MikroTik Bandwidth Management and Monitoring of an ISP Network

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An internship paper submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Electronics and Telecommunication Engineering

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DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

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APPROVAL

This Internship Report Titled "**MikroTik Bandwidth Management and Monitoring of an ISP Network**" is submitted by **Md. Zahidul Islam** to the Department of Electronics & Telecommunication Engineering, Daffodil International University, has been accepted as fit for the partial fulfillment of the condition for the Degree of B.Sc. in Electronics and Telecommunication Engineering and approved as to its style and guts. The Presentation will be held on March 2021.

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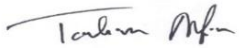

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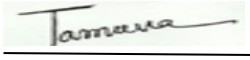

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DECLARATION

This internship report is submitted to the Electronics and Telecommunication Engineering, Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science. So, I hereby, declare that this internship report is based on the practical work done by me and the theoretical study for that work. Materials of work found by other researchers are mentioned by reference. This internship report, neither in whole, nor in part, has been previously submitted for any degree.

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ACKNOWLEDGEMENT CERTIFICATE

First we express our heartiest thanks and gratefulness to almighty Allah for His divine blessing makes us possible to complete this project successfully.

We fell grateful to and wish our profound our indebtedness to **Ms. Sirajum Munira. Lecturer**, **(Senior Scale)**, Department of ETE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "**MikroTik Bandwidth Management and Monitoring of an ISP Network**" us to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to **Md. Taslim Arefin, Associate Professor and Head,** Department of ETE, for his kind help to finish our project and also to other faculty member and the staff of ETE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

This report focuses on design, implementation and monitoring of an ISP network. Ensuring minimal downtime and maximum continuity of a network service is the main goal of an Internet Service Provider Company.

Internet Service Provider (ISP) can provide various services like data connectivity service, Internet service, Security ensures, Fiber optic networks, Network infrastructure design and maintenances and support. In enterprise network infrastructure, ISP provide backup links that can keep up a network even when unplanned outage occurs. To ensure maximum availability of a designed network it is difficult when power outage or load shedding occurs.

If we can design a network that is more beneficial, more secure, highly reliable and faster, then it will be more useful for any organizations. Besides, if we can ensure maximum continuity of a network by using redundant links, power backup by using renewable energy source and proper monitoring then the quality of service of the network will also increase.

EXTERNAL SUPERVISOR'S CERTIFICATION

This is to certify that "**Md.Zahidul Islam**", **ID: 161-19-1870**, Department of Electronics and Telecommunication Engineering (ETE),Daffodil International University, has done this internship report on **"MikroTik Bandwidth Management and Monitoring of an ISP Network"** as a partial requirement of his Bachelor of Science Degree. During his attachment with "Infocom Limited" as an Intern, he worked in the "Network Operation Center (NOC)" under my guidance and supervision. To the best of my knowledge this work has been completed solely by him unless otherwise stated.

I wish him every success in life.

Md. Shiplu Hossain
Manager, Network Administration

Deputy Manager of the Network Operation Center (NOC),

Infocom Limited

PREFACE

First, I would like to convey my gratitude to almighty Allah for giving me the strength to perform my responsibility as an intern and complete the report within due time.

My special thanks go to supervisor **Ms. Sirajum Munira**, **Lecturer (Senior Scale),** Department of Electronics and Telecommunication Engineering, Daffodil International University for her cordial guidance, encouragement, and active help to prepare my internship report. He allocated valuable time throughout the Internship period to guide me for successfully completion of the internship and preparing this report.

I would specially like to convey my gratitude to my company supervisor, Deputy Manager of the NOC, Infocom Limited who gave me the opportunity of the internship under his department and guiding me with lots of effort and time.

Last but not the least; I would like to convey my gratitude to my colleagues, friends and teachers who gave me good advice, suggestion, inspiration of support.

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Chapter-1

In this chapter brief description about Information and Technology (IT) and importance of IT will be discussed. Computer networking is a major part of Information and Technology. Now a day it is playing an important role in modern society.

Introduction

1.1. Background of the Study:

We live in "Information and Technology" century. In this century information and technologies is a main part of our modern life. We will not move forward without Information and Technology. IT has different types of categories; among them Computer Networking is the major part of IT infrastructure. Now each and every organization is highly depending on Computer Networking. Many of other organizations are servicing computer networking technologies. And they are earning a lot of revenue from these services.

I had an opportunity to work with most leading IT and Internet Service Provider (ISP) service provider that is BDCOM Online Limited. I consider myself timely to get a chance to take a deep look to their development methods, working models, deals and industrial behavior. And I was intending to look into the Networking Industry and how it looks like practically, how they interact with their clients, how they design a system and what are their rules in their environmental work.

1.2. Statement of Problems:

I got the chance to work in Network Operation Center (NOC) in Infocom Limited. We know computer networking is the principal part of our modern life. I decided to know about computer networking and how does it work, how to design a wide area network and backbone network, what are the important keys to design a beneficial network, how can I design cost effective network and how to mitigate downtime of a network.

We know network downtime depends on many other problems. One of them is power problem. Due to lack of electricity load shedding can be occurred and that has caused many devices offline. We can use UPS for backup power, but it has only for a limited time on the other hand fuel of generator is costlier to long time maintain these devices.

1.3. Objectives:

Computer network technologies are being an explosive in this modern era. We narrow the scope considerably. First, we have designed a green energy technology that can ensure maximum uptime in our computer network technologies. We confine ourselves to designing a solar system technology that can ensure us maximum uptime of our designed network. Then we move to planning and designing of backbone networks. These are most frequently owned by organizations for their own employment; that is, private networks. This takes out the very large networks, especially those public networks implemented by communication service vendors such as the telephone companies, and the largest internet service providers. In this paper, we have developed a solar power system technology that attached to our computer network and ensure us maximum uptime and high reliability. We also designed and optimize a complex backbone network that can be more beneficial for any large organization.

Chapter-2

In this chapter, we will discuss about the background research of our project. We will also discuss about different types of networking devices that are commonly use in networking sector. To design a commercial network what are the requirements and design process that will be discussed here.

Literature Review

2.1. Background Research:

In this modern age, Computer communication and information are the most important and beneficial parts for networking as well as on economic sector. For the interconnection of people, to communicate with each other and to meet the daily requirements of daily life, networks are becoming more important. The business networks must have be equivalent with respect to time and should be always under perfect maintenance and monitored to observe during the change of traffic load. So, proper planning is must to design a business network before implementation takes place. A good network always has all of its documentation for future reference and well planned.

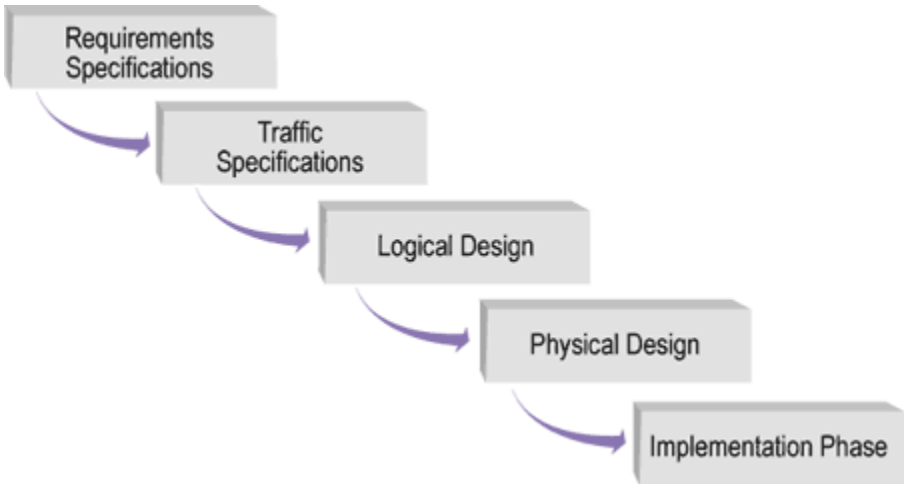

Figure 2.1: Network design steps

2.2. Switch:

In networking sector, Switch is a computer networking device that connects other devices together on a computer network, by using packet switching to receive, process and forward data to the destination device.

Figure 2.2: Switch

Multiple data cables are plugged into a switch to enable communication between different networked devices. Switches manage the flow of data across a network by transmitting a received message only to the one or more devices for which the message was intended. Each networked device connected to a switch can be identified using a MAC address, allowing the switch to regulate the flow of traffic. This maximizes the security and efficiency of the network.
An Ethernet switch operates at the data link layer (layer 2) of the OSI model to create a separate collision domain for each switch port**.**

2.3. Router:

In internet or in a packet switched networks, a router is call a device or software in a computer, which specifies the next free destination point on the network to which a packet should be forwarded. In OSI (Open System Interconnection) model, a router performs as Network Layer. Commonly Cisco, Juniper, HP, Dlink and Blink, Netgear, Nortel, Linksys, Redback, Lucent, 3Com are the popular companies currently making routers.

Figure 2.3: Cisco Router

Figure 2.3.1: MikroTik Router

After plugging power on router, it loads the Operating System from its flash memory. Then it loads the configuration file from Non Volatile RAM (NVRAM) that has lastly saved and set up the configurations from there. After completing set up all the configurations, when a router receives a request from any end device, it checks the destination IP address against its routing table. According to the destination IP address, the packet should be forwarded on the correct interface to the next free router. All next routers repeat the previous process until the packet reaches the destination.

2.4. Fiber Optic:

An optical fiber is a flexible, transparent fiber made by drawing glass (silica) or plastic to a diameter slightly thicker than a human hair. Optical fibers are used most often as a means to transmit light between the two ends of the fiber and find wide usage in fiber-optic communications, where it permits transmission over longer distances and at higher bandwidths than wire cables.

Advantage of fiber optic:

- Transmission of higher bandwidth to longer distance.
- Data can be transmitted digitally rather than analogically.
- Costs less to maintain.
- Much lighter and thinner than other cables.

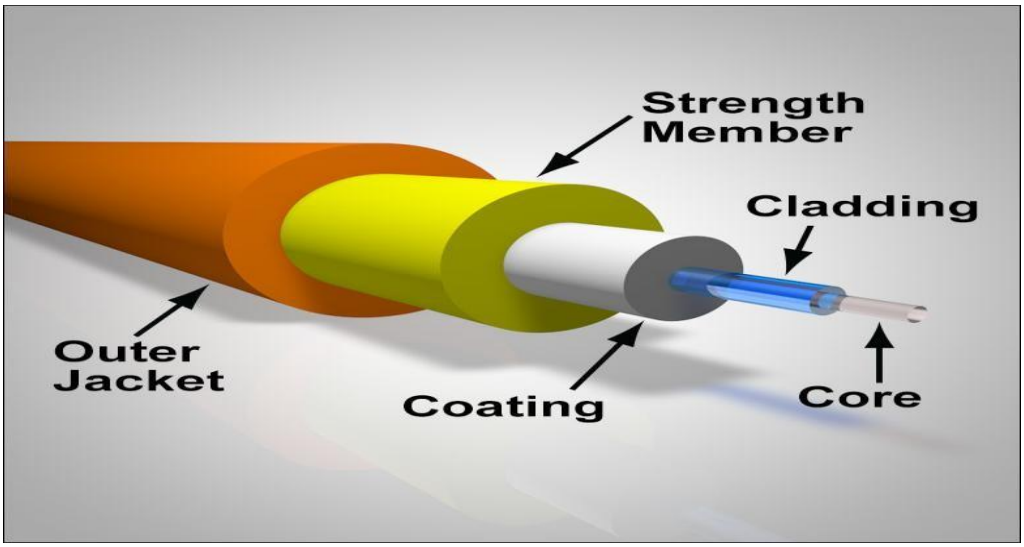

Figure 2.4: Fiber Optic Cable

2.5. Media Converter:

Media Converters is such a kind of networking device which enable connections of UTP copper-based Ethernet equipment over a fiber optic link to take advantage of the benefits of fiber by extending links over greater distances using fiber optic cable, protecting data from noise or any interference and making advantage for increasing additional bandwidth capacity for the future wide network.

Figure 2.5: Media Converter

Copper-based Ethernet connections are limited to a data transmission distance of only hundred (100) meters when using unshielded twisted pair (UTP) cable. There by using an Ethernet to fiber conversion system, fiber optic cabling can now use to extend that link over a longer distance.

2.6. Power over Ethernet (POE):

Power over Ethernet (PoE) is a technology for wired Ethernet LANs (Local Area Networks) that allow the electrical current necessary for the operation of each device to be carried by the data cables rather than by power cords. By minimizing the number of wires must be strung in order to install the network.

Figure 2.6: POE (Power Over Ethernet) Device

On a PoE device, the electrical current must go into the data cable at the power-supply end, and come out at the device end, in such a way that the current is kept separate from the data signal so that neither interferes with the other. The current enters the cable by means of a component called an injector.

In radio communication on networking, if PoE connected with radio tower then the sender and receiver radio tower must have to be in the same line of site.

Advantages of Power Over Ethernet:

1. Lower cost
2. Less downtime
3. Easier maintenance
4. Greater installation flexibility than traditional wiring

2.7. Field Required Theories:

2.7.1. Required things to design a network:

Some of the requirements must have to fulfill to design a network. These are:

- Network should be operational in all time even on the time of power failure, mechanical failure and on overloaded conditions.
- Reliability between client and service provider.
- Ensuring security of networking devices and mediums.
- Ensuring space availability for future wide range of network.
- Reduce downtime of link, findings and fixing of a problem should be faster.

2.7.2 Specification of a Corporate Network:

- Availability: A corporate network uptime should be 24 hours in a day and 7 days in a week. Also, redundant link should be available as a backup for every single link failure.
- Manageability: A corporate network should be simple in every case, because it is difficult to maintain too much complex network for all the time.
- Scalability: A well designed network should be scalable as to growth with the requirements. Any server, host or other stuff can be changed or increase at any time. So, design should be compatible for any increased case.
- Security: Security is the most important thing for a corporate network. Network should be secured from all the threats because there are many important & private documents can be existing on a corporate network

2.7.3 Network design methodology:

The following steps should be always maintained to design and fulfill all the requirement of a corporate network.

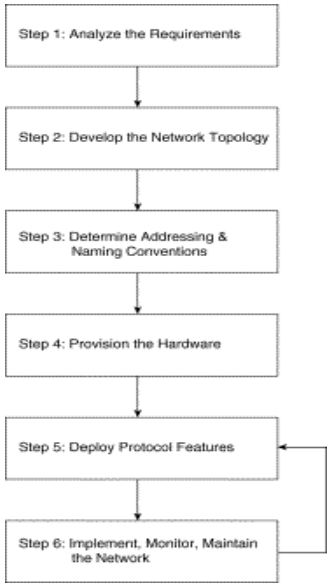

Figure 2.7.3: Design Steps of a Corporate Network

2.7.4 Objectives to design a network:

To design of a network some objectives can be followed as needed.

- How should the autonomous system be delineated? How many areas should it have and what should the boundaries be?
- Do your network and its data need to have built-in security?
- What information from other autonomous systems should be imported into the network?
- Which sites will have links that should be preferred (lower cost)?
- Which sites will have links that should be avoided (higher cost)?

2.7.5 Core things to design a network:

1. Performance Requirements
2. Protocols Required
3. Bandwidth Requirements
4. Quality of Service
5. Scalability
6. Security
7. Sensitivity to Packet Loss and Delay
8. Way of troubleshooting.

CHAPTER 3

Internship Activities:

This paper is about ISP network design and maintenance from Network Operation Center (NOC). The main works of NOC is to ensure the proper maintenance service, providing reliable connection to the clients, ensure high security of the network and providing required information related to the network to client.

3.1. ISP NOC support technique:

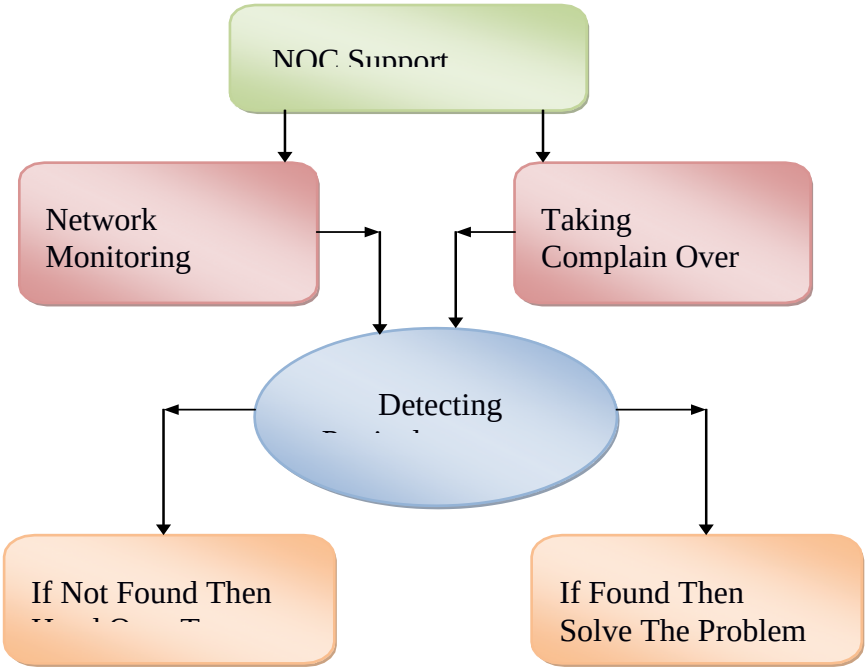

Figure 3.1: ISP NOC

Monitoring of the whole network is the main task of NOC department. For monitoring purposes BDCOM NOC uses Network Performance Monitoring tools like Orion or Solarwind, Nagios, MRTG and Cacti.

3.2. Solarwind:

Orion or Solar-wind Network Performance Monitor is a comprehensive bandwidth performance management and fault management application that allows to view the real-time statistics of the network directly from web browser. The Orion Network Performance Monitor will monitor and collect data from routers, switches, servers, and any other SNMP enabled device. Additionally, Orion monitors CPU Load, Memory utilization, and available Disk Space. Orion NPM is highly scalable, capable of monitoring from 10 to over 10,000 nodes.

Solar-wind monitors and easily informs users of system problems. By using Page Gate in conjunction with Solar-winds, urgent alerts can be sent to mobile phones, cellular phones and wireless devices, alerting administrators of critical issues. The combined benefit of using Note Page's software in conjunction with Solar-wind simply adds an advanced level of notification to a comprehensive network management solution.

- Monitoring and analyzes of real-time network condition for routers, switches, servers, and any other SNMP-enabled devices.

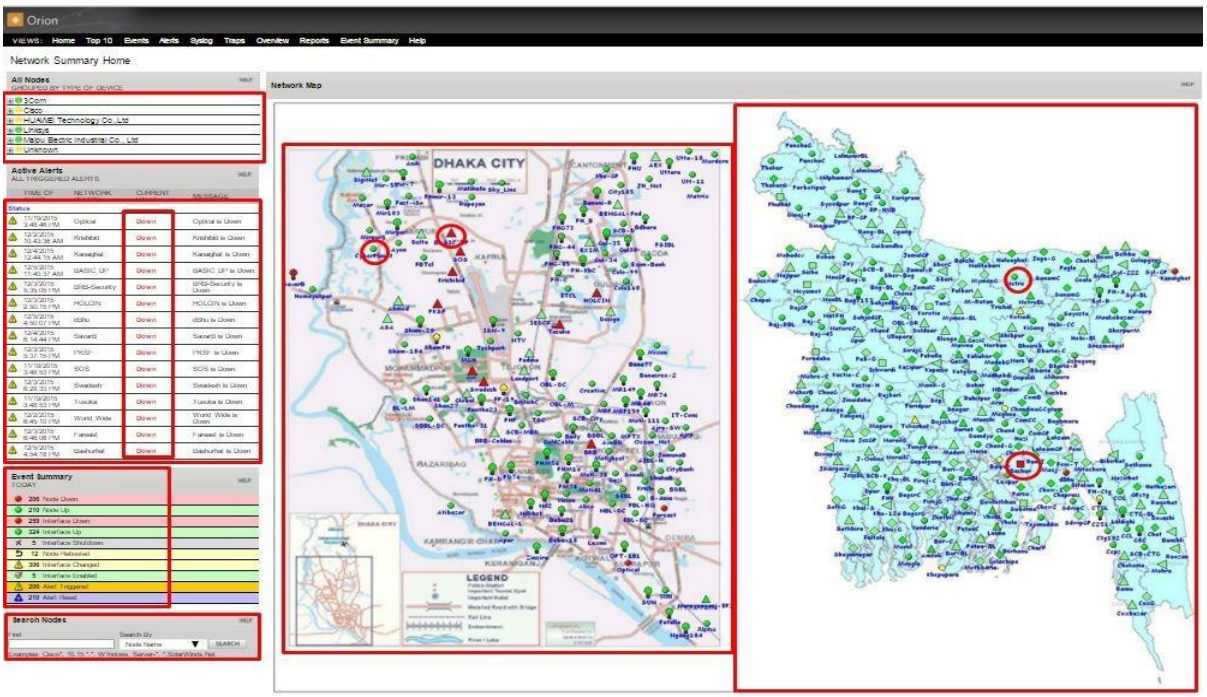

Figure 3.2: Network Performance Monitoring using Solarwind

Here, one the left portion of the home window of Orion shows the device list, switch status, down time and switch location. The middle portion shows the nodes of inside Dhaka city and the

last portion is the switch location of whole country. The red color defines the down nodes, green color defines the up nodes and yellow color defines the critical nodes.

- Operational efficiency and alert of dashboard for individual nodes.

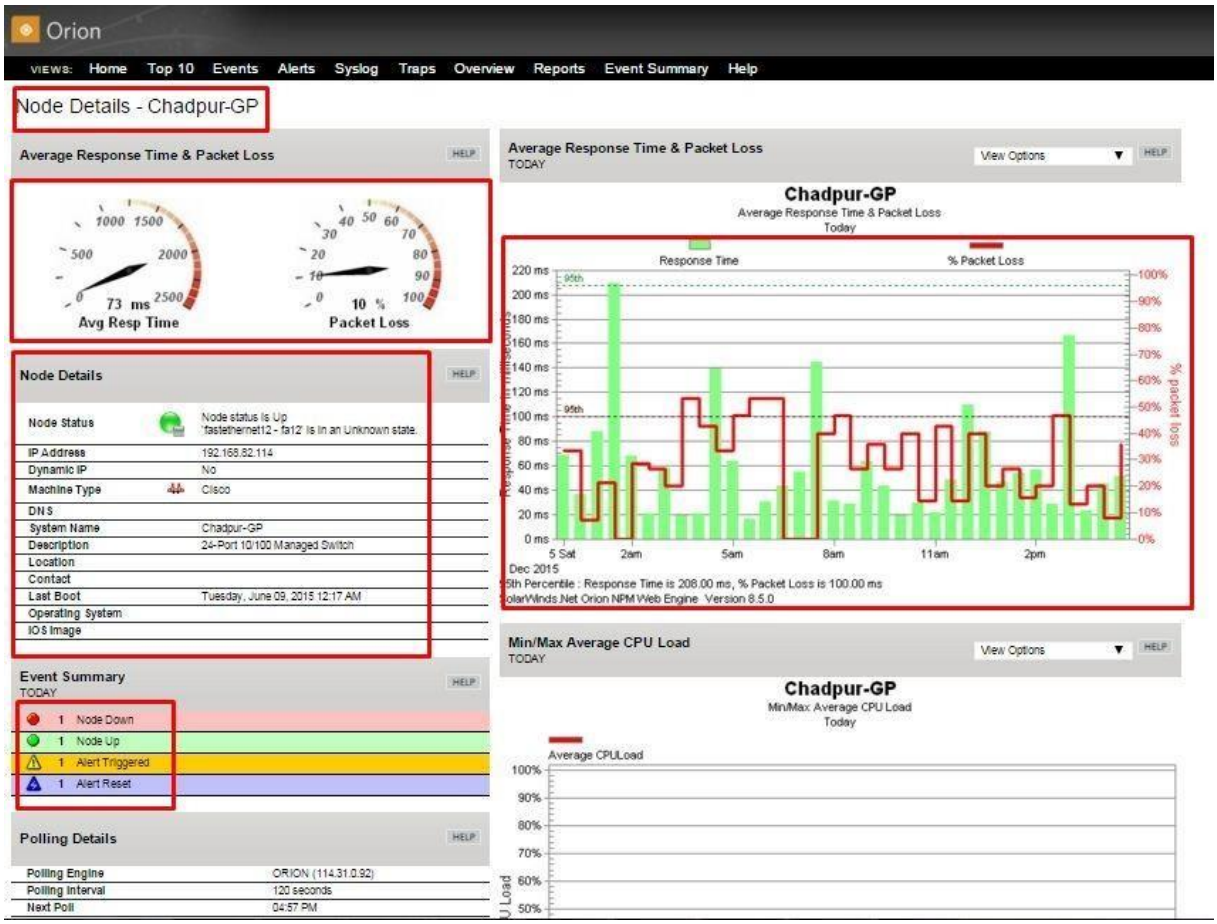

Figure 3.2.1: Status of an Individual Node

Here is the scenario of individual node on Orion. The upper marking area shows the node name, then the average response time and if any packet loss exists. Lest left portion defines the node detail and current status. The right portion of the figure defines the consumed bandwidth against the time response and also shows the packet loss too.

- Switch port status, transmit and receive alert for individual nodes.

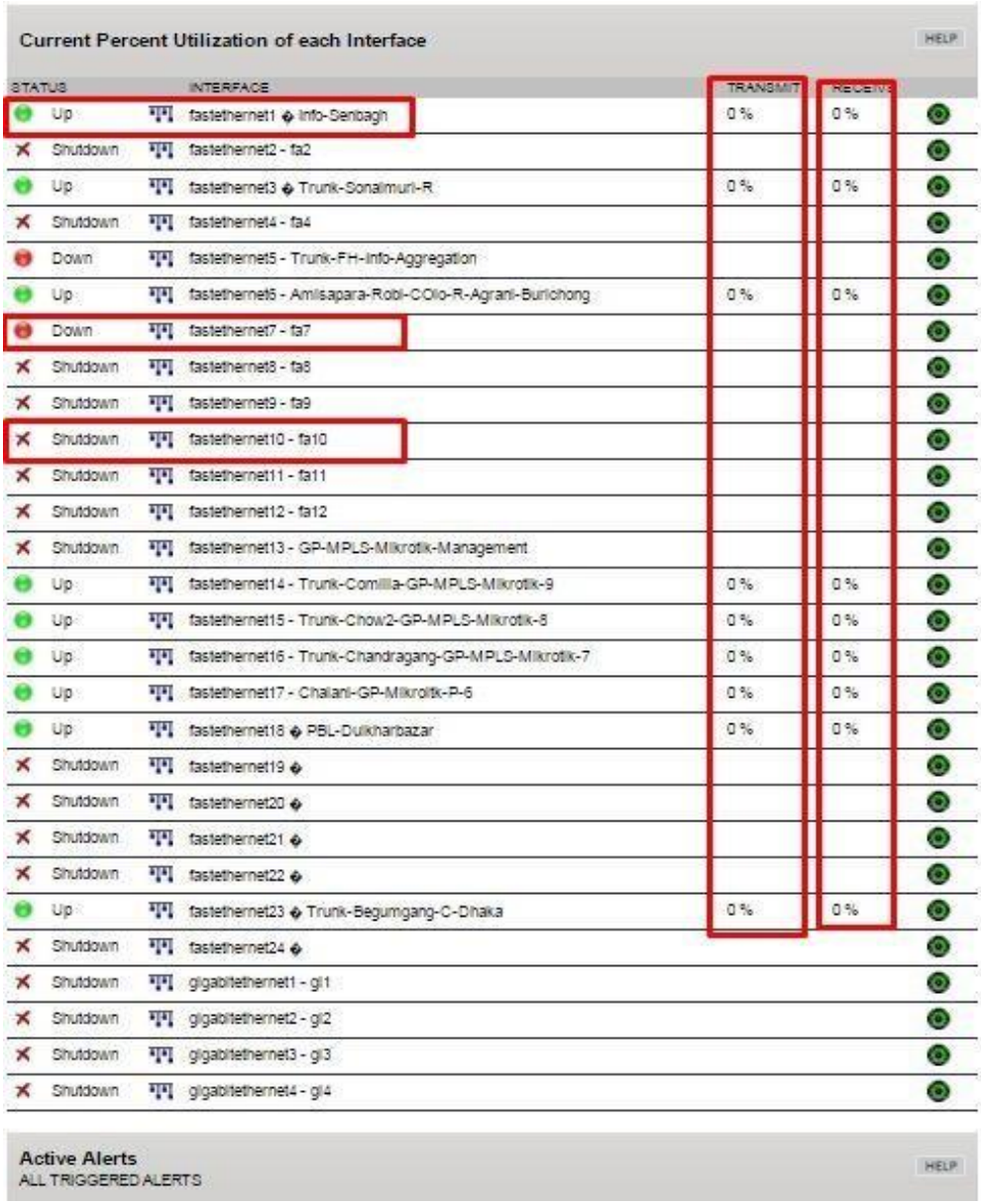

Figure 3.2.2: Switch port status for one node

Here is the scenario of different port status on an individual switch. On the left side, green color remarks the UP status of switch port, red color remarks the down status and red crossed symbol defines the shutdown status for the switch ports.

- Bandwidth alert of switches

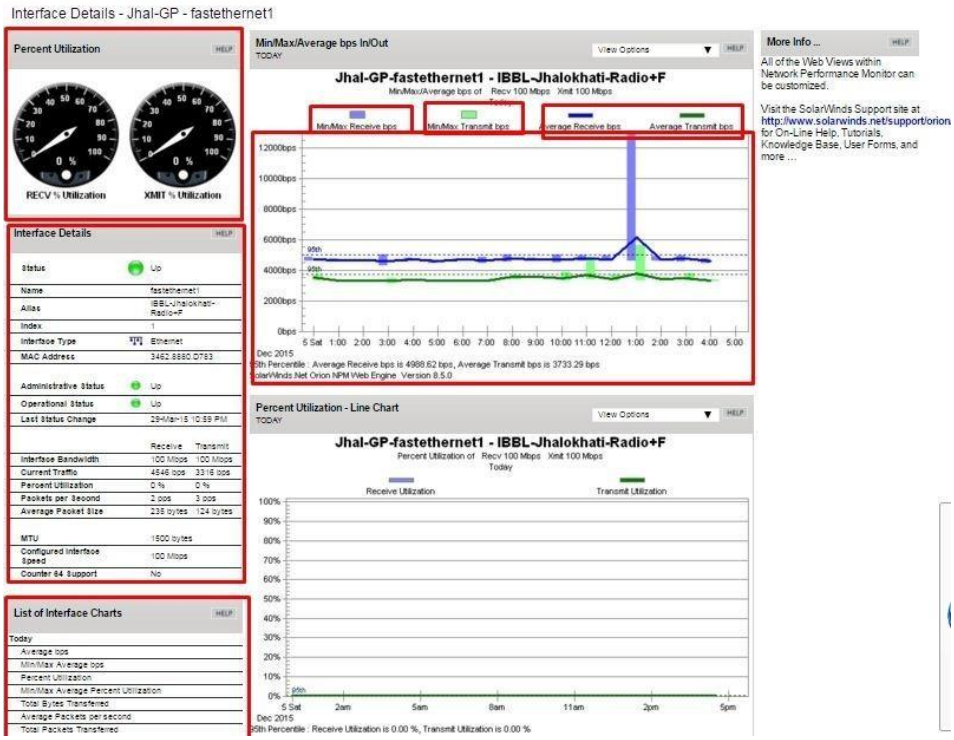

Figure 3.2.3: Bandwidth status for one node

- Summary of total consumed bandwidth through switches for one day, week or month.

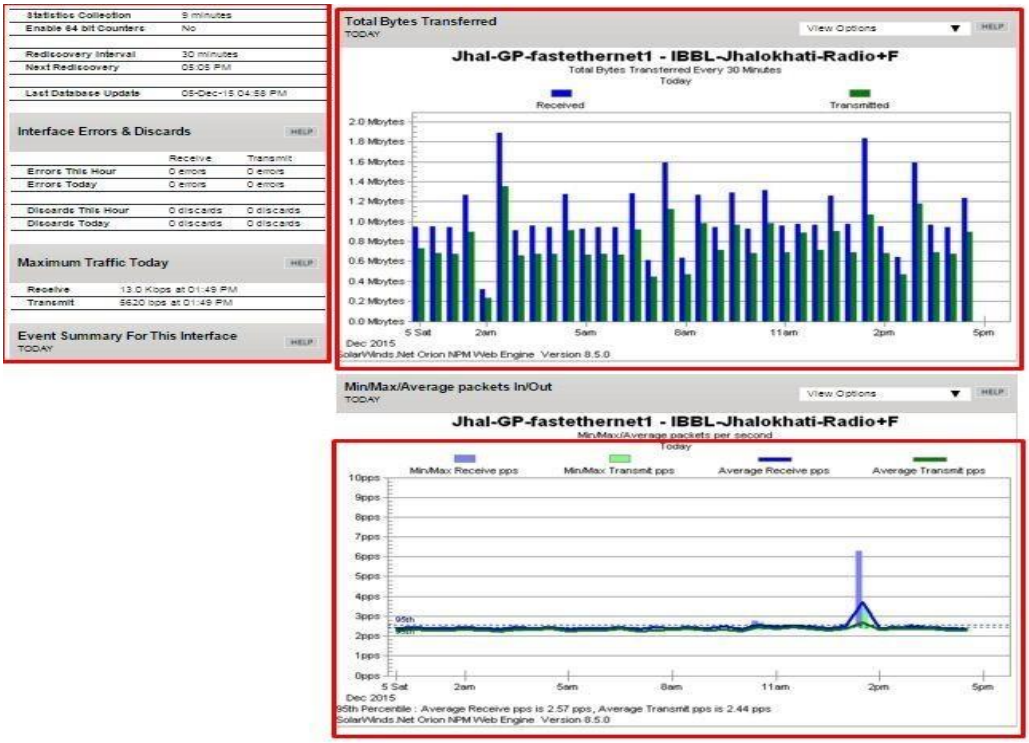

Figure 3.2.4: Consumed bandwidth summery

- Summary of all routers connected to the networks, their response time, packet loss, current status and the time of changing status.

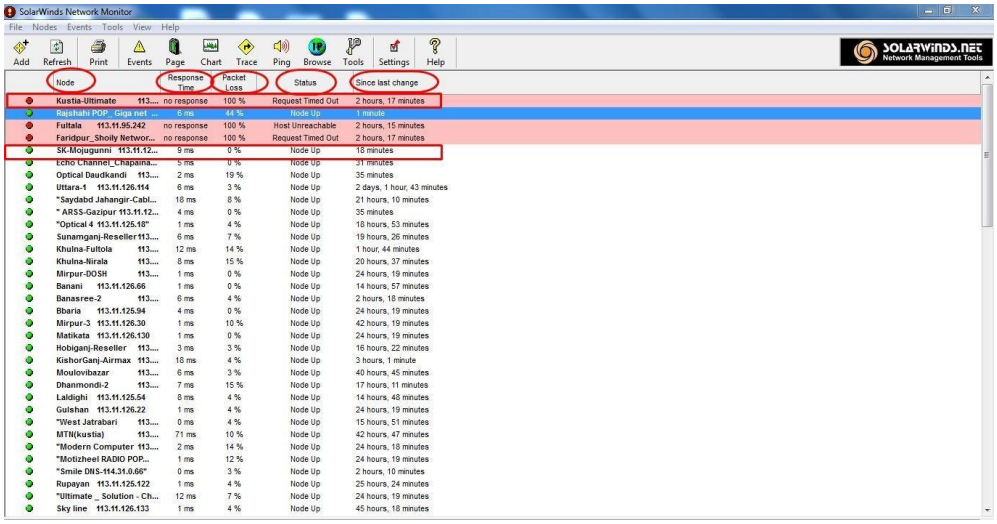

Figure 3.2.5: Solarwind Summery of all routers connected with network

3.3. Nagios:

Nagios is an open-source computer software application which monitors systems, networks and infrastructure. Nagios offers monitoring and alerting services for servers, switches, applications and services. It alerts users when things go wrong and alerts them a second time when the problem has been resolved.

Nagios network analyzer provides an in-depth look at all network traffic sources and potential security threats allowing system admins to quickly gather high-level information regarding the health of the network as well as highly granular data for complete and thorough network analysis.

It watches all host and service group and monitor their up, down and critical status to create alarm to inform system admin.

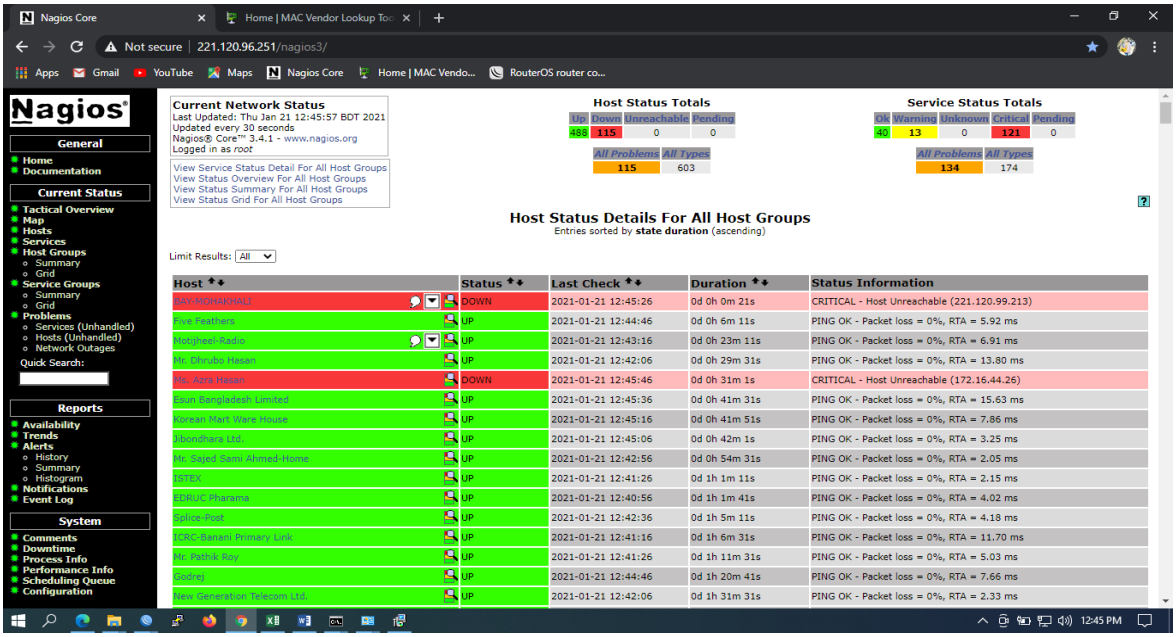

Figure 3.3: Up and Down interfaces with its status

Here on the figure, the left portion defines the groups, middle portion describes the current network status, host summery and other information. From status summery it is easy to define several hosts up, down or critical status.

Up and down interfaces with its detail status.

Here on the figure, it shows the detail monitoring scenario by Nagios monitoring tool with its automatic ping status and up or down time. The most effective advantage of Nagios monitoring tool is, here the down or up hosts can be filtered easily by its status.

Current status with response time inside one individual interface.

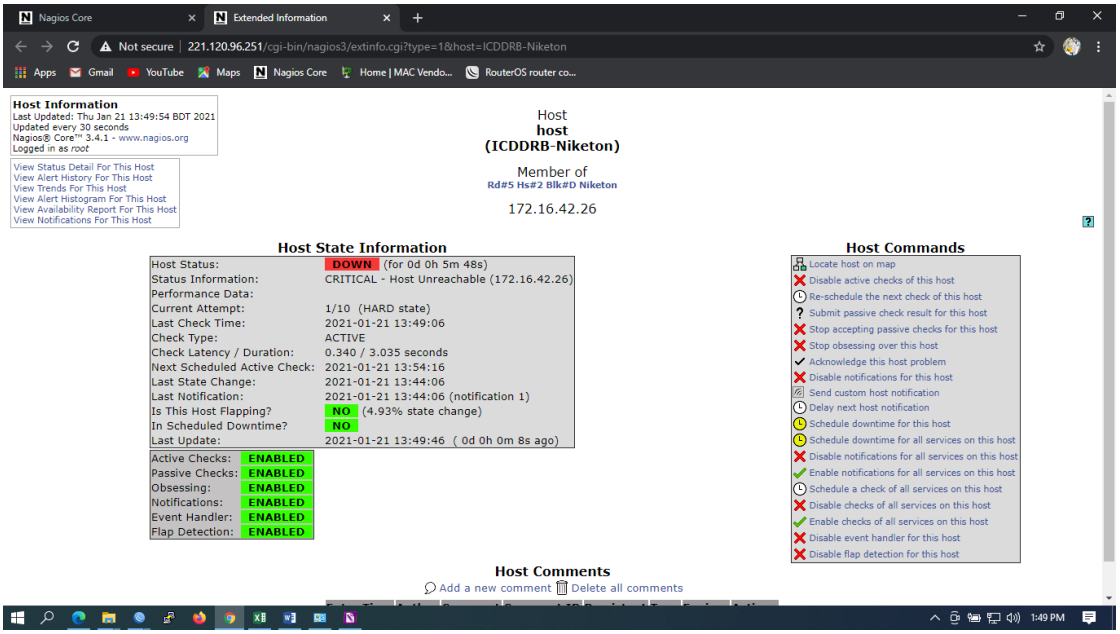

Figure 3.3.1: Individual hosts response detail

3.4. MRTG:

MRTG stands for Multi Router Traffic Graper, is a utility that is mainly works for administrators and users to keep track of the data transfer occurring through a router or other type of device. The devices that support the Simple Network Management Protocol (SNMP) can be subject to monitoring through MRTG.

By using Simple Network Management Protocol (SNMP), MRTG sends requests with two object identifiers to a device. The device, which must be SNMP-enabled, will have a management information base to look up the object identifiers specified. After collecting the information, it will send back the raw data encapsulated in an SNMP protocol. MRTG records this data in a log on the client along with previously recorded data for the device. The software then creates an HTML document from the logs, containing a list of graphs detailing traffic for the selected devices in the server.

Traffic summery of different routers of INFOCOM

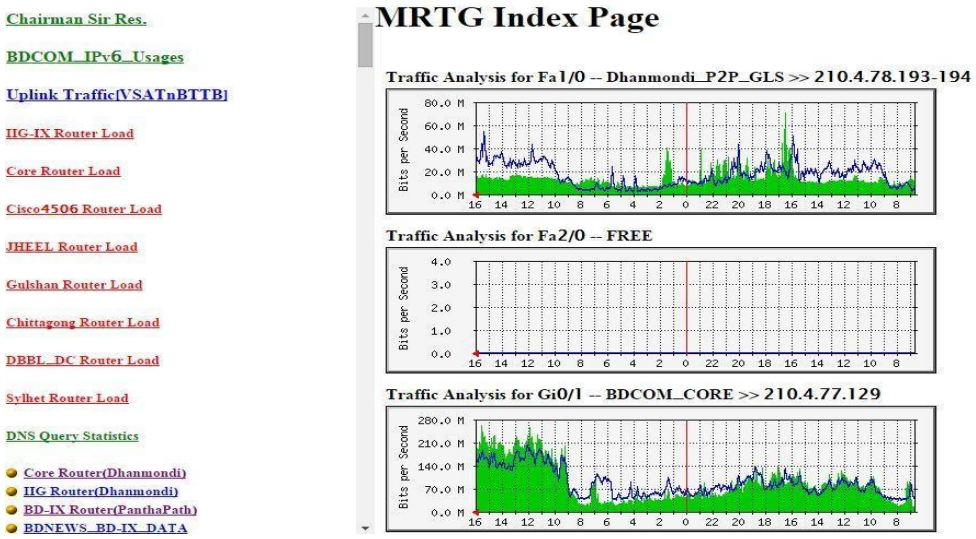

Figure 3.4: Bandwidth usages showing on MRTG

Traffic analysis for an individual link.

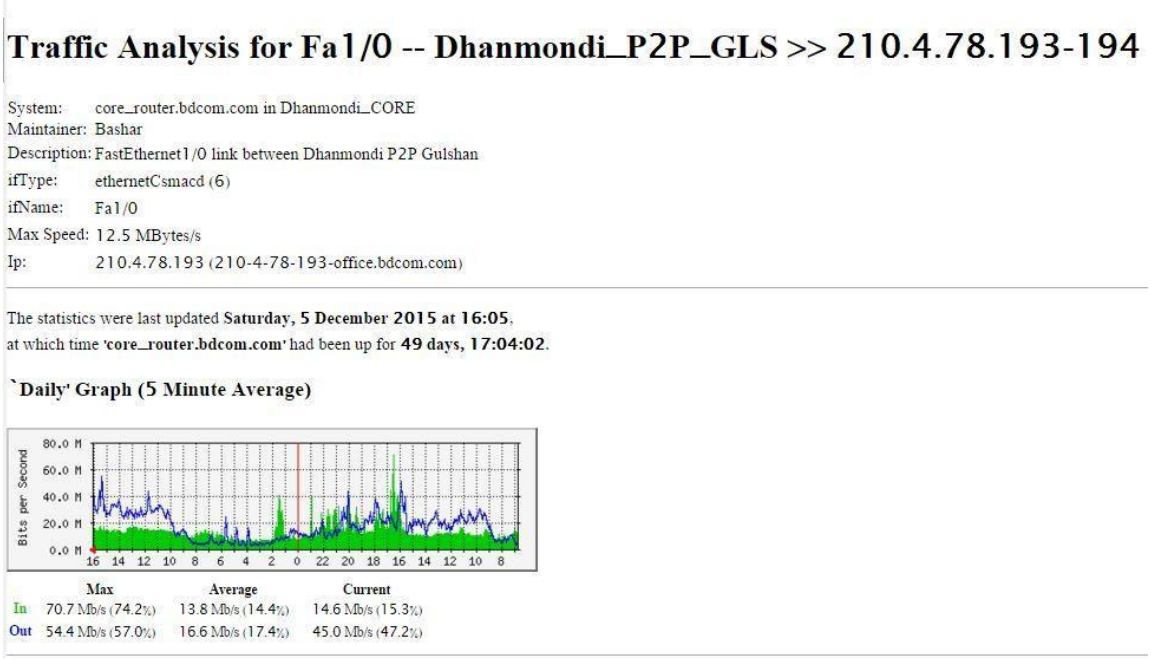

Figure 3.4.1: Traffic analysis for individual link showing on MRTG

3.5. Cacti:

Cacti is a complete network graphing solution designed to harness the power of RRDTool's data storage and graphing functionality. Cacti provide a fast polar, advanced graph tinplating, multiple data acquisition methods, and user management features. All of this is wrapped in a simple and easy to use interface that makes sense for LAN-sized installations up to complex networks with hundreds of devices.

RRDTool is the Open Source industry standard, high performance data logging and graphing system for time series data. RRDTool can be easily integrated in shell scripts, perl, python, ruby, lua or tcl applications.

Traffic analysis for individual switch ports of BDCOM switches.

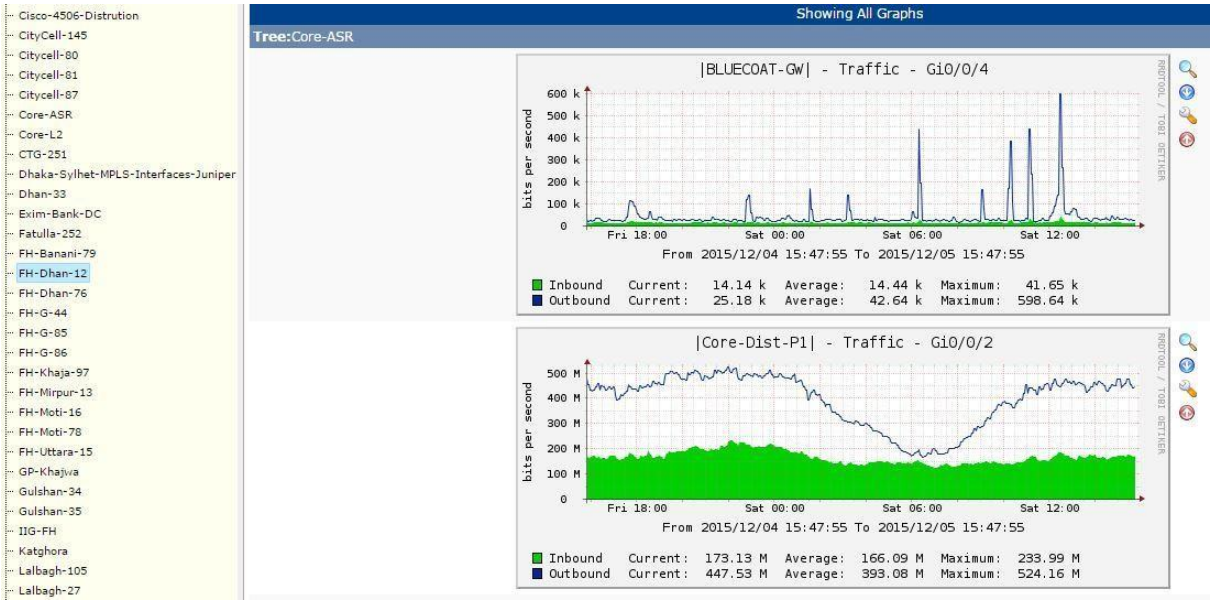

Figure 3.5: Traffic analysis for individual link showing on Cacti

3.6. Winbox:

Winbox is one of the interfaces to configure the Mikrotik Operating System router which is currently a popular running on the operating system Microsoft windows and MAC. It is more helpful for graphical user interface and also has console system. Here are some specifications of Mikrotik router using Winbox.

Overview of a Winbox with PPP, interface list, router log and address list.

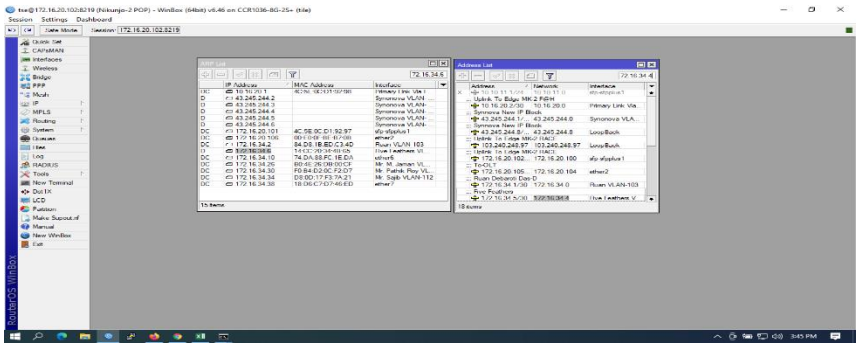

Figure 3.6: Different type of routing, firewall and monitoring on Winbox

Firewall, ARP list, IP Pool, RIP, OSPF, BGP, Queue list, and Ping

Firewall, ARP list, IP Pool, RIP, OSPF, BGP, Queue list, and Ping

Mikrotik Terminal command prompt, IPsec, Traffic monitoring, Bandwidth test and IP Bridge.

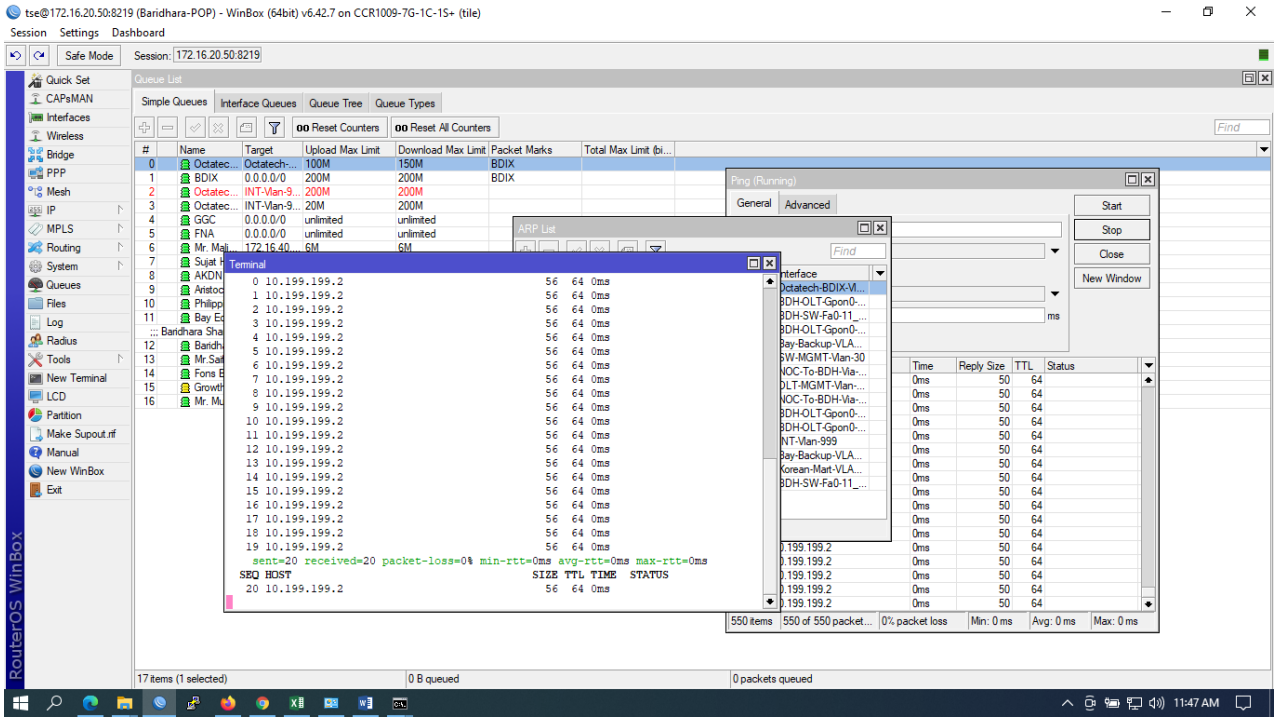

Figure: 3.6.1: Terminal, Bridge and Bandwidth monitoring on Winbox

3.7. Improvements:

During my internship time, I have noticed that due to power and backbone problem many networking devices down situation occurred. Network downtime can be reduced by using solar enabled power backup system and backup power monitoring tools merged with network monitoring tools. Besides, if the power of fiber backbone can be monitor time to time then downtime of network should be reduced to half. Solar power backup system costs lower than Uninterruptible Power Supply (UPS) backup system. If we use solar power backup system then, the power pressure on our national grid will also be reduced. If we can do that it will be more beneficial for us in both ways.

3.8. Basic Network Diagnostic & Troubleshot:

The basic network diagnostic & troubleshot using some windows command prompt such as ping, path ping, traceroute, IP config, Flush DNS.

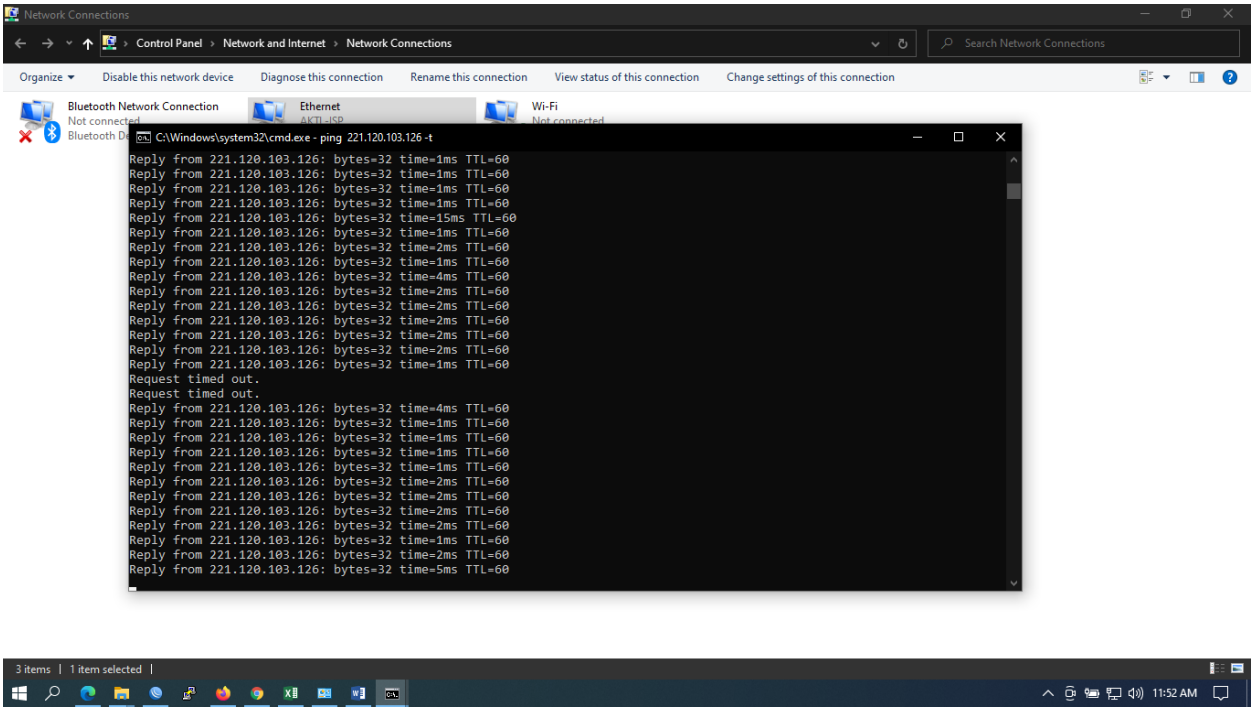

Figure 3.8: Windows Command Prompt ping check

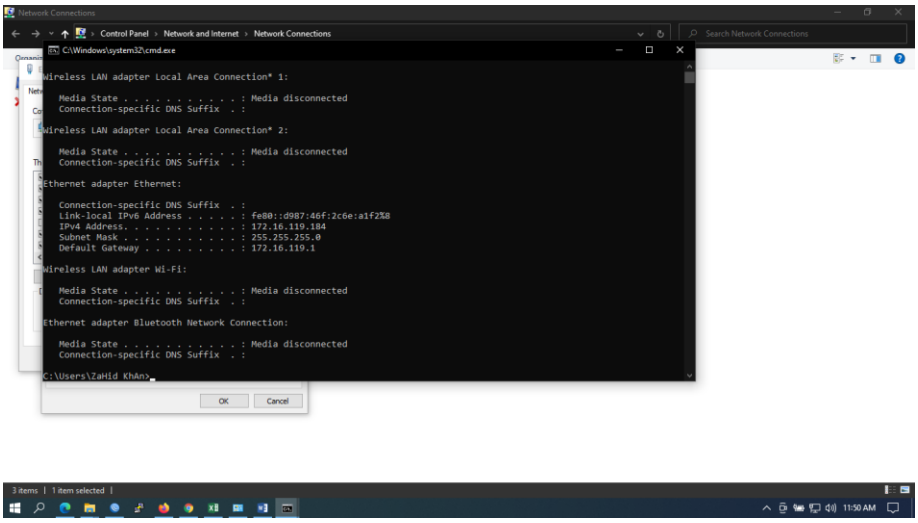

Figure 3.8.1: Windows command prompt IP check

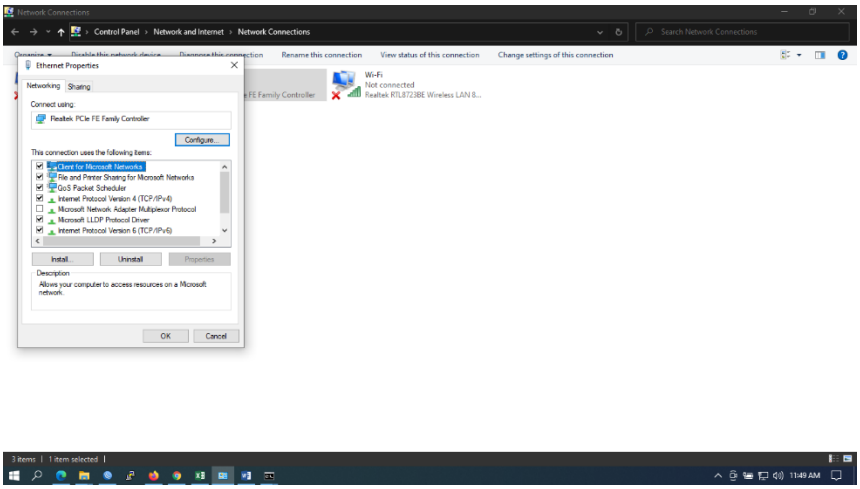

Figure 3.8.2: Troubleshooting of ethernet

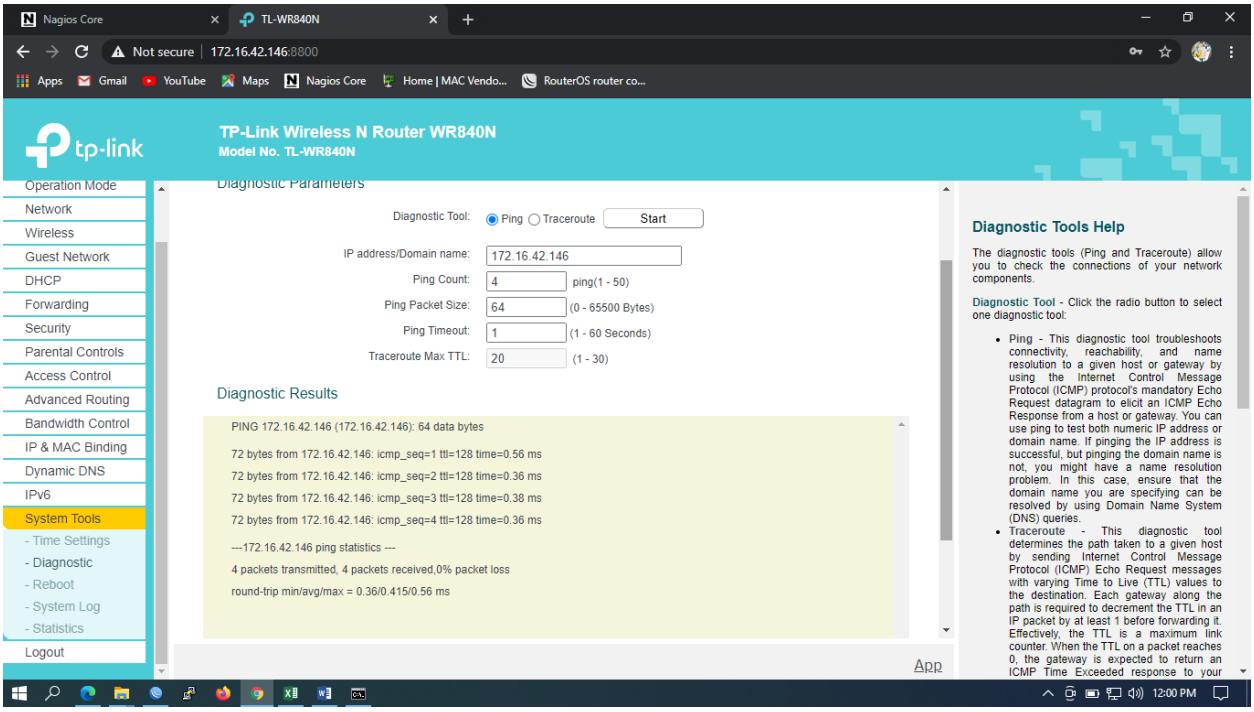

Figure 3.8.3: Used ping tool of router

BDCOM OLT interface status:

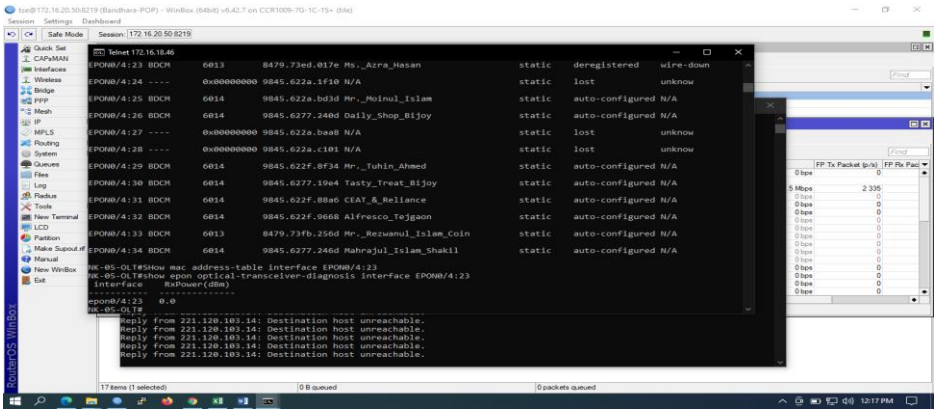

Figure 3.8.4: Check the connection path

Putty is a 3rd party software for connecting the remote device such as switch router and server via telnet, ssh and serial port.

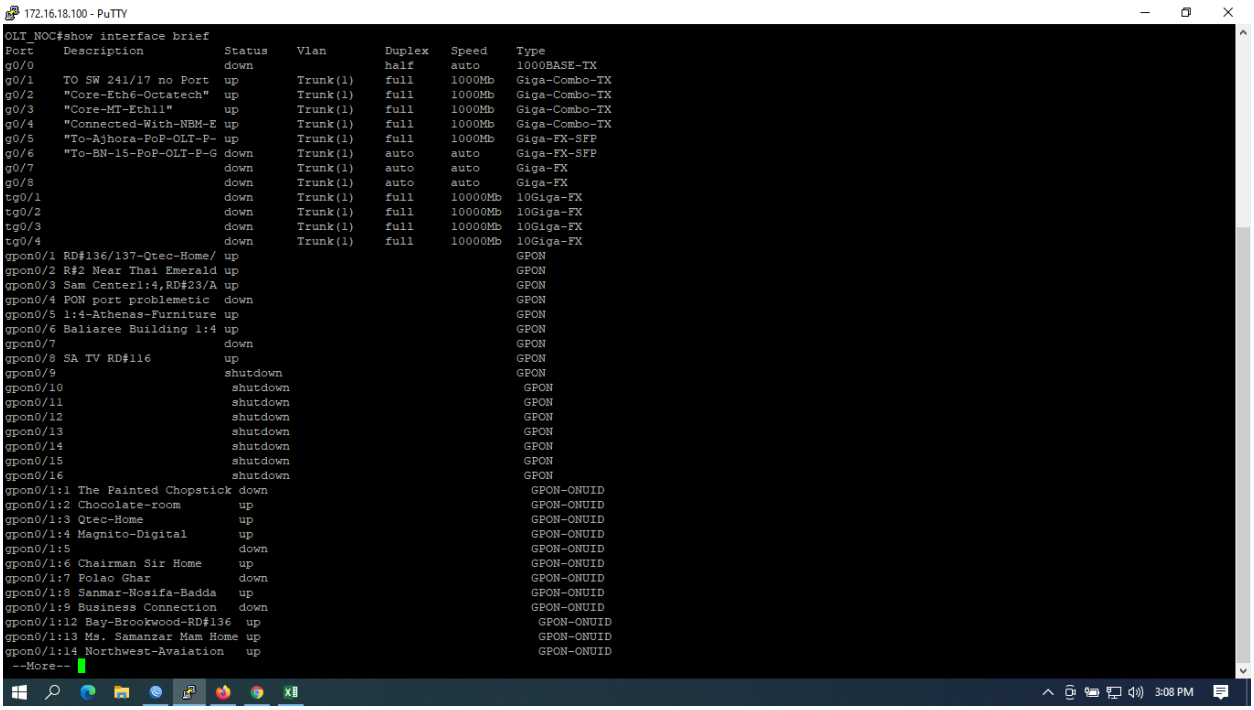

Figure 3.8.5: Olt Physical link monitoring

Chapter-4

Methodology:

In this chapter, we will discuss about the design process of a corporate network, process of the downtime of network and security of the network.

4.1. Concepts:

4.1.1. Backbone Network Design:

To design a corporate network, we need to follow some rules that create a network more efficient. A designed corporate network has some goals that we have already discussed earlier.

These are:

Scalability

- Redundancy
- Performance
- Security
- Manageability
- Maintainability

Hierarchical network is mainly divided into three layers.

1. Core layer: This layer mainly connects the other distribution layer devices. Core Layer consists of biggest, fastest, and most expensive routers with the highest model numbers and Core Layer is considered as the back bone of networks.

2. Distribution layer: This layer interconnects the smaller local networks with core layer. Distribution Layer is located between the access and core layers. The purpose of this layer is to provide boundary definition by implementing access lists and other filters. Therefore, the Distribution Layer defines policy for the network including high- end layer 3 switches which ensures that packets are properly routed between subnets and VLANs in the enterprise.

3. Access layer: This layer provides connectivity for network hosts and other end devices. Access layer includes access switches which are connected to the end devices (Computers, Printers, and Servers etc). Access layer switches ensures that packets are delivered to the end devices.

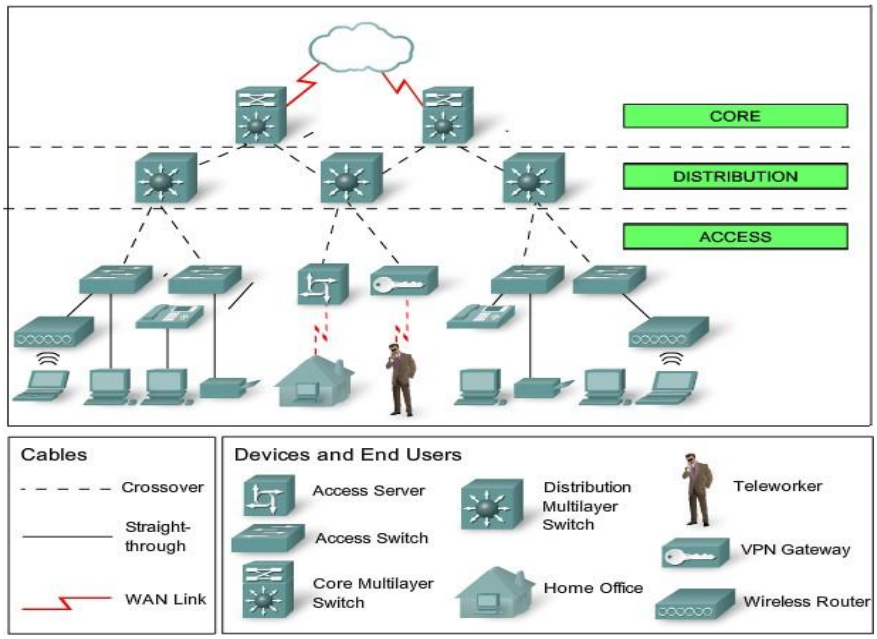

Figure 4.1.1: Backbone network design

For the wide area network in long distance communication, we can use fiber optics backbone medium in the place of Ethernet cable. Besides, using radio transmission and GSM (E1) backbone are also useful way for long distance network communication.

4.2. Methods:

4.2.1 Network Planning:

Network planning process involves three main steps:

- **Topological Design**: This stage involves determining where to place the components and how to connect them. The topological methods that can be used in this stage come from an area of mathematics called Graph Theory. These methods involve determining the costs of transmission and the cost of switching, and thereby determining the optimum connection matrix and location of switches and concentrators.

- **Network Synthesis**: This stage involves determining the size of the components used, subject to performance criteria such as the Grade of Service (GoS). The method used is known as "Nonlinear Optimization", and involves determining the topology, required GoS, cost of transmission, etc., and using this information to calculate a routing plan, and the size of the components.

- **Network Realization:** This stage involves determining how to meet capacity requirements, and ensure reliability within the network. The method used is known as "Multicommodity Flow Optimization", and involves determining all information relating to demand, costs and reliability, and then using this information to calculate an actual physical circuit plan.

4.2.2 Network Design:

In hierarchical design contains separate broadcast domains. And it is used to group of devices into multiple networks. This model is mainly divided into three layers.

1. Core layer
2. Distribution Layer
3. Access layer

Advantages of 3-Layered model:

- Provide the flexibility in the network with three layers distribution, each layer is mapped with physical implementation and each of layers has its own features and functionality.
- 3-layer model is easier to understand and easy to grow your network.
- 3-layer model is easy to troubleshoot because of its logical distribution into layer, as each layer has its own functionality.
- Allow us the lower cost in implementation.

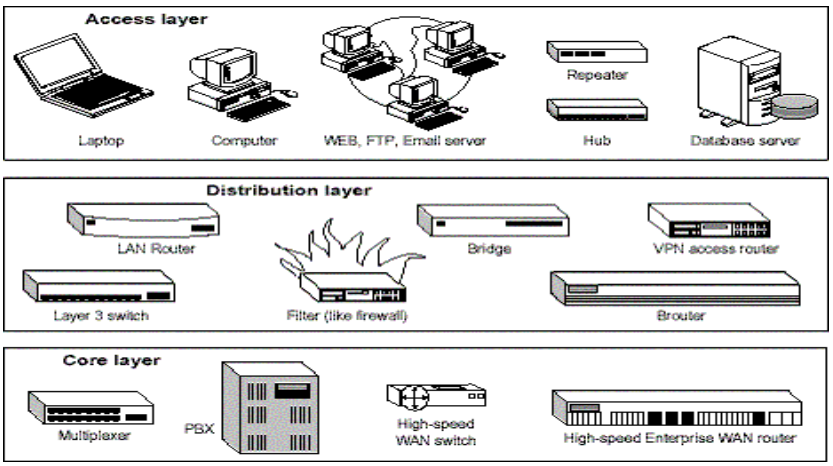

Figure 4.2.2: Three layers hierarchical model

4.2.2.1 Design of Core Layer:

The key characteristics of core-layer are following:

- Fast transport and large amount of data
- Redundancy
- High reliability and availability
- Low latency and good manageability
- Quality of service (QoS) classification, or other processes
- Fault tolerance
- Limited and consistent diameter

Devices of Core Layer:

- High end routers and switches
- Layer-3 switches
- Gateways and media converters
- Soft Switches for IP telephone

4.2.2.2 Design of Distribution Layer:

key characteristics of distribution-layer are as following:

- Route filtering by source or destination address and filtering on input or output ports
- Hiding internal network numbers by route filtering
- Static routing
- QoS mechanisms, such as priority-based queuing
- Redundancy and load balancing
- Aggregation of LAN wiring closets and WAN connections

- Security filtering
- Route summarization
- Broadcast or multicast domain definition
- Routing between virtual LANs (VLAN)
- Redistribution between routing domains.

Devices of Distribution Layer:

- LAN Router
- Layer 3 Switches
- Bridge
- Filter (Like Firewall)
- VPN Access Router

4.2.2.3 Design of Access Layer:

key characteristics of access-layer are as following:

- High availability
- Layer 2 switching
- Port security
- Broadcast suppression
- QoS classification and marking and trust boundaries
- Rate limiting/policing
- Address Resolution Protocol (ARP) inspection
- Virtual access control lists (VACL)
- Spanning tree protocol (STP)
- Trust classification
- Power over Ethernet (PoE) and auxiliary VLANs for VoIP

Devices of Distribution Layer:

- End Devices (Desktop, Laptop, IP Camera, Printer)
- WEB, FTP, Email Server
- Repeater
- Hub
- Database Server
- Video conferencing
- IP telephony

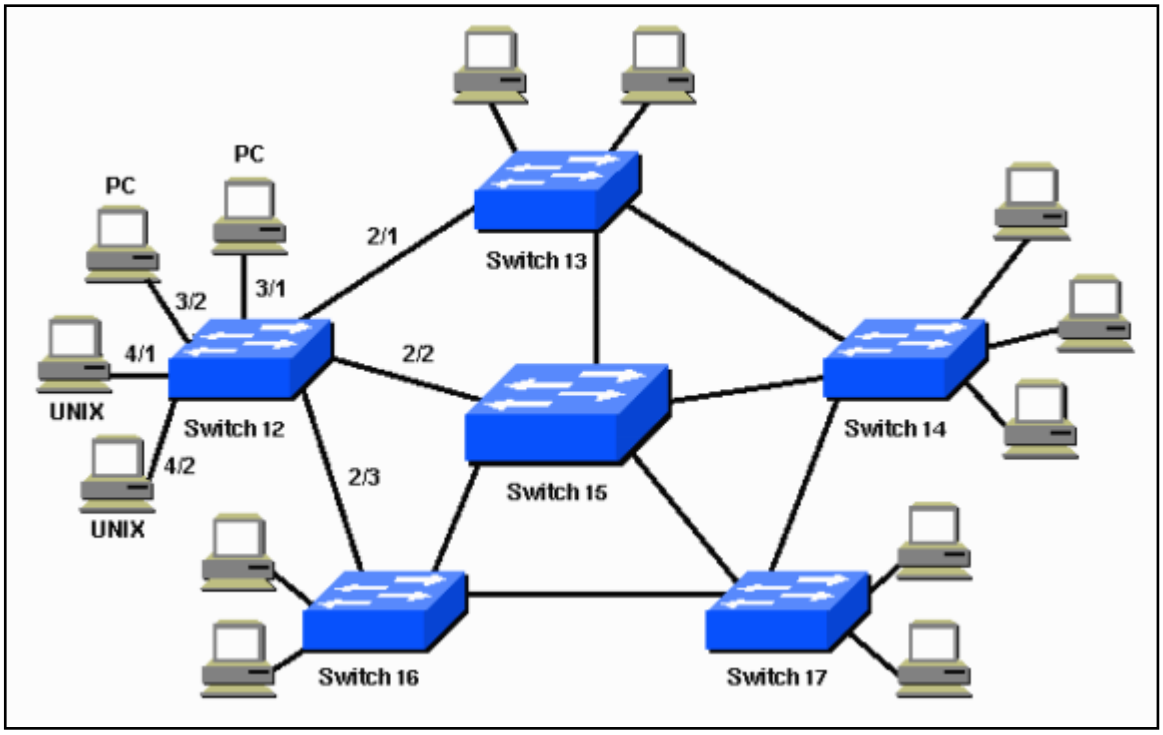

Figure 4.2.2.3: Network Diagram Using Spanning tree protocol

4.2.2.4. Overall Designed Network:

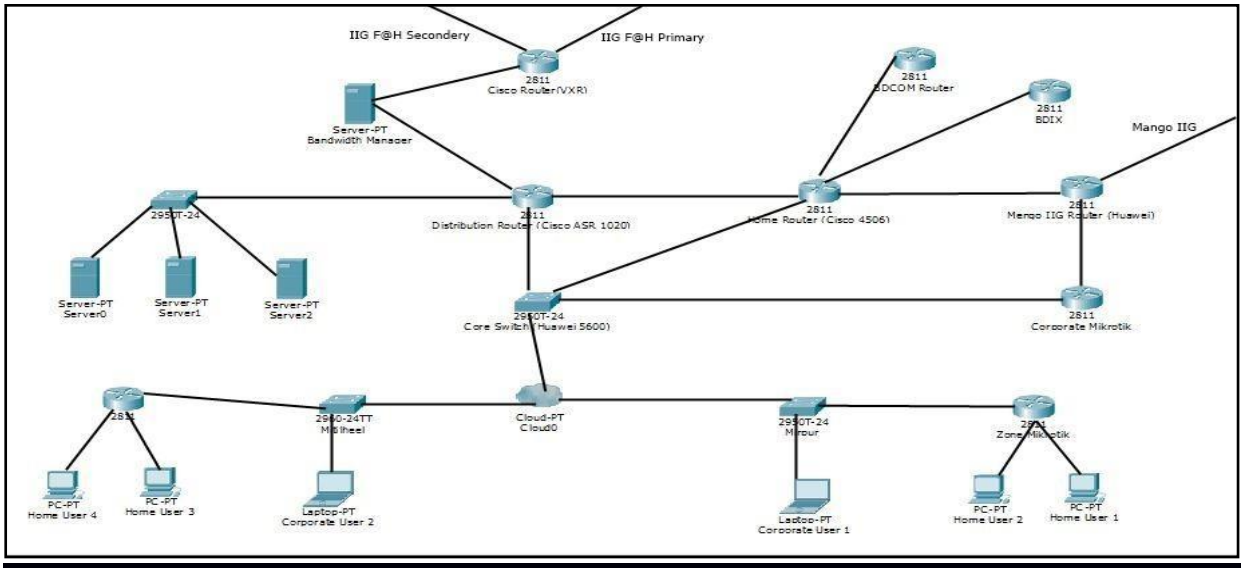

Figure 4.2.2.4: Complete Network Design Of Infocom

4.2.2.5. IPTSP Network:

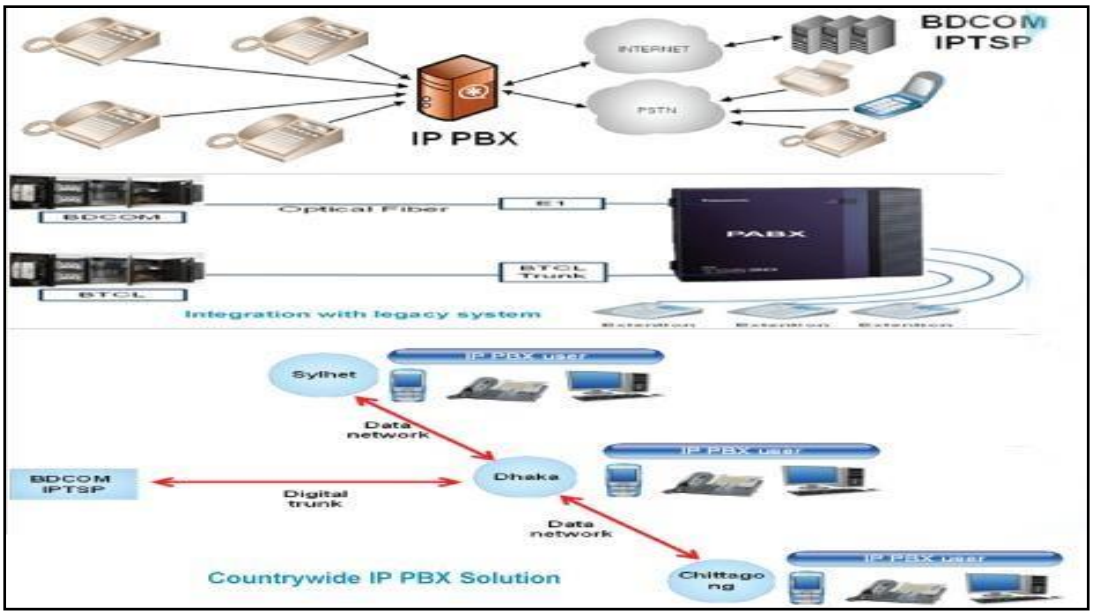

Figure 4.2.2.5: IPTSP Network Of Infocom

Chapter-5

Finding and Analysis:

In this chapter, we will describe about project results and will analyze them particularly. We will also describe about redundant links and power and backbone monitoring and their backup system to reduce downtime of a network.

5.1. Project Specific Analysis:

5.1.1. Quality of Service of a corporate network:

- Bandwidth management
- Availability for all the time.
- Network traffic prioritization
- High latency control
- Security maintenance
- Reduction of error rate

By using redundant backup links, a corporate network can be ensured maximum availability and power monitoring with solar enabled power backup system can ensure maximize the network uptime. Multiprotocol Label Switching (MPLS) best for ATM's circuit switching and IP packet routing that can reduce latency. Traffic classification, prioritization and assuring proper security can provide a best QoS. To avoid any other violence ensuring network security, update mechanism and proper monitoring can also ensure QoS. Besides, to reduce downtime of a network we can use renewable technology than any other power backup system.

Chapter-6

Conclusion

I got an opportunity to serve Infocom Ltd. in many ways and gathered a lot of experience throughout the entire internship period. There was a scope in the field of computer network planning and designing, data and internet connectivity, ensuring network security, different types of application configuration and maintain. In this report I have explained my experiences about Network Designing and Optimization. I have learned so many significant procedures from my supervisors and colleagues and conducted some tasks on a regular basis throughout my entire Internship period and ultimately earned the confidence to deal with assignment myself. It is a great opportunity to use the knowledge and skills that I had acquired. I also learned how to handle critical faults and got the new ideas. Doing this kind of work is really helpful for my career and I like to do this kind of work again.

Bibliography

[1] (2020, September) wikipedia.org. [Online]. https://en.wikipedia.org/wiki/Network_switch

[2] (2020, September) www.inetdaemon.com. [Online]. http://www.inetdaemon.com/tutorials/internet/ip/routing/define_router.shtml

[3] (2020, September) www.informit.com. [Online]. http://www.informit.com/library/content.aspx?b=CCNA_Practical_Studies&seqNum=78

[4] (2020, September) en.wikipedia.org. [Online]. https://en.wikipedia.org/wiki/Optical_fiber

[5] (2020, September) www.perle.com. [Online]. https://www.perle.com/products/ethernet-to-fiber-media-converter.shtml

[6] (2020, October) searchnetworking.techtarget.com. [Online]. http://searchnetworking.techtarget.com/definition/Power-over-Ethernet

[7] (2020, September) www.mojavewifi.com. [Online]. http://www.mojavewifi.com/assets/POE-device_enl.jpg

[8] (2020, October) www.notepage.net. [Online]. http://www.notepage.net/solar-winds/orion.htm

[9] (2020, October) en.wikipedia.org. [Online]. https://en.wikipedia.org/wiki/Nagios

[10] (2020, October) www.nagios.com. [Online]. https://www.nagios.com/products/nagios-network-analyzer/

[11] (2020, October) www.softpedia.com. [Online]. http://www.softpedia.com/get/Network-Tools/Network-Monitoring/MRTG.shtml

[12] (2020, October) en.wikipedia.org. [Online]. https://en.wikipedia.org/wiki/Multi_Router_Traffic_Grapher

[13] (2020, October) www.cacti.net. [Online]. http://www.cacti.net/

[14] (2020, November) wikipedia.org. [Online]. https://en.wikipedia.org/wiki/Network_planning_and_design

[15] (2020, November) www.infocom.com. http://www.infocom.com/profile.html

[1 (2020, September) www.cisco.com. [Online].
6] http://www.cisco.com/c/dam/en/us/products/switches/ps9876/ps11245/3D-stacked.jpg

Bibliography

[1 (2020, September) network-guarantee.co.uk. [Online]. http://network-
7] guarantee.co.uk/network/wp-content/uploads/2011/11/28016.jpg

[1 (2020, September) www.thorlabs.com. [Online].
8] https://www.thorlabs.com/images/TabImages/Cable-Structure-Still.jpg

[1 (2020, September) www.webclasses.net. [Online].
9] http://www.webclasses.net/courses/design/6.0/demo/units/media/figures/unit01/AnalysisDesignSteps.gif

[2 (2020, October) www.cisco.com. [Online].
0] http://www.cisco.com/cpress/cc/td/cpress/design/ospf/on0407.htm

[2 (2020, October) www.semsim.com. [Online].
1] http://www.semsim.com/images/StudyGuide/SG_INT.2.1.gif

[2 (2020, October) www.cisco.com. [Online].
2] http://www.cisco.com/c/dam/en/us/support/docs/lan-switching/spanning-tree-protocol/5234-5-a.gif

[2 Infocom. (2020, Augut) Infocom Limited.
3] http://www.bdcom.com/factsheet.html

[2 (2020, November) www.infocom.com.
4] http://www.infocom.com/images/slide_pic_iptsp_1.png

Chapter-7

Company History:

7.1. Company Profile:

Infocom Limited is leading and trusted name for Nationwide Secured Data Connectivity, IPTSP (IP Telephony Service), Internet Service, System Integration & Managed Service. With these services e-commerce, Fleet Management and Vehicle Tracking Solution, IT Infrastructure Development, BPO and many more are served from the house of INFOCOM. The mission and vision, INFOCOM is the value centric service Market place and an architect of high value end-to-end ICT solutions for both National and International market.

It was incorporated as a private limited company on 2000. In 2004 was registered with the Registrar of Joint Stock Companies. And the company has converted into a public limited company in 2004. INFOCOM also is an official license form Telecom Regulatory Commission (BTRC) to provide nationwide Data Communication Service.

7.2. Nature of Services:

- Internet Service
- Data Communication Services
- IP Telephony Services (IPTSP)
- System Integration
- Consultancy for IT Infrastructure Development
- Co-Location Service
- Automated Vehicle Location Service (AVLS)
- Domain Hosting
- Business Process Outsourcing Service

7.3. Department worked with:

In Infocom Limited I worked with Network Operation Center (NOC). In this section the main tasks were network monitoring, diagnosis, implementation, maintenance and problem solution. This Department is keeping key rules of this company. Clients have different problems and the solution has been done by Network Operation Center.

7.4. Recent Achievements:

Under the Institute of Chartered Secretaries of Bangladesh (ICSB), the only recognized professional body in Bangladesh awarded Infocom Ltd. the Bronze award for the massive development in IT sector among the IT, Telecom and the Service Companies Category.