				enabled	running	plave							

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.

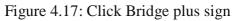
Step 1: From the left menu bar, click on the Bridge menu.

C4 Safe Mode Session: 203.190.13.210	Memory 1496.8 MB Time 14:26:02 CPU 17%	-
Quick Set		
I CAPSMAN		
im Interfaces		
1 Wreless		
Bridge		
HE PPP		
°tå Mesh		
型 IP 1 型		
⊘ MPLS ►		
🔀 Routing 🗈		
⊕ System ♪		
P Queues		
E Files		
E Log		
A Radus		
🔀 Teols 🗈		
Mew Teminal		
ECD		
the Partition		
Make Supout rf		
😯 Manual		
New WinBox		
E Ext		

Figure 4.16: Select Bridge

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

**	Session: 203.190.13.210								Memory 1502.4 MiB Time 14:28:18 CPU 12%
	Bidge								
CAPsMAN	Bridge Ports VLANs	MSTIs Port MST O	venides Filters NAT Hos	ts MDB					
im Interfaces	+	Settings							Find
🗓 Wireless	Content of Longer Longer Longer	Туре	L2 MTU Tx	Rx	Tx Packet (p/s)	Rx Packet (p/s)	FP Tx	FP Rx	FP Tx Packet (p/s) FP Rx Packet (p/s) MA
💦 Bridge									• • •
et PPP									
Pis Mesh									
∰ IP ト									
🖉 MPLS 🛛 🗈									
🛋 Routing 💦									
💮 System 🗈									
Queues									
💼 Files									
E Log									
Radius	tem out of 243								
🔨 Tools 🕅	TREN OUL OF 245								
New Terminal									
🖷 LCD									
Partition									
🛄 Make Supout nf									
😧 Manual									
🕒 New WinBox									
Ext									



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

C* Safe Mode	Session: 203.190.13.210								Memory: 1496.	0 MiB Time: 14:38:1	11 CPU-9%	
Guick Set	Bridge											
I CAPeMAN	Bridge Ports VLANs MS	STIs Port MST	Overrides Filters NA	Hosts MDB								
Interfaces	+ * 🛛	Y Setting	28									nd .
T Wireless	Name / Ty		L2 MTU Tx	Rr	Tx Packet (b/s)	Ry Packet (b/s)		FP Rx	FP Tx Pa	cket (p/s) FP Rx P	acket (p/s)	MAC
Bridge	R #1bridge1 Bri	idge	1580	191.3 Mt Interface <bridge1></bridge1>				0 bps	21.7 Mbps	0	14 607	64.D
PPP				General STP VLA	N Status Traffic		OK					
18 Mesh				Name	bridge1		Cancel					
· 역 4월				Type	Bridge		Apply					
MPLS 1				MTU				2				
Routing				Actual MTU			Disable					
System				L2 MTU			Comment					
Files							Сору					
					64:D1:54:D5:70:63		Remove					
Log Radius	•			ARP	enabled	•	Torch					
💥 Tools 🗈	1 item out of 246 (1 selected)			ARP Timeout		-						
Mew Terminal				Admin. MAC Address		•						
Partition				Ageing Time								
Make Supout of					IGMP Snooping Fast Forward							
Manual					Past Porward							
New WinBox												
Ext												
ED LAN												
				enabled	running	slave						

Figure 4.18: Add Bridge Name

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

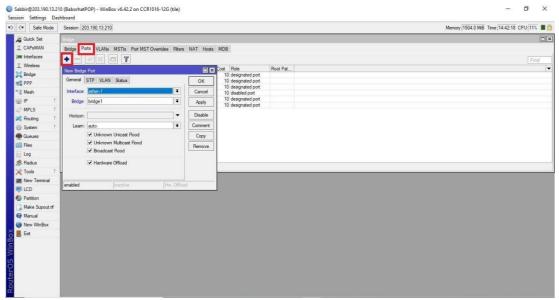


Figure 4.19: Add Port

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

C* Safe Mode	Session: 20	03.190.13.210					Memory: 1503.2 MiB Time: 14:45:58 CPU: 10%
🔓 Quick Set	Bridge						
CAP\$MAN	Bridge Po	ets VLANs MSTIs Port MSTO	verrides Filters	NAT Hosts	MDB		
m Interfaces	+ -	X 🗖 T					Find
1 Wireless	Bridge Port	contract lawsed lawsed			Cost Role	Root Pat	
Bridge	and the second se	STP VLAN Status		OK	10 designated port 10 designated port		
PPP			_		10 designated port		
18 Mesh	Interface:		÷	Cancel	10 disabled port 10 designated port		
1 91 🕸	Bridge:	bridge 1	Ŧ	Apply	10 designated port		
MPLS 1	Horizon:			Disable			
Routing	Leam:		Ŧ	Comment			
System	10.100	Unknown Unicast Flood	. hour	Сору			
Files		Unknown Multicast Flood					
Log		Broadcast Flood		Remove			
Radius		Hardware Officiad					
Tools							
New Terminal							
LCD							
Partition							
Make Supout of							
Manual	enabled	inactive	Hw: Office				
New WinBox	Cenadied	harna	1.1.7.01008		J		
Ext							

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.

C* Safe Mode	Session: 203.190.13.210	Memory 1497.6 MB Time 15:10:32 CPU 9%
Code Made Code Made CAPSMAN CAPSMAN	Interview Image: Constraint of the second seco	
LCD		
🕼 Partition		
🛄 Make Supout nf	11 tems (1 selected)	
🚱 Manual		
New WinBox		
Eot		

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.

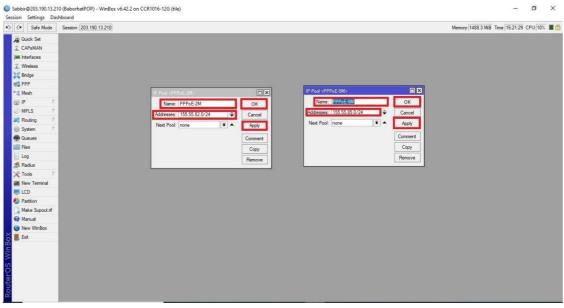


Figure 4.22: Create 2 another IP Pool

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.

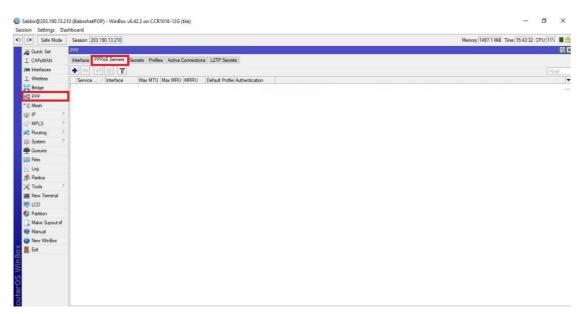


Figure 4.23: PPPoE Server

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.

	Memory 1491.9 MiB Time 15:49:12 CPU	9% 🔳 🛅
Guick Set		6×
Interface PPPoE Servers Secrets Profiles Active Con		
🖮 Interfaces 🕂 🗕 🖌 🕱		Find
J. Wireless Service / Interface Max MTU Max MRU MF		-
Bridge @PPPoEbridge1 PPPoE Service <pppot< td=""><th></th><td>1000</td></pppot<>		1000
Service Name:	ок	
°IS Mesh	ancel	
THE P I		
W MELS I	ppy	
Routing N Max MRU:	sable	
System MRRU:	ору	
Queues Keepalive Timeout: 10	move	
Default Profile: de		
Log		
Max Sessions:		
PADO Delay:		
LCD Authentication:		
Separation		
Make Supout //f		
@ Manual		
S New WinBox		
Ext		
Sot		

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.

C# Safe Mode	Session: 203.190.13	8.210					Memory 1488.0 MiB Time 16:05:27 0	CPU: 7%	
Guick Set	PPP								E
CAPSMAN	Interface PPPoE S	ervers Secrets Pro	files Act	ve Connections La	2TP Secrets				
im Interfaces	+ - 0 1	r						Fin	nd.
📜 Wreless	PPP Profile <profile-< th=""><th>1MB></th><th></th><th></th><th>Bridge</th><th></th><th></th><th></th><th></th></profile-<>	1MB>			Bridge				
Bridge	General Protocols	Limits Queue S	ripts	ОК					
PPP		Profile-1MB	_	Cancel					
°të Mesh	Concession of the local division of the loca	The second s		and the owner where the owner					
IP N	and the second se	PPPoE-GATEWAY		Apply					
MPLS F	Remote Address:	PPPoE-1M	₹ ▲	Comment					
Routing	Bridge:	-	-	Copy					
System	Bridge Port Priority:		-	Remove					
Queues	Bridge Path Cost:		-						
Files	and the second second		=÷						
Log Radius	Bridge Horizon:		_						
💥 Tools 🗈	Incoming Filter:		•						
New Teminal	Outgoing Filter:		-						
LCD	Address List:		\$						
Partition	Interface List:								
Make Supout of	interrace List.								
Manual	DNS Server:	8.8.8.8	\$						
S New WinBox		203.190.10.252	•						
📕 Ext	WINS Server:		\$						
	- Change TCP MS	S							
	C no C yes	default							
	- Use UPnP								
	C no C yes	default							

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).

C* Safe Mode	Session: 203.190.13.210		Memory 1500.9 MB Time 17:57:16 CPU 11%
Quick Set	PPP		6
I CAPSMAN	Interface PPPoE Servers Secrets	ofiles Active Connections L2TP Secrets	
im Interfaces	+ x 🗂 🍸 P	P Authentication&Accounting	Find
🚊 Wireless	PPP Secret <alamin@dol.com></alamin@dol.com>		
Bridge	Name: alamin@dol.com	ОК	
ei PPP	Password: alamin321	Cancel	
°të Mesh	Service: pppoe		
型IP ト ② MPLS ト	Caller ID:		
Routing	Profile: Profile-1MB	Disable	
System	Profile: Profile-IMB	Comment	
Queues	Local Address:	 Сору 	
Files	Remote Address:	▼ Remove	
E Log			
A Radius	Routes:	• • • • • • • • • • • • • • • • • • •	
🄀 Tools 🗈 🏌	Limit Bytes In:	•	
New Terminal	Limit Bytes Out:	-	
LCD			
Partition	Last Logged Out:		
Make Supout of Manual			
Manual Sew WinBox			
Exit			
E CA			

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.

C# Safe Mode	Session: 203.190.11.50.246					CPU 0% Date J	an/01/2020 Time 18:09	9:44
Quick Set	Queue List							
I CAPSMAN	Simple Queues Interface Queues Queue Tree Queue	Types						
Interfaces	+ - 0 8 2 7 00 Reset Counters	00 Beset All Counters						
1 Wreless	# Name	Target	Upload Max Limit	Download Max	limit Unload	Download	Total Max Limit (bi	T
Bridge	::: Prometric/VUE	Taylor	opidad max amit	Dominodo max	Lank Opioda	DOM NODU	Total max came pro-	•
	0 @ Prometric/VUE	192.168.168.0/24	100M	100M	0 bps	0 bps		
e PPP	1 🖀 Facebook Messanger	0.0.0/0	unlimited	unlimited	0 bps	26.4 kbps		
C Mesh	2 B speedtest	0.0.0/0	50M	50M	0 bps	0 bps		
	3 BDIX New For All	0.0.0/0	1000M	1000M	13.4 kbps	0 bps		
型 IP 下	4 @ Youtube_New_For_All	0.0.0.0/0	400M	400M	62.4 kbps	7.4 Mbps		
MPLS N	5 🚊 Tik Tok	0.0.0/0	800M	800M	0 bps	0 bps		
Routing	6 🗮 Fast	0.0.0/0	800M	800M	0 bps	0 bps		
	7 🚊 IMO	0.0.0/0	unlimited	unlimited	0 bps	0 bps		
💮 System 🗅	8 🖀 Facebook-0	172.16.0.0/24	unlimited	unlimited	121.0 kbps	9.0 Mbps		
Queues	9 🔮 Facebook-1	172.16.1.0/24	unlimited	unlimited	11.7 kbps	474.2 kbps		
and the second	10 🚊 Facebook-2	172.16.2.0/24	unlimited	unlimited	0 bps	0 bps		
Files	11 🔮 Facebook-3	172.16.3.0/24	unlimited	unlimited	0 bps	0 bps		
Log	12 🗮 Facebook-Boy's	10.10.0/25	unlimited	unlimited	0 bps	0 bps		
	13 🕮 Facebook-Boys-H3	110.79.9.0/24	unlimited	unlimited	15.5 kbps	1677.8 kbps		
💁 Radius	14 🗮 Facebook-Boys-Concord	5.5.5.0/25	unlimited	unlimited	0 bps	0 bps		
Tools	15 🚇 NOC-YouTube	172.16.0.68, 172.16.1.62	100M	800M	0 bps	0 bps		
	16 B NOC-PC	172.16.0.68, 172.16.1.62	100M	800M	0 bps	0 bps		
New Terminal	17 🚇 Maliha	172.16.1.224	3M	3M	0 bps	0 bps		
LCD	18 🗰 Sani	192.168.168.248	10M	10M	0 bps	0 bps		
Partition	19 🔮 Vue Admin PC	192.168.168.254	100M	100M	0 bps	0 bps		
	::: <<<<< <real ip="" list<="" td=""><td></td><td></td><td></td><td></td><td>144</td><td></td><td></td></real>					144		
Make Supout nf	20 Boys-Hostel-IP_Camera	203.190.12.32/29	10M	10M	0 bps	0 bps		
Manual	21 BOffice-CCTV	203.190.10.112/29	10M	10M	418 bps	562 bps		
	22 Boys-Hostel-Concard-IP_Camera	203.190.12.168/29	3M	3M	245 bps	0 bps		
S New WinBox	23 Girl's-Hostel-IP_Camera	203.190.12.16/29	10M 3M	10M	0 bps	0 bps		
Ext	24 @ queue2 	203.190.12.16/29	JM	10M	0 bps	0 bps		
	25 Bohanur Rahman (Sohan)	10.10.10.30.10.10.10.70	2M	2M	0 bps	0 bos		
	25 B Sonanur Hanman (Sonan) 26 Abu Bakar Liton (march to may pament complete)	10.10.10.30, 10.10.10.70	2M 2M	2M 2M	0 bps	0 bps		
	26 ADU Bakar Liton (march to may pament complete) 27 Rayhan Hasan(Mukter)	10.10.10.3, 10.10.10.6, 10.10.73	2M 2M	2M	0 bps	0 bps		
	27 B Haynan Hasan(Mukter) 28 B Prosenit Kumer Rov (June 26-18, July-18)	10.10.10.25, 10.10.10.56	2M 2M	2M	0 bps	0 bps		
	20 Aveatullah	10.10.10.53, 10.10.10.72	2M 2M	2M	0 bps	0 bps		
	30 Sadi Roon DOL	10.10.10.45, 10.10.10.43, 10.10.10.60, 172.16.1.90	2M 10M	10M	0 bps	0 bps		
	30 Saved Ahmed-R:201	10.10.10.45, 10.10.10.43, 10.10.10.60, 172.16.1.50	2M	2M	0 bps	0 bps		
	31 B Sayed Anmed-H:201 32 Mir Aman	10.10.10.32, 10.10.10.55, 10.10.10.31	2M 2M	2M	0 bps	0 bps		

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.

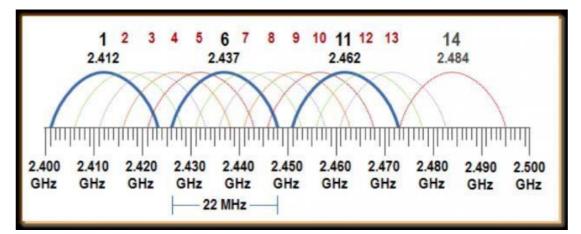
802.11b -The expansion to 802.11 is also known as 802.11 High Rate which Wi-Fi and provides 11 Mbps (with a fallback to 5.5, 2 and 1 Mbps) in the 2.4 GHz band. Only DSS uses 802.11b. In 1999, 802.11b had approved the original standard 802.11, allowing Ethernet-like wireless features.

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





- > 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

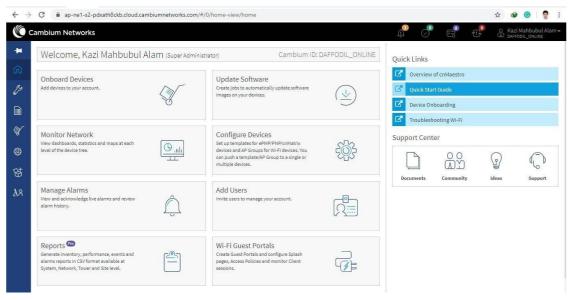


Figure 5.7: cnMaestro Home Page

5.9 Wireless Configuration

🖹 🖅 🔇 cnPilot E400 - E400-B	$\alpha \times + \vee$				- 0)
	92.168.0.1/#/home-view				
Cambium Networks	cnPilot E400 - E400-BC611C				😃 Reboot 🛛 🖨 Logout
Jul Dashboard	Home / Dashboard				Refresh 30sec -
🖀 Monitor 👻	Clients 0	Channel auto 2.4GHz auto 5GHz	Ethernet 100M ETH1		F Quality 2.4GHz 5GHz
Configure -	Access Point Info		Radio Info		
System	MAC Address	00-04-56-BC-61-1C	Туре	2.4GHz	5GHz
• Radio	Model	cnPilot E400	WLANS	0	0
🕏 WLAN	Software Version	3.11.3-r7	Clients	0	0
	Location		Channel	auto	auto
A Network	Hostname	E400-BC611C	Channel Width	20MHz	80MHz
	Uptime	0 days, 0 hours 39 minutes	Power	0	0
Services	Available Memory	61 %	MAC Address	00-04-56-BC-71-3	0 00-04-56-BC-90-70
	CPU Utilization	10 %	Transmitted packets	0 pkts/sec	0 pkts/sec
Operations	Hardware Type	Dual Band Indoor Integrated	Received Packets	0 pkts/sec	0 pkts/sec
	Regulatory	ROW	Average TX	0 bps	0 bps
🗲 Troubleshoot 🗸	Serial Number	W8SH2231XBX2	Average RX	0 bps	0 bps
	cnMaestro Connection Status	Resolving URL	Mesh	OFF	OFF

Figure 5.8: cnPilot E400 dashboard

5.9.1 System Configuration

Go to System > Name: Md. Sabbir Ahamed

Location : Bangladesh

Placement : Indoor

🖶 🖅 🔇 cnPilot E400 - E400-BCE 🗙 –	+ ~			- 0 ×
\leftarrow \rightarrow \circlearrowright \textcircled{o} 192.168.0.1/	#/home-view/configure-system			□☆ たん ピ …
Cambium Networks cnPil	ot E400 - E400-BC611C	;		🗢 Reboot 😁 Logout
Let Dashboard	Configure / System			
🚯 Monitor 👻	System			
Configure -		Name	Md. Sabbir Ahamed Bangladesh	Hostname of the device (max 64 characters) Location where this device is placed (max 64 characters)
System	Co	Contact	India	Contact information for the device (max 64 characters) For appropriate regulatory configuration
∳ Radio		Placement	Indoor O Outdoor Configure the AP placement	
🗢 WLAN		LED	Whether the device LEDs should be ON during of	peration
A Network		LLDP	Whether the AP should transmit LLDP packets	

Figure 5.9: cnPilot E400 System setup

5.9.2 System – Management

Go to System > Management. Then given Admin Password.

C cnPilot E400 - E400-BCt × + ∨			- o ×
← → ♡ ⋒ ③ 192.168.0.1/#/home-view	i/configure-system		□☆☆んピ…
	Name	Md. Sabbir Ahamed	Hostname of the device (max b4 characters)
Configure -	Location	Bangladesh	Location where this device is placed (max 64 characters)
🖵 System	Contact		Contact information for the device (max 64 characters)
	Country-Code	India	For appropriate regulatory configuration
* Radio	Placement	Indoor Outdoor Configure the AP placement	t details
🗢 WLAN	LED	Whether the device LEDs should be ON during of	peration
A Network	LLDP	Whether the AP should transmit LLDP packets	
Services	agement		
후 Operations	Admin Password	******	Configure password for authentication of GUI and CLI sessions
	Autopilot	Master ~	Autopilot Management of APs
F Troubleshoot -	Teinet	Enable Telnet access to the device CLI	
	SSH	Enable SSH access to the device CLI	
	SSH Key	×	Use SSH keys instead of password for authentication
	нттр	Enable HTTP access to the device GUI	
	HTTP Port	80	Port No for HTTP access to the device GUI(1-65535)
	HTTPS	Enable HTTPS access to the device GUI	

Figure 5.10: cnPilot E400 management setup

Go to System > cnMaestro. Then given cnMaestro URL.

Remote Management		
/alidate Server Certificate		
cnMaestro URL	cloud.cambiumnetworks.com	
Cambium ID		

Figure 5.11: cnPilot E400 cnMaestro cloud setup

5.9.3 System – NTP

Can be set as IP or full server name.

NTP Server 1	pool.ntp.org		Name or IP address of a Network Time Protocol server
NTP Server 2			
Time Zone	Asia/Dhaka	\sim	Configure Timezone

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.

$\leftarrow \rightarrow \bigcirc \bigcirc \bigcirc 192$	168.0.1/#/home-view/configure-wlan						□☆☆	LE
	outer, ynanie nenytanigae nin							1 I
	Add WLAN							
Monitor -	Edit WLAN							
Configure -	sabbir							
System								
- Oyatem	Basic Radius Server	Guest Access	Usage Limits	Scheduled Access	Access	Passpoint		Delete
Radio								
🕈 WLAN	Basic							
	-	Enable						
A Network		Mesh	on	~	Mesh E	Base/Client/Recovery m	ode	
		-			-			
Services		SSID	sabbir		The SS	SID of this WLAN (upto 3	32 characters)	
			sabbir					
		VLAN	1		Default	VLAN assigned to clier	ts on this WLAN. (1-4094)	
Ξ Operations		VLAN Security	sabbir 1 WPA2 Pre-shared	Keys 🗸	Default Set Aut	VLAN assigned to clier	its on this WLAN. (1-4094) ion type	
E Operations		VLAN	1	Keys 🗸	Default Set Aut WPA2 I	VLAN assigned to clier thentication and encrypt Pre-shared Security pas	its on this WLAN. (1-4094) ion type isphrase or key	
Ξ Operations		VLAN Security	1 WPA2 Pre-shared		Default Set Aut WPA2 I Define	VLAN assigned to clier thentication and encrypt Pre-shared Security pas	its on this WLAN. (1-4094) ion type	
 Services Operations Troubleshoot - 		VLAN Security Passphrase	1 WPA2 Pre-shared		Default Set Aut WPA2 I Define should	VLAN assigned to clier thentication and encrypt Pre-shared Security pas radio types (2.4GHz, 50	its on this WLAN. (1-4094) ion type isphrase or key	

Figure 5.13: cnPilot E400 add WLAN

5.9.5 WLAN - Rate Limi

Go to WLAN > Usage Limits.

🔁 🖅 💽 cnPilot E400 - E400-BCE ×	+ v					-	L B	×
\leftrightarrow \rightarrow \circlearrowright \textcircled{O} 192.168.0.1/	#/home-view/configure-wlan				□ ☆	\$≞	€ Log	
Cambium Networks [®] CnPile	ot E400 - E400-BC611		Success Usage Limits Configuration Saved	×		Contemporation Reboot	🕞 Lo	gout
Lul Dashboard	Configure / Wlan							
🖀 Monitor 🗸	Add WLAN							
Configure -	sabbir)						
System								
* Radio	Basic Radius Serv	er Guest Acce	ss Usage Limits Schedul	ed Access Access Passpoint			Delete	
🗢 WLAN	Rate	Limit per Client	Upstream:	Downstream:	spoint			
A Network			5120 Kbps	5120 Kbps				
Services	Rate I	imit per WLAN.	Upstream: 51200	Downstream: 51200				
Ξ Operations			Kbps	S1200 Kbps				
F Troubleshoot -			Sav	Cancel				

Figure 5.14: cnPilot E400 usage Limits setup

5.9.6 WLAN – Scheduled Access

Go to WLAN > Schedule Access.

Chi Con Con Control	~							- 0	5	×
← → Ů ⋒ 🗍 192.168.0.1/#	/home-view/	configure-wlan					☆ ☆	e la	ß	
Gystem										2
• Radio	Basic	Radius Server	()	Success Scheduled Access Config Saved	uration CCESS	Access Passpoint		Delet	te	
🕏 WLAN			Sunday	Start Time	End Time	HH:MM format				
A Network				02:00	23:00					
INCIMUIK			Monday	Start Time	End Time	HH:MM format				
Services		ſ	Tuesday	Start Time	End Time	HH:MM format				1
			nucsuuj	03:10	23:50					
F Troubleshoot -			Wednesday	Start Time	End Time	HH:MM format				
			Thursday	Start Time	End Time	HH:MM format				
			Friday	Start Time	End Time	HH:MM format				
			Saturday	Start Time	End Time	HH:MM format				
					Save Cancel					

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.

- → Ŭ ⋒ 0 19	2.168.0.1/#/home-view/configure-network				□ ☆	t⁄≡	2	B
Monitor -	VLAN Routes Ethernet Ports Security Di	ICP Tunnel PPPoE VLAN Pool						
	VLAN							
Configure -	Edit VLAN 1 V	Delete this interface			Ad	d new L3 In	terface	
System	IP Address	O DHCP						
Radio		Static IP 172.16.100.1	Network Mask 255.255.255.	0				
WLAN	NAT	When NAT is enabled, IP addresses unde	r this SVI are hidden					
Network	Zeroconf IP	Support 169.254 x x local IP address						
Network	Management Access	Allow from both Wired & Wireless	Ý	CLI/GUVSNMP access via this interface				
Services	DHCP Relay Agent	0.0.0.0		Enables relay agent and assign DHCP server to it				
Operations	DHCP Option 82 Circuit ID	None	~					
	DHCP Option 82 Remote ID	None	~					
Troubleshoot -								
	Routing & DNS							
	Default Gateway	172.16.100.1		IP address of default gateway				
	Domain Name		/	Domain name				
	DNS Server 1	203.190.10.252		Primary Domain Name Server				
	2	203.190.10.253		Secondary Domain Name Server				
	DNS Proxy	DNS Praxy						

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.

🖻 🖅 📀 cnPilot E400 - E400-BCE	× + ~			- o ×
← → ♡ ŵ ◎ 192.1	68.0.1/#/home-view/configure-network			
Cambium Networks	cnPilot E400 - E400-BC611C			ර් Reboot 🕞 Logout
III Dashboard	Configure / Network			
🔁 Monitor 🗸	VLAN Routes Ethernet Ports	Security DHCP	Tunnel PPPoE	VLAN Pool
🌣 Configure 🗸	Edit pool 1 ~	Delete this Pool	172.16.100.25	Create Pool
System	Default Router	172.16.100.1	Default router IP	
Radio	Domain Name		Domain Name	
🗢 WLAN	DNS Address	203.190.10.252	203.190.10.253	Domain name for the client
A Network	Network	172.16.100.0	255.255.255.0	Subnet number and mask of the DHCP address pool
Services	Lease	1 Save Cancel	23	59 Lease time (days:hours:minutes)
후 Operations	Add Bind List			
🗲 Troubleshoot 🗸	MAC Address		IP Address	Save
	XX:XX:XX:XX:XX		XXX.XXX.XXX.XXX	

Figure 5.17: cnPilot E400 DHCP setup

5.10 Hierarchical Navigation

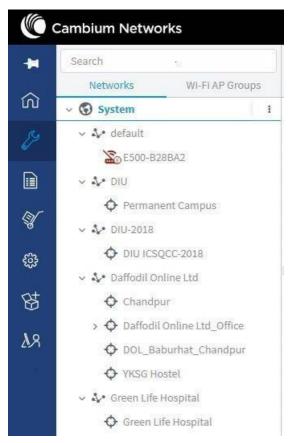


Figure 5.18: Hierarchical Navigation

5.11 OnboardDevicesUsingMSN

-Select Onboard Devices from Home or Navigate to Onboard

-Select "Claim Device"

-Enter MSN E500 Device

On	nboard											
Or	nboard Claim	from Device										
		ieue holds devices before th by setting location, configu			be approved in order	to complete the on	boarding process a	nd be managed l	by cnMaestro. Yo	i can pre-pro	vision devices	befo
Q	ζ Search								Claim Device	Approve All	Export 👻	
Ту	vpe T	Serial Number 🔻	Device T	MAC T	IP Address 🖭	Added By	Status T	Duration	Configure			
cn	Pilot e500	W85D1670GC2N	E500-B28BA2	00:04:56:B2:8B:A2	203.190.13.158	Kazi Mahbub Using Serial N	100 100 100 100 100 100 100 100 100 100	4d 23h 26m	Summary	ON	BOARDED 📌	
								Sho	wing 1 - 1 Total: 1	10 🔻	Previous	Ne
*7V	lote: Devices wil	l remain in the queue for 1 v	week after onboardin	g successfully.								

Figure 5.19: onboard device

5.12 System Dashboard

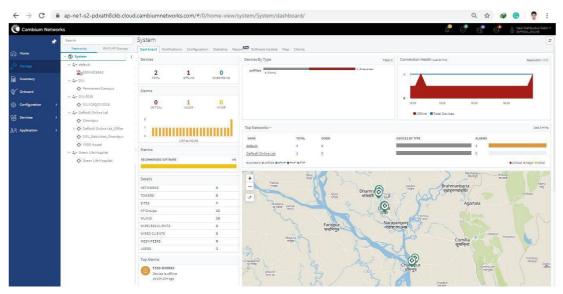


Figure 5.20: system dashboard

5.13 AP Dashboard

	*	Search	Sites > Daffodil Online	e Ltd_Office				
ப் Home		Networks Wi-FLAP Groups	Dashboard Notifications Co	nfiguration Statistics Report	Floor Plan APs	Clients		
		~ 😨 System	Wi-Fi	Wireless Last 5 mina	Throughput	Last 5 mina	RF Quality	Last 5 mir
		∼ 🎶 default		1 1111 2 0	27.14	13.78 Kbps	(()	((),
		SE500-B28BA2	Last Week Total Offline	Last Week Clients Mesh Peer		20	2.4 GHz 5 C	
Onboard		 	AP Types	Clients	Resolution : 1 hr	Throughput		Resolution : 1)
Gonfiguration	*	DIU ICSQCC-2018		5				
5 Services		 Daffodil Online Ltd Chandpur 			u w L	2 56 92	1	
Application	*	>			M M N	1	h	3
		OOL_Baburhat_Chandpur	100.0%		in 5 h	Ν.	MILL	A had
		YKSG Hostel	cnPilot e400	0 28 Dec 30 Dec	01 Jan	281	Dec 30 Dec	01 Jan
		🗢 🎝 Green Life Hospital		- 2.4 GHzi - 5	GHz: -	- Downlink: -	Uplink: -	
		Green Life Hospital		Channel Distribution by AP	Last 5 mins	Radio/WLAN Dist	cribution by AP	Last 5 mil
			Top Wi-Fi APs by Throughput	2.4 GHz 5 GHz		Radios	WLANS	

Figure 5.21: AP Dashboard

5.14Inventory

- Column Groups Change ColumnDisplay
- Wireless LAN View Uses AP Table Instead

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Figure 5.22: Inventory

5.15 Alarm Page

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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.

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