NETWORK ARCHITECTURE FOR DIU CAMPUS & ITS PERFORMANCE EVALUTION

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APPROVAL

This Thesis titled **"Network Architecture for DIU New Campus and its performance evaluation"** submitted by Mohd.Moniruzzaman, Md. Mahafuz Aziz and Shek Md. Mijanur Rahman to the Department of Electronics and Telecommunication Engineering, 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 has been held on

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Mr. Md. Mirza Golam Rashed, Assistant Professor, Department of ETE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

This project is on "Network Architecture for DIU Campus and its performance evaluation". In this project a network architecture has been designed that will be able to support the demand of potential users of   DIU campus. The aim of the project is to build up full network architecture for science faculty and library. The network is designed for students, Teachers, Executives to use internet and inter communication. A wired network has been designed according to the hierarchical form. This network has been given access for 320 users .The performance analysis of this network is evaluated in terms of number users and packets per unit of time. Opnet software simulation gives us the network performance which we designed.

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CHAPTER 1: INTRODUCTION

1.1 Motivation

The Internet is a global system of interconnected computer that use the standard to serve billions of users worldwide. Now-a-days internet is the most important thing. Without internet our every terms of life become undeveloped. Bangladesh is fast growing country information technology and internetworking is increasing day by day here. We the students are going to lead the nation. So we should think about it and try to develop our country in terms of virtual world. Our university is running in Dhanmondi main campus with 5 level bulilding including Student, Executive, Teacher Student lab. Now we are trying to think a good access with internetwork of the science faculty of our campus. From this thinking this project is a small step to build up a network infrastructure.

As days go, the need of people becomes more and more. In addition, their expectations become higher. In today's world, globalization is a must. And to connect with the world internet is the best way. All offices, business organizations, educational institutions use internet for many purposes. Especially student should be aware about current world. For those educational institutions, especially universities must give students internet facilities.

In that case, authorities have to measure some points, like-

> ➢ Amount of students

> ➢ Area that authority can give for student

> ➢ A well decorated network topology by which more student can get internet in small area

> ➢ Technology which is more useful

> ➢ How much costly the topology will be.

> ➢ Interconnection Security infrastructure.

1.2 Campus Networking

Daffodil international university is one of the best universities in Bangladesh. And it is very popular for its given benefits to students. This project is about the network topology plan for daffodil international university. To maintain its popularity a wellfurnished network topology is proposed here. However, before describe about it, the points given above is described below for daffodil international university:

➢ **Amount of student:** As this plan is for the campus of daffodil international university, and as the area is vast here, so definitely a huge amount of student will be there. And before plan, a network topology amount of student must keep in mind. In addition, here must use the technique of internet facility that can give a huge amount of student.

➢ **Internetworking area:** Area is one of the major parts for plan a topology. How much area authority can give to the student for that? The plan must be done by keep in mind the area.

➢ **Well-decorated network topology:** The topology should be like this more student could get benefit. Moreover, it should be more stable, traffic free and speedy.

➢ **Technology that is more useful:** Here we proposed the total wired connection of our campus.

1.3 Network Connections

As per running Government declaration our nation should take a hard challenge about digital Bangladesh. For these reason every honors level student must grow up their

knowledge about internet and internetwork connection. Why we fall in back. Our campus also needs a well internetwork connection. Here is some point

1.4.1 Wired connection:

Computer networks for the home and small business can be built using either wired or wireless technology. Wired LANs use Ethernet cables and network adapters. Although two computers can be directly wired to each other using an Ethernet crossover cable, wired LANs generally also require central devices like hubs, switches, or routers to accommodate more computers. For dial-up connections to the Internet, the computer hosting the modem must run Internet Connection Sharing or similar software to share the connection with all other computers on the LAN. Broadband routers allow easier sharing of cable modem or DSL Internet connections, plus they often include built-in firewall support.

1.4.2 Wireless connection Wi-Fi

There are many Wi-Fi advantages to users. Let's have a closer look at them:

➢ Wi-Fi uses unlicensed radio spectrum and does not require regulatory approval for individual deplorers.

➢ It allows local area networks (LANs) to be setup with cabling. The can reduce associated costs of network connection and expansions. Places where cables cannot be run, such as outdoor areas and historical buildings can use wireless LANs.

➢ Wi-Fi products are extensively available in the market. There are different brands of access points and user's network interfaces are able to inter-operate at a very basic service level.

➢ Numerous access points and network interfaces support various degrees of encryption to protect traffic from interception.

➢ Prices are considerably lower as competition amongst vendors' increases.

➢ Wi-Fi networks can support roaming. This allows mobile users with laptop computer to be able to move from one access point to another.

➢ Wi-Fi has a set of global standards. Not like the cellular carriers, the same Wi-Fi users can work in different countries around the world at all time.[2]

CHAPTER: 2 Wired Networks

2.1 Wired Network

Wired network is such a network where every device and connected through a cable.

A wired network is more secure than wireless network.

2.2 Cabling

Cable is the medium through which information usually moves from one network device to another. There are several types of cable which are commonly used with LANs. In some cases, a network will utilize only one type of cable, other networks will use a variety of cable types. The type of cable chosen for a network is related to the network's topology, protocol, and size. Understanding the characteristics of different types of cable and how they relate to other aspects of a network is necessary for the development of a successful network.[12]

2.3 Types of Cable

There are different types of cable used in network communication [8]

2.3.1 Twisted-Pair Cable

Twisted-pair cable is a type of cabling that is used for telephone communications and most modern Ethernet networks. A pair of wires forms a circuit that can transmit data. The pairs are twisted to provide protection against crosstalk, the noise generated by adjacent pairs. Two basic types of twisted-pair cable exist: Unshielded twisted pair (UTP) and Shielded twisted pair (STP).The following sections discuss UTP and STP cable in more detail. …

2.3.2 Unshielded Twisted Pair (UTP) Cable

UTP cable is a medium that is composed of pairs of wires.UTP cable is used in a variety of networks. Each of the eight individual copper wires in UTP cable is covered by an insulating material.

Fig 2.1: Unshielded twisted pair

UTP cable often is installed using a Registered Jack 45 (RJ-45) connector. The RJ-45 is an eight-wire connector used commonly to connect computers into a local-area network (LAN), especially Ethernets.Unshielded Twisted Pair Connector

2.3.3 Shielded Twisted Pair (STP) Cable

Shielded twisted-pair (STP) cable combines the techniques of shielding, cancellation, and wire twisting. Each pair of wires is wrapped in a metallic foil. The four pairs of wires then are usually Wrappedin an overall metallic braid or foil, air

Fig 2.2 : Shielded Twisted pair 150-ohm cable. [12]

2.3.4 Coaxial Cable

Coaxial cabling has a single copper conductor at its center. A plastic layer provides insulation between the center Fig 2.4: Coaxial cableconductor and a braided metal shield (See fig). The metal shield helps to block any outside interference from interference.   Although coaxial cabling is difficult to install, it is highly resistant to signal interference. In addition, it can support greater cable lengths between network devices than twisted pair cable.[8]

Fig 2.3: Coaxial Cable

2.3.5 Optical fiber

An optical fiber is a thin "10^{6m}" flexible, transparent fiber that acts as a waveguide, or "light pipe", to transmit light between the two ends of the fiber without much attenuation. The field of applied science and engineering concerned with the design and application of optical fibers is known as fiber optics. Optical fiber can be used as a medium for telecommunication and networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables.[7]
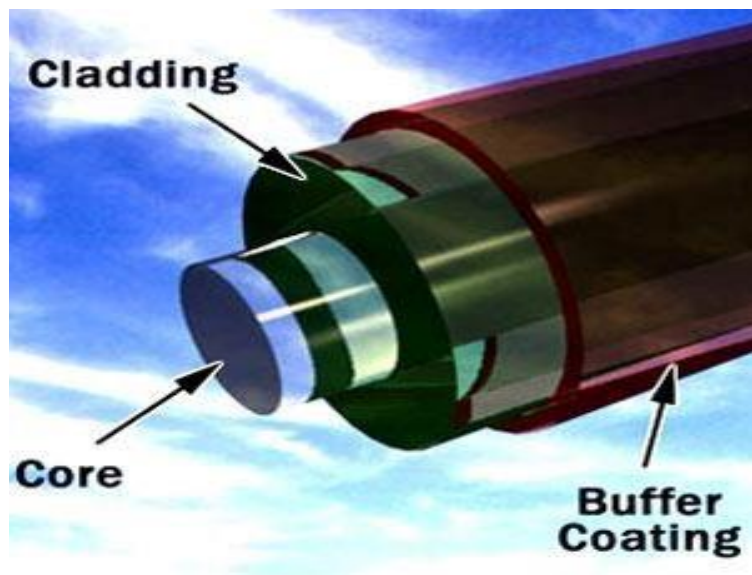

Fig 2.4: Optical Fiber [15]

2.4 Network topology

Network topology is the arrangement of the various elements (links, nodes, etc.) of a computer or biological network. Essentially, it is the topological structure of a network, and may be depicted physically or logically. Physical topology refers to the placement of the network's various components, including device location and cable installation, while logical topology shows how data flows within a network, regardless of its physical design. Distances between nodes, physical interconnections, transmission rates, and/or signal types may differ between two networks, yet their topologies may be identical.

Network topology recognizes eight basic topologies:

> Point -to- point
> Bus
> Star
> Ring
> Mesh
> Tree
> Hybrid

Point-to-point Topology

The simplest topology is a permanent link between two endpoints. Switched point-topoint topologies are the basic model of conventional telephony. The value of a permanent point-to-point network is unimpeded communications between the two endpoints.
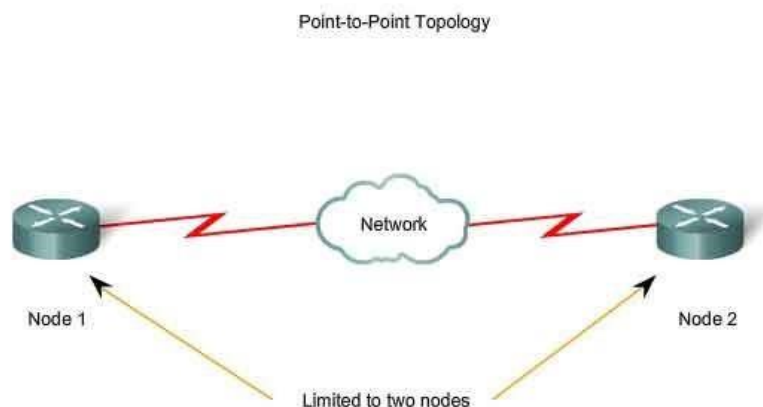
Point-to-Point Topology

Limited to two nodes

Fig 2.5: point-to-point Topology

Bus Topology

In local area networks where bus topology is used, each node is connected to a single cable. Each computer or server is connected to the single bus cable. A signal from the source travels in both directions to all machines connected on the bus cable until it finds the intended recipient. If the machine address does not match the intended address for the data, the machine ignores the data. Alternatively, if the data matches the machine address, the data is accepted. Since the bus topology consists of only one wire, it is rather inexpensive to implement when compared to other topologies. However, the low cost of implementing the technology is offset by the high cost of
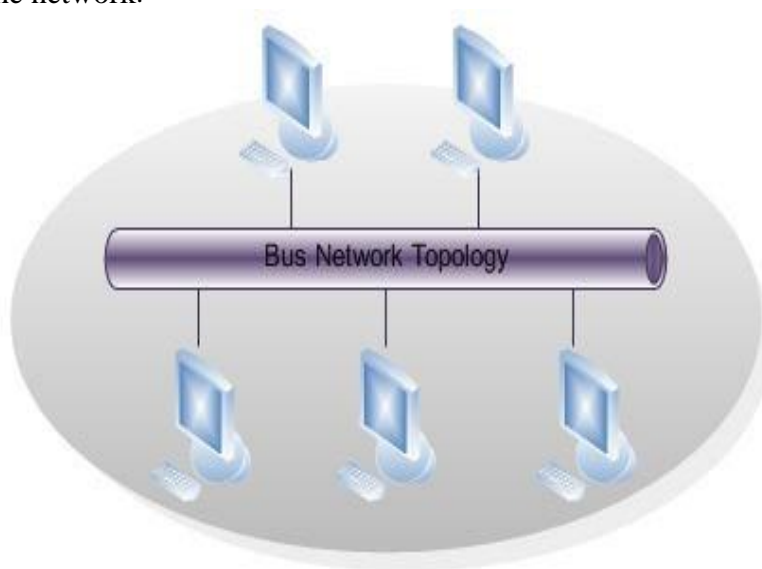
managing the network.

Fig 2.6: Bus topology

Star Topology

In local area networks with a star topology, each network host is connected to a central hub with a point-to-point connection. In Star topology every node (computer workstation or any other peripheral) is connected to central node called hub or switch. The switch is the server and the peripherals are the clients. The network does not necessarily have to resemble a star to be classified as a star network, but all of the nodes on the network must be connected to one central device. All traffic that traverses the network passes through the central hub. The hub acts as a signal repeater. The star

topology is considered the easiest topology to design and implement. An advantage of the star topology is the simplicity of adding additional nodes.
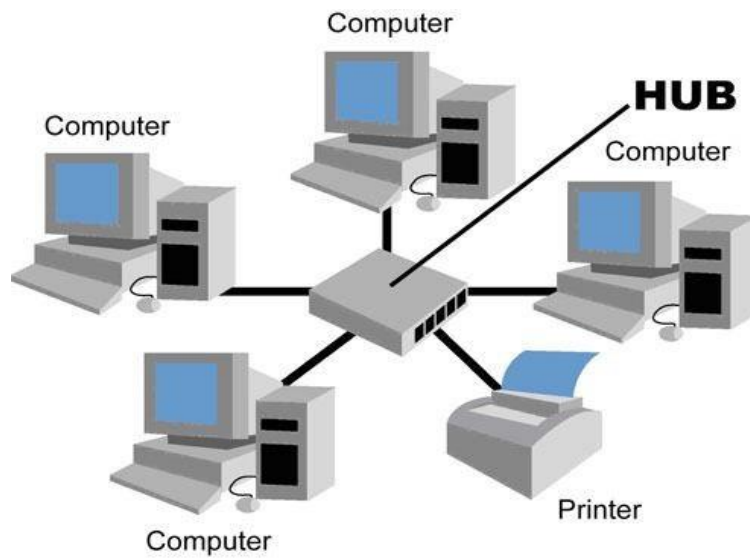

Fig 2.7: Star topology

Ring Topology

A network topology that is set up in a circular fashion in which data travels around the ring in one direction and each device on the right acts as a repeater to keep the signal strong as it travels. Each device incorporates a receiver for the incoming signal and a transmitter to send the data on to the next device in the ring. The network is dependent on the ability of the signal to travel around the ring.

Fig 2.8:Ring topology

Mesh Topology

The value of fully meshed networks is proportional to the exponent of the number of subscribers, assuming that communicating groups of any two endpoints, up to and including all the endpoints.
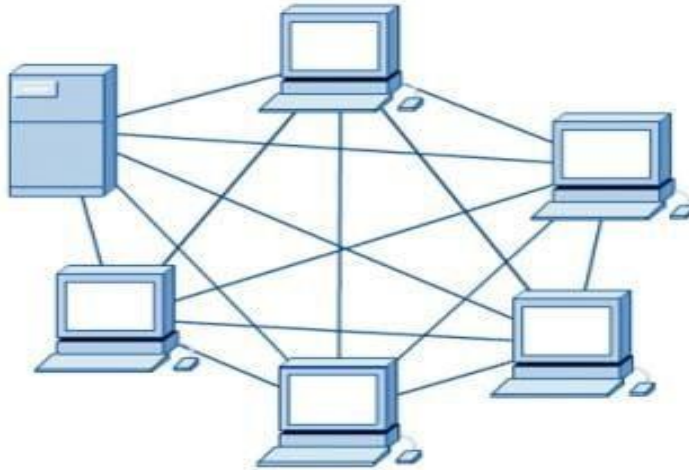
Fig 2.9: Mesh Topology

Tree Topology

Among all the Network Topologies we can derive that the Tree Topology is a combination of the bus and the Star Topology. A Tree Structure suits best when the network is widely spread and vastly divided into many branches. Like any other topologies, the Tree Topology has its advantages and disadvantages. A Tree Network may not suit small networks and it may be a waste of cable to use it for small networks. Tree Topology has some limitations and the configuration should suit those limitations.
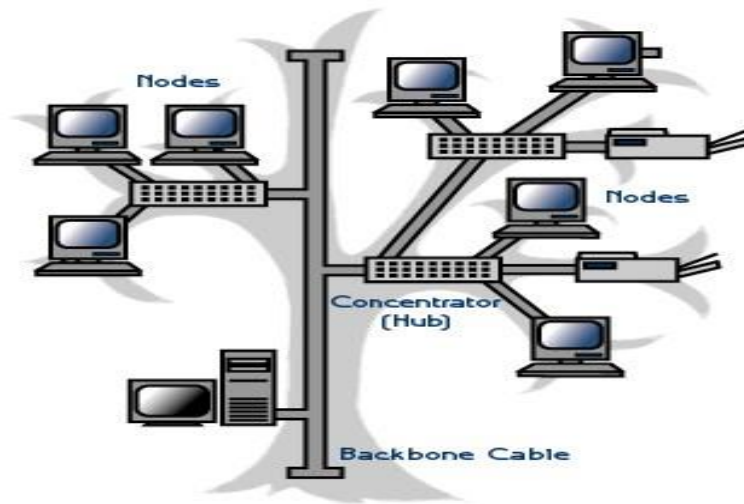
Fig 2.10: Tree Topology

Hybrid topology

Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard topologies (e.g., bus, star, ring, etc.). For example, a tree network connected to a tree network is still a tree network topology. A hybrid topology is always produced when two different basic network topologies are connected. Two common examples for Hybrid network are: star ring network and star bus network.

Fig 2.11 Hybrid Topology

CHAPTER3: WIRELESS NETWORK

3.1 Wireless Network

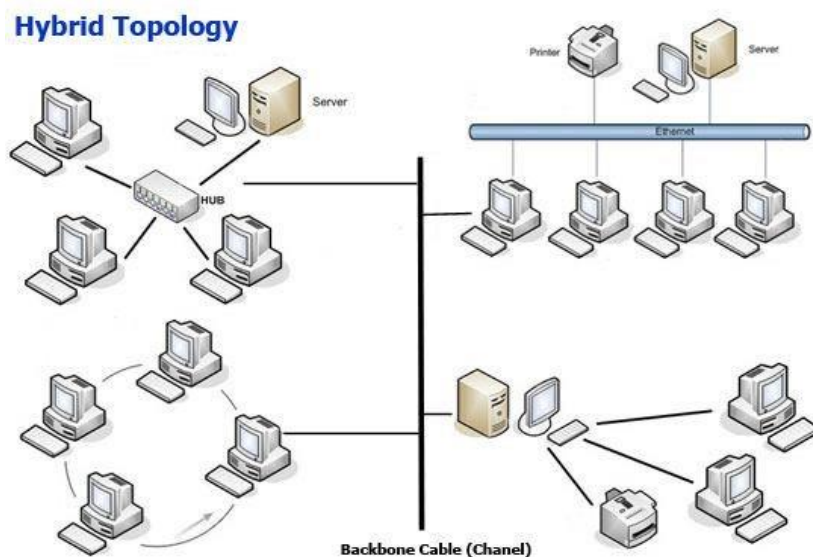Wireless network refers to any type of computer network that is not connected by cables of any kind. It is a method by which telecommunications networks and enterprise (business), installations avoid the costly process of introducing cables into to a building, or as a connection between various equipment locations. Wireless telecommunications networks are generally implemented and administered using a transmission system called radio waves. This implementation takes place at the physical level, (layer), of the network structure.[6]

3.2 Types of wireless connections

- · Wireless PAN
- · Wireless LAN
- · Wireless MAN
- · Wireless WAN
- · Mobile devices networks

3.2.1 Wireless PAN

Wireless Personal Area Networks (WPANs) interconnect devices within a relatively small area, generally within a person's reach. For example, both Bluetooth radio and invisible Infrared light provides a WPAN for interconnecting a headset to a laptop. ZigBee also supports WPAN applications. Wi-Fi PANs are becoming commonplace (2010) as equipment designers start to integrate Wi-Fi into a variety of consumer electronic devices. Intel "My Wi-Fi" and Windows 7 "virtual Wi-Fi" capabilities have made Wi-Fi PANs simpler and easier to set up and configure.[1]

3.2.2 Wireless LAN

A wireless local area network (WLAN) links two or more devices using a wireless distribution method, providing a connection through an access point to the wider internet. The use of spread-spectrum or OFDM technologies also gives users the mobility to move around within a local coverage area, and remain connected to the network.

> Wi-Fi: "Wi-Fi" is a term used to describe 802.11 WLANs, although it is technically a declared standard of interoperability between 802.11 devices.

> Fixed Wireless Data: This implements point-to-point links between computers or networks at two distant locations, often using dedicated microwave or modulated laser light beams over line of sight paths. It is often used in cities to connect networks in two or more buildings without installing a wired link.

3.2.3 Wireless MAN

Wireless metropolitan area networks are a type of wireless network that connects several wireless LANs.

WiMAX is a type of Wireless MAN and is described by the IEEE 802.16 standard.

.

3.2.4 Wireless WAN

Wireless wide area networks are wireless networks that typically cover large outdoor areas. These networks can be used to connect branch offices of business or as a public internet access system. They are usually deployed on the 2.4 GHz band. A typical system contains base station gateways, access points and wireless bridging relays. Other configurations are mesh systems where each access point acts as a relay also. When combined with renewable energy systems such as photovoltaic solar panels or wind systems they can be stand-alone systems.[9]

3.2.5 Mobile devices networks

With the development of smart phones, cellular telephone networks routinely carry data in addition to telephone conversations:

> Global System for Mobile Communications (GSM): The GSM network is divided into three major systems: the switching system, the base station system, and the operation and support system. The cell phone connects to the base system station, which then connects to the operation and support station; it then connects to the switching station where the call is transferred to where it needs to go. GSM is the most common standard and is used for a majority of cell phones.[4]

> Personal Communications Service (PCS): PCS is a radio band that can be used by mobile phones in North America and South Asia. Sprint happened to be the first service to set up a PCS.

> D-AMPS: Digital Advanced Mobile Phone Service, an upgraded version of AMPS, is being phased out due to advancement in technology. The newer GSM networks are replacing the older system.

We can get the wireless signal in many ways. It can be like mobile phone network like GSM, CDMA, it can be very high raged system like Wi-MAX, or it can be low or short range like Wi-Fi.

3.3 Wireless standards

The 802.11 family consists of a series of over-the-air modulation techniques that use the same basic protocol. The most popular are those defined by the 802.11b and 802.11g protocols, which are amendments to the original standard. 802.11-1997 was the first wireless networking standard, but 802.11b was the first widely accepted one, followed by 802.11g and 802.11n. Security was originally purposefully weak due to export requirements of some governments, and was later enhanced via the 802.11i amendment after governmental and legislative changes. 802.11n is a new multistreaming

modulation technique. Other standards in the family (c–f, h, j) are service amendments and extensions or corrections to the previous specifications.

802.11b and 802.11g use the 2.4 GHz ISM band, operating in the United States under Part 15 of the US Federal Communications Commission Rules and Regulations. Because of this choice of frequency band, 802.11b and g equipment may occasionally suffer interference from microwave ovens, cordless telephones and Bluetooth devices. 802.11b and 802.11g control their interference and susceptibility to interference by using direct-sequence spread spectrum (DSSS) and orthogonal frequency-division multiplexing (OFDM) signaling methods, respectively. 802.11a uses the 5 GHz U-NII band, which, for much of the world, offers at least 23 non-overlapping channels rather than the 2.4 GHz ISM frequency band, where all channels overlap. Better or worse performance with higher or lower frequencies (channels) may be realized, depending on the environment.

The segment of the radio frequency spectrum used by 802.11 varies between countries. In the US, 802.11a and 802.11g devices may be operated without a license, as allowed in Part 15 of the FCC Rules and Regulations. Frequencies used by channels one through six of 802.11b and 802.11g fall within the 2.4 GHz amateur radio band. Licensed amateur radio operators may operate 802.11b/g devices under Part 97 of the FCC Rules and Regulations, allowing increased power output but not commercial content or encryption. [5]

3.3.1 802.11a

The 802.11a standard uses the same data link layer protocol and frame format as the original standard, but an OFDM based air interface (physical layer). It operates in the 5 GHz band with a maximum net data rate of 54 Mbit/s, plus error correction code, which yields realistic net achievable throughput in the mid-20 Mbit/s

Since the 2.4 GHz band is heavily used to the point of being crowded, using the relatively unused 5 GHz band gives 802.11a a significant advantage. However, this high carrier frequency also brings a disadvantage: the effective overall range of 802.11a is less than that of 802.11b/g. In theory, 802.11a signals are absorbed more readily by

walls and other solid objects in their path due to their smaller wavelength and, as a result, cannot penetrate as far as those of 802.11b. In practice, 802.11b typically has a higher range at low speeds (802.11b will reduce speed to 5 Mbit/s or even 1 Mbit/s at low signal strengths). However, at higher speeds, 802.11a often has the same or greater range due to less interference

3.3.2 802.11b

802.11b has a maximum raw data rate of 11 Mbit/s and uses the same media access method defined in the original standard. 802.11b products appeared on the market in early 2000, since 802.11b is a direct extension of the modulation technique defined in the original standard. The dramatic increase in throughput of 802.11b (compared to the original standard) along with simultaneous substantial price reductions led to the rapid acceptance of 802.11b as the definitive wireless LAN technology.802.11b devices suffer interference from other products operating in the 2.4 GHz band. Devices operating in the 2.4 GHz range include microwave ovens, Bluetooth devices, baby monitors and cordless telephones.[6]

3.3.3 802.11g

In June 2003, a third modulation standard was ratified: 802.11g. This works in the 2.4 GHz band (like 802.11b), but uses the same OFDM based transmission scheme as 802.11a. It operates at a maximum physical layer bit rate of 54 Mbit/s exclusive of forward error correction codes, or about 22 Mbit/s average throughput. 802.11g hardware is fully backwards compatible with 802.11b hardware and therefore is encumbered with legacy issues that reduce throughput when compared to 802.11a by ~21%.

3.3.4 802.11n

802.11n is an amendment which improves upon the previous 802.11 standards by adding multiple-input multiple-output antennas (MIMO). 802.11n operates on both the 2.4GHz and the lesser used 5 GHz bands. The IEEE has approved the amendment and it was published in October 2009Prior to the final ratification, enterprises were already

migrating to 802.11n networks based on the Wi-Fi Alliance's certification of products conforming to a 2007 draft of the 802.11n proposal.

3.4 Wi-Fi

Wi-Fi (short for "wireless fidelity") is a term for certain types of wireless local area network (WLAN) that use specifications in the 802.11 family. The term Wi-Fi was created by an organization called the Wi-Fi Alliance.[4]
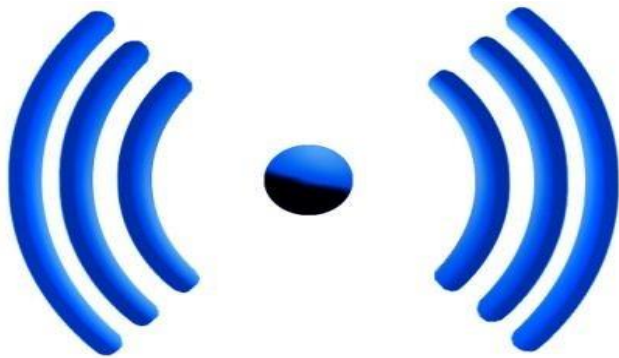

Fig 3.1: Wi-Fi Symbol

3.4.1Internal Works of Wi-Fi

A station is a device by which 802.11 connectivity is accessible. It is the end device in which user can get Wi-Fi connectivity. Usually it is a laptop, mobile phone and other mobile devices. Some station together make a basic service set connected to an access point. Access point is such a device that itself is a station and gives connectivity to the stations under its BSS to access the distribution system via wireless. The distribution system can be a wired medium or can be wireless. Normally it is a wired connection. Which is connected to several access point and portal device? To integrate the IEEE802.11 architectures with traditional wired LAN a portal is used. Portal device are Bluetooth Device, Bridge, Router etc. A portal logic is implemented in those devices. Together all these things form a single Extended Service Set. When a mobile station comes across to the wireless coverage, it tries to get access to the distribution system. In between the station and Distribution System, there is an access point.

Fig 3.2 :Wireless Access point

The access point is housed some central co-ordination function and authentication process, by which it can determine the eligibility of the station to access the distribution system as well as to W-LAN. If the access point allows the station can associate with the access point. The station will be able to stay connected until it leaves the coverage area or if not the station disassociated by the distribution system.[6]

Wi-Fi Devices

To make a particular place Hotspot we just need an Access point or a wireless router. A **hotspot** is a site that offers Internet access over a wireless local area network with a router connected to a link to an Internet service provider. Hotspots typically use Wi-Fi technology In computer networking, a **wireless access point** (WAP) is a device that allows wireless devices to connect to a wired network using Wi-Fi standards. The WAP usually connects Fig: Wireless Access Point to a router (via a wired network), and can relay data between the wireless devices (such as computers or printers) and wired devices on the network.A**wireless router** is a device that performs the functions of a router but also includes the functions of a wireless access point and a network switch. They are commonly used to allow access to the Internet or a computer network without the need for a cabled connection. It can function in a wired LAN (local area network), a wireless only LAN (WLAN) or a mixed wired/wireless network.

By connecting a wireless access point or the wires router to the computer or directly to the Ethernet cable wireless signal can be spared to the air medium. Which will be received by the end user device and will connect them with the access point and as well as to the internet Wi-Fi is easily accessible with Laptop, Notebook, PDA, Netbook, Mobile phone etc. It is important to WLAN installed in these devices previously. Wi-Fi

also can be accessed from desktop computers for this we have to use an extra wireless adaptor.

CHAPTER: 4 NETWORK DESIGN

4.1 Introduction

Wired network a very important part of a network architecture. Total network and also the wireless network depend on it. Wired networks provide users with plenty of security and the ability to move lots of data very quickly. Wired networks are typically faster than wireless networks, and they can be very affordable. In wired network it is important to select the topology. In our plan we selected star topology because of its advantage.[11]

4.2 Wired plan

Here is our campus wired plan. That consists of Science faculty building and Library building.
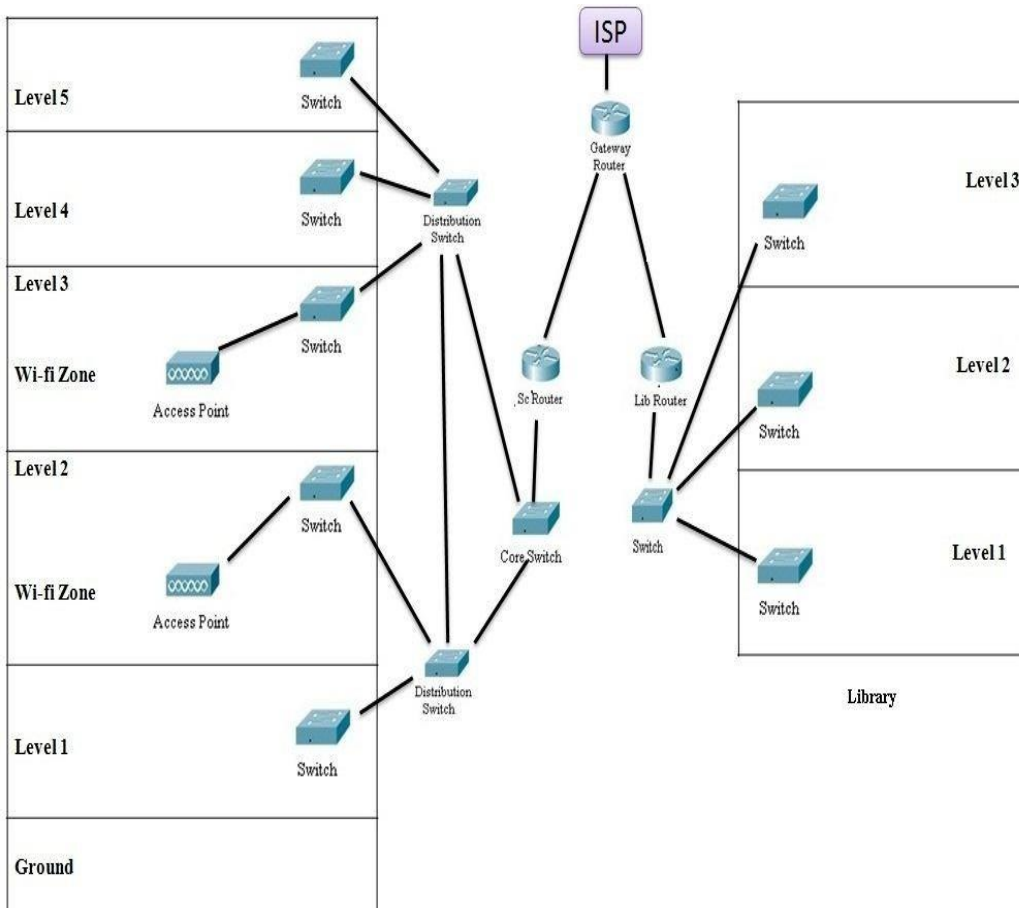
Fig 4.1 Building network distributions

Each level of science faculty buildings pc areconnected with individual switch.where level 1,2 switch connected with a core switch and level 3,4,5 switches are connected through another core switch.Both core switches are connected with each other also connected through to the core router.

Again the library building also designs by switches in every level. 3 level library switches are directly connected with a core switch of library building. This switch also directly connected through library building router.

Both Library building router and science faculty building router r connected through a gateway router. With this gateway routerIsp can provide their service through to the hole campus.

4.3 Preferred Topology

We preferred star topology for our plan. Because it is advantageous then other topologies. The advantages are

> **Better performance:** star topology prevents the passing of data packets through an excessive number of nodes. At most, 3 devices and 2 links are involved in any communication between any two devices. Although this topology places a huge overhead on the central hub, with adequate capacity, the hub can handle very high utilization by one device without affecting others.[12]

> **Isolation of devices:** Each device is inherently isolated by the link that connects it to the hub. This makes the isolation of individual devices straightforward and amounts to disconnecting each device from the others. This isolation also prevents any non-centralized failure from affecting the network.

> **Benefits from centralization:** As the central hub is the bottleneck, increasing its capacity, or connecting additional devices to it, increases the size of the network very easily. Centralization also allows the inspection of traffic through the network. This facilitates analysis of the traffic and detection of suspicious behavior.

> Easy to detect faults and to remove parts.

> No disruptions to the network when connecting or removing devices

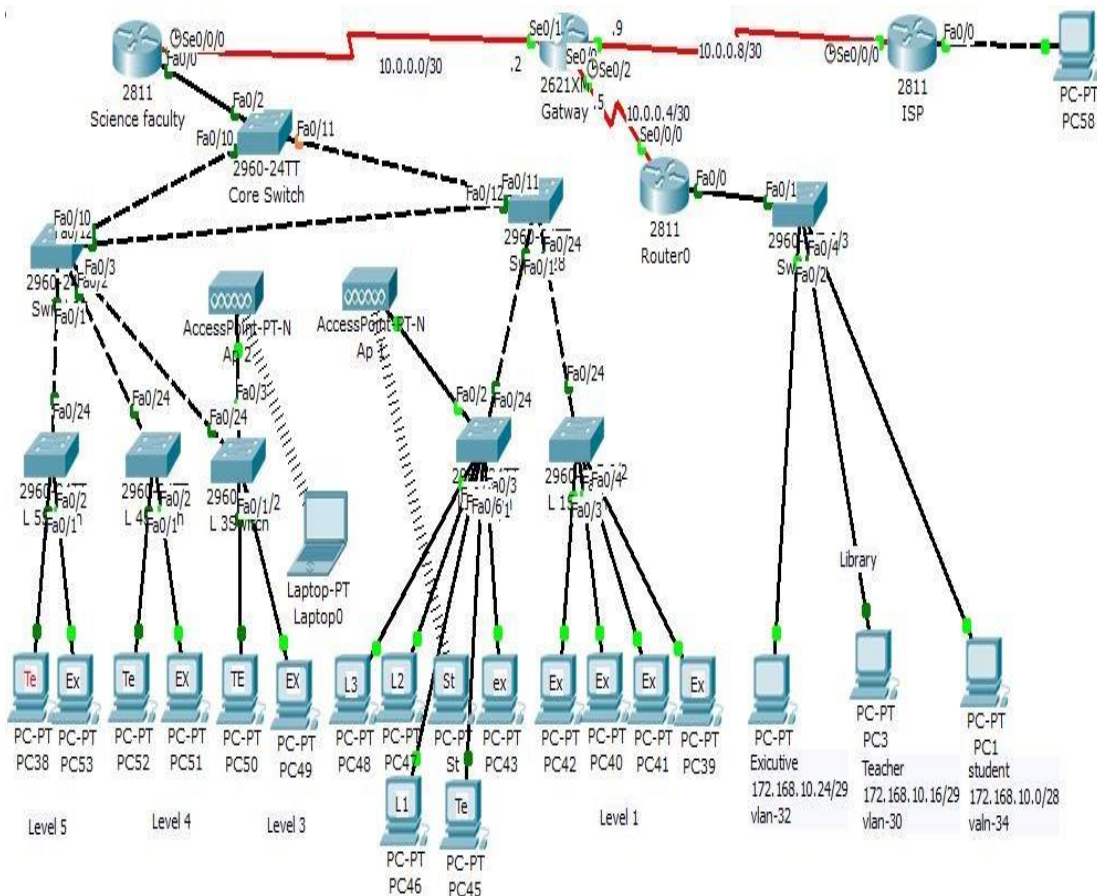According to the building plan we have designed the topological plan.

Figure 4.2: Topological plan

Here we have two portion of network. Science faculty andLibrary.

Science faculty topology: Wemainly use Hierarchical Design Model including core level, Distribution level then Access level. Atcore level router and core switch Connected through copper straight-through cable. Core switch connected with 2 Distribution level switches and using the STP protocol. Distribution switch 1 connected through the switches of building Level 3, 4, 5 .Again 2 Distribution switch connected through the switches of building Level 1,2.

Library topology: The network design of library 4 level include a router that

connected 'through a switch then switch given the access through to the users.

4.4 Internet protocol

IP is the primary protocol in the Internet Layer of the Internet Protocol Suite and has the task of delivering datagram from the source host to the destination host solely based on the addresses. For this purpose, IP defines datagram structures that encapsulate the data to be delivered. It also defines addressing methods that are used to label the datagram source and destination. The Internet Protocol is responsible for addressing hosts and routing datagram (packets) from a source host to the destination host across one or more IP networks. For this purpose the Internet Protocol defines an addressing system that has two functions: identifying hosts and providing a logical location service. This is accomplished by defining standard datagram and a standard
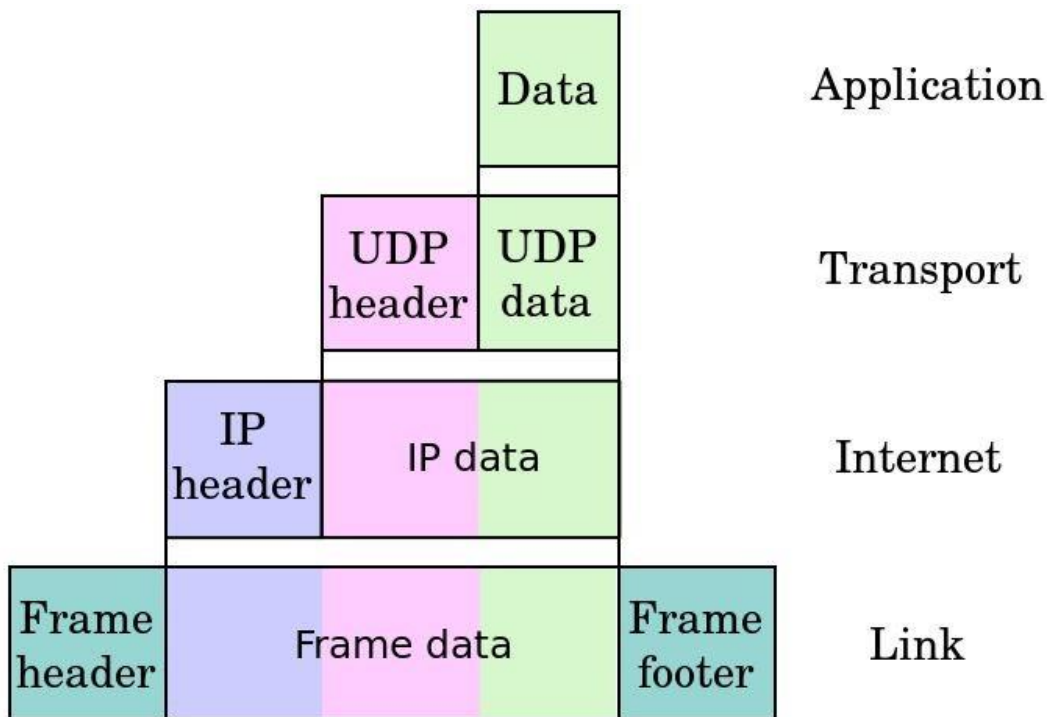
addressing system.[17]

Fig 4.3:UDP to link protocol frame

Each datagram has two components, a header and a payload. The IP header is tagged with the source IP address, destination IP address, and other meta-data needed to route and deliver the datagram. The payload is the data to be transported. This process of nesting data payloads in a packet with a header is called encapsulation.

The most complex aspects of IP are IP addressing and routing. Addressing refers to how end hosts are assigned IP addresses and how sub networks of IP host addresses are divided and grouped. IP routing is performed by all hosts, but most importantly by routers, which typically use either interior gateway protocols (IGPs) or external gateway protocols (EGPs) to decide how to move datagrams among networks.

IP routing is also common in local networks. For example, Ethernet switches sold today support IP multicast. These switches use IP addresses and Internet Group Management Protocol for control of the multicast routing but use MAC addresses for the actual routing.

4.5 Classification of Ip address

Each TCP/IP host is identified by a logical IP address. The IP address is a network layer address and has no dependence on the data link layer address (such as a MAC address of a network interface card). A unique IP address is required for each host and network component that communicates using TCP/IP. The IP address identifies a system's location on the network in the same way a street address identifies a house on a city block. Just as a street address must identify a unique residence, an

IP address must be globally unique and have a uniform format. Each IP address includes a network ID and a host ID.[16]

•The network ID (also known as a network address) identifies the systems that are located on the same physical network bounded by IP routers. All systems on the same physical network must have the same network ID. The network ID must be unique to the internetwork.

•The host ID (also known as a host address) identifies a workstation, server, router, or other TCP/IP host within a network. The address for each host must be unique to the network ID. The use of the term network ID refers to any IP network ID. An IP address is 32 bits long. Rather than working with 32 bits at a time, it is a common practice to

segment the 32 bits of the IP address into four 8-bit fields called octets. Each octet is converted to a decimal number (the Base 10 numbering system) in the range 0-255 and separated by a period (dot). This format is called dotted decimal notation.

There are five classes of available IP ranges: Class A, Class B, Class C, Class D and Class E, while only A, B, and C are commonly used. Each class allows for a range of valid IP addresses. Below is a listing of these addresses.

Class A 0 ⟹ to 127

Class   B ⟹ 128 to 191

Class   C ⟹ 192 to 223

Class   D ⟹ 224 to 239
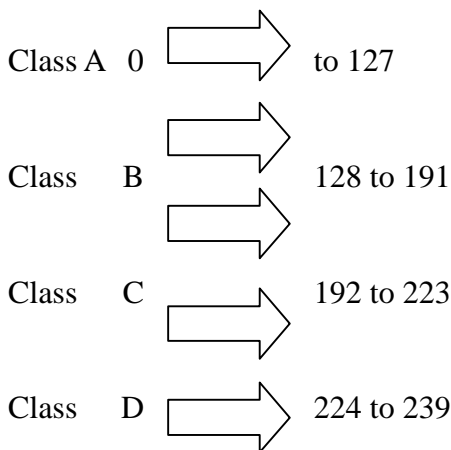
Class E 240 to 255

Class	Address Range	Supports
Class A	1.0.0.1 to 126.255.255.254	Supports 16 million hosts on each of 127 networks.
Class B	128.1.0.1 to 191.255.255.254	Supports 65,000 hosts on each of 16,000 networks.
Class C	192.0.1.1 to 223.255.254.254	Supports 254 hosts on each of 2 million networks.
Class D	224.0.0.0 to 239.255.255.255	Reserved for multicast groups.
Class E	240.0.0.0 to 254.255.255.254	Reserved for future use, or Research and Development Purposes.

Ranges 127.x.x.x are reserved for the loopback or local host, for example, **127.0.0.1** is the common loopback address. Range **255.255.255.255**broadcasts to all hosts on the local network.

Network Masks

A network mask helps to know which portion of the address identifies the network and which portion of the address identifies the node. Class A, B, and C networks have default masks, also known as natural masks, as shown here:
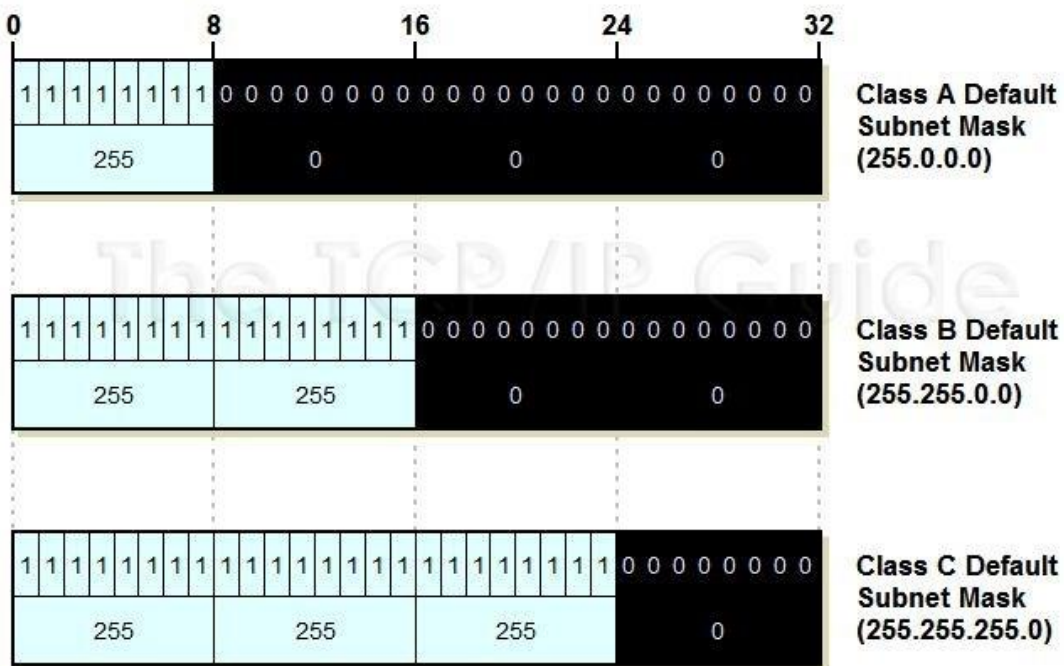
Class A: 255.0.0.0
Class B: 255.255.0.0
Class C: 255.255.255.0

Fig 4.4: Subnet mask

Here the subnet mask shows us that network bit and subnet or host bit. Class A has only 8 bit for network address and 24 bit for subnet or host. On the other hand class B has 16 network bit and 16 subnet or host bit. Again class C has only 8 bit for host.

4.6 Ip Sub netting

We consider class B Ip 172.168.0.0/16

For Science faculty

Our Science faculty building has 5 level and Library has 4 level. Where we try to give access According to the Classification of Executive, Teacher, Student, Lab

Which table is given below

Science faculty

Level	Executive	Teacher	Student	Lab1	Lab2	Lab3
Level 1	30	0	0	0	0	0
Level 2	5	25	50	25	25	25
Level 3	10	40	0	0	0	0
Level 4	5	30	0	0	0	0
Level 5	4	30	0	0	0	0

Library

Level	Executive	Teacher	Student
Level 1	2	3	2
Level 2	3	1	0

Level 3	1	0	0

Total Executive Teacher Student Lab 1 Lab 2 Lab 3 Library

54	130	50	25	25	25	12

Science Faculty

Network given	Teacher	172.168.0.0/24
Next Available		172.168.1.0/24
Network given	Executive	172.168.1.0/26
Next Available		172.168.1.64/26
Network given	Student	172.168.1.64/26
Next available		172.168.1.128/26
Network given	Lab 1	172.168.1.128/27
Next available		172.168.1.160/27
Network given	Lab 2	172.168.1.160/27
Next available		172.168.1.192/27
Network given	Lab 3	172.168.1.192/27
Next available		172.168.1.224/27

Library

Network given	Library	172.168.1.224/27
	Student	172.168.10.0/28

Teacher	172.168.10.16/29	
Executive	172.168.10.24/29	

4.7 Routing protocol preferred

There are different types of dynamic routing protocol. But we preferred one of them for its standardization capability. A table proved about our preferable protocol

No	Content	Rip ver 1	Rip ver 2	EIGRP
1	Metric	Hop	Hop	K value
2	Information Sharing	Broadcast	Multicast	Multicast
3	Convergence	Slow	Medium	Very fast
4	Hierarchical design	No(flood)	No(flood)	No(flood)
5	Classless	No(Classful)	Yes	Yes
6	VLSM	No	Yes	Yes
7	Algorithm	Bellman Ford	BF	Dual Diffusion Unit Algorithm

EIGRP: Enhanced Interior Gateway Routing Protocol (EIGRP) or Enhanced IGRP is a Cisco proprietary routing protocol utilizing the Diffusing Update Algorithm

(DUAL). The DUAL algorithm was invented by Dr. J.J. Garcia-Luna Accedes of SRI International as an improvement to the IGRP routing protocol. EIGRP was designed to be interoperable with standard IGRP. EIGRP is a hybrid protocol as it incorporates features of a Distance Vector routing protocol and features of a Link State routing protocol. EIGRP is often used in Cisco-based networks running multiple networklayer protocols. EIGRP is being used as a more scalable protocol in both medium and large scale networks since 1992.[19]

EIGRP can redistribute its routes (and metrics) into other routing protocols and accepts redistribution from other routing protocols as well.

EIGRP Features

- · Hybrid Distance Vector/Link State algorithm
- . Supports VLSM (subnets/supersets)
- · Integrates seamlessly with IGRP o Automatic Redistribution of Routes (IGRP <-> EIGRP) o EIGRP metrics are 256 times the IGRP metric and therefore 'directly

    translatable'

- . Fast convergence
- . Performs Partial Updates as needed
- · Consumes less bandwidth (no broadcasts, no periodic updates, updates contain only changes)
- · Supports multiple network layer protocols
  - o AppleTalk
  - o Internet Protocol (IP) o Novell Netware (IPX/SPX)

EIGRP Operation

- ➢ Four EIGRP Components o Neighbor Discovery/Recovery
  - ▪ Dynamically find other routers running IGRP/EIGRP
  - ▪ Dynamically forms neighbor relationships
  - ▪ Discover neighbor state (unreachable or inoperative) - Uses

HELLO packets

- o Reliable Transport Protocol - Utilizes Reliable Transport Protocol (RTP) for delivery of EIGRP packets.

- o DUAL Finite State Machine o Protocol Dependant Modules

➤ EIGRP tracks all routes advertised by all neighbors (feasible successor routes) o Selects best path

- o Selects a feasible successor route
  - ▪ CISCO.COM: A feasible successor is a neighboring router used for packet forwarding that is a least-cost path to a destination that is guaranteed not to be part of a routing loop

- o If no feasible successor exists,
  - ▪ queries are sent out to the network
  - ▪ Diffusing computation is performed to select another feasible route
  - ▪ Diffusing computation is not processor intensive (but affects convergence time

➤ Maintains a copy of each neighbor's route table.

➤ Sends updates only when changes in the metrics occur

➤ Sends only the changes

➤ Sends changes only to neighbors that need the information (no broadcasts)

➤ Can redistribute routes from RTMP, OSPF, RIP, IPX RIP/SAP, IS-IS, EGP and BGP

➤ Routing o Administrative Distance for EIGRP

- ▪ Summary Routes [5]
- ▪ Internal Routes [90]
- ▪ External Routes [170] o Neighbor Tables
- ▪ Neighbors recorded (IP and interface of neighbor)
- ▪ One neighbor table for each network protocol

- Neighbors send hold time in HELLO packet

- Hello packet contains hold down time

- If neighbor is not heard from within the hold down time, topology table is changed via DUAL

- Contains RTP information (Sequence Number, transmission list of packets, round trip timers optimize retransmission interval).

o Topology Tables

- Contains all destinations advertised by all neighboring routers ▪ Each topology table entry contains:

- destination address
- list of neighbors used to reach the destination

- for each neighbor store the advertised metric for each destination

- Best Path = sum of best advertised metric from all neighbors and the link cost to the best neighbo

o Feasible Successors

- Route(s) inserted by EIGRP into the routing table will have the best metric of all the routes in the table.

- Any route to a destination whose metric is less than the current entry or entries in the routing table is a *feasible successor.*

- When the current route enters the 'active' state, the *feasible successor* is inserted in the routing table.

- The list of feasible successors may have to be re-evaluated if a neighbor sends a topology change or updates the metric to a destination.

- If a neighbor who is the only feasible successor to a destination goes down, all of the neighbor's routes enter the active state and trigger route recompilation.

o Route States (two states)

- Active - recompilation is being performed

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- Passive- no recompilation going on
- If feasible successors are always available, a destination never goes into the active state.
- Recompilation occurs when no feasible successor route exists
- If a neighbor who is the only feasible successor to a destination goes down, all of the neighbor's routes enter the active state and trigger route recompilation.
- Recompilation Process
- Send a query packet to all neighboring routers
- Neighbor sends
- a reply that it has a feasible successor, or
- a query packet to indicate it is participating in the recompilation
- Routes in the active state cannot have their routing table information changed
- Once all neighbors have replied the topology table entry for the destination returns to the pasive state and the router may then select a feasible successor.
- Route Tagging
  - Internal routes come from neighbors with the same (E) IGRP AS number or from directly attached interfaces over which IGRP or EIGRP runs.
  - External routes come from other routing protocols or from static routes and are tagged with the following information:
    - Router ID of the router that distributed the route
      - AS number of the destination
      - Configurable administrator tag
      - ID of the external protocol
      - Metric from the external protocol
      - Bit flags for default routing

4.8 Packet Tracer Configuration Command

To design a topology cisco packet tracer is the best software. We also used cisco packet tracer to design our topology.

Basic Configuration of network[18]

Trunk the switch ports Switch>enable

Switch#config terminal

Switch(config)#int fa0/24
Switch(config-if)#Swmo t

Switch(config)#int fa0/10

Switch(config-if)#Swmo t

Vtp configuration Switch>enable

Switch#config terminal

Switch(config)#vtpmo server

Switch(config)#vtp do nuruzzaman

Switch(config)#vtp pass 1234

Switch>enable

Switch#config terminal

Switch(config)#vtpmo client

Switch(config)# vtp do nuruzzaman

Switch(config)#vtp pass 1234

Configuring V-LanOn coreSwitch

Switch>enable

Switch#config terminal Switch(config)#vlan

10

Switch(config-vlan)# vlan 10

Switch(config-vlan)#vlan 12

Switch(config-vlan)#vlan 14

Switch(config-vlan)#vlan 16

Switch(config-vlan)# vlan 18

Switch(config-vlan)# vlan 20 **Configuring acces mode V-lan on access Switch**

Switch>enable

Switch#config terminal

Switch(config)#int fa0/1

Switch(config-if)#swmoaccVl 14

Router configuration Router>enable

Router# config terminal

Router(conf-if)#no sh

Router(conf-if)#f0/0.10

Router(conf-subif)# encapsulation dot 1Q 10

Router(conf-subif)#ip add 172.168.1.1 255.255.255.192

Eigrp protocol

Router(config)#rouei 10

Router(config-router)#no auto-summary

Router(config-router)#redistribute static

Router(config-router)#net 10.0.0.0 0.0.0.3

Router(config-router)#net 172.168.0.0 0.0.0.255

Router(config-router)#net 172.168.1.0 0.0.0.63

Router(config-router)#net 172.168.1.64 0.0.0.63

Router(config-router)#net 172.168.1.128 0.0.0.31

Router(config-router)#net 172.168.1.160 0.0.0.31 Router(config-router)#net
172.168.1.192 0.0.0.31

Chapter 5   Simulation

5.1 Simulation in Opnet

Our simulation term focused by Opnet software .Actually we try to observed distribution level to user level simulation. This is the main window where we put the network equipment in software window. The equipments are distribution switch, access level switch and number of nodes. Where the number of nodes are directly connected

through to the access level switches. Each and every access switches are given access to the nodes.
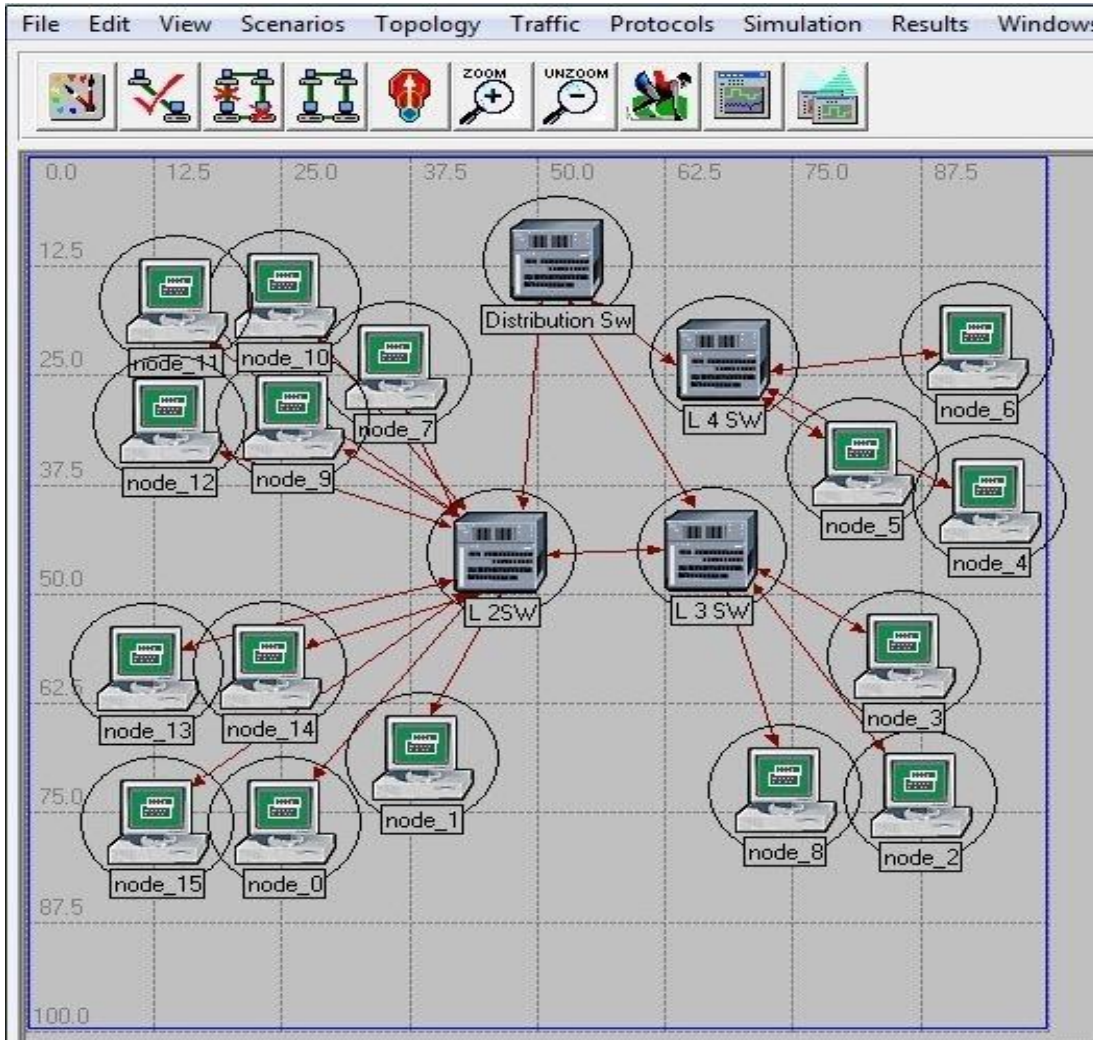
Fig 5.1:Opnet main window

This is our a main window where we putted our networking equipment.

Simulation sequence:
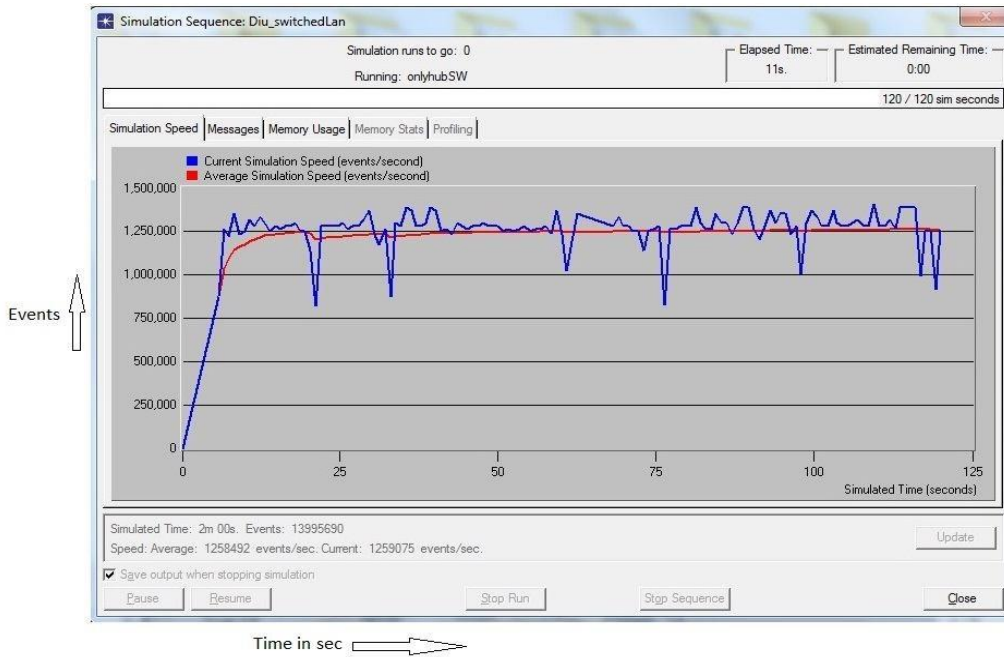
Fig 5.2: Simulation sequence

Software given us its simulation sequence that shows two color sequences. Blue one is our simulation speed & red is the average. From this graph we get above 12,50,000 packets sent & received around 15 second in simulation time. Where the average curve shows 12,50,000 packets send & received in event simulation time. [3]

Collusion count:
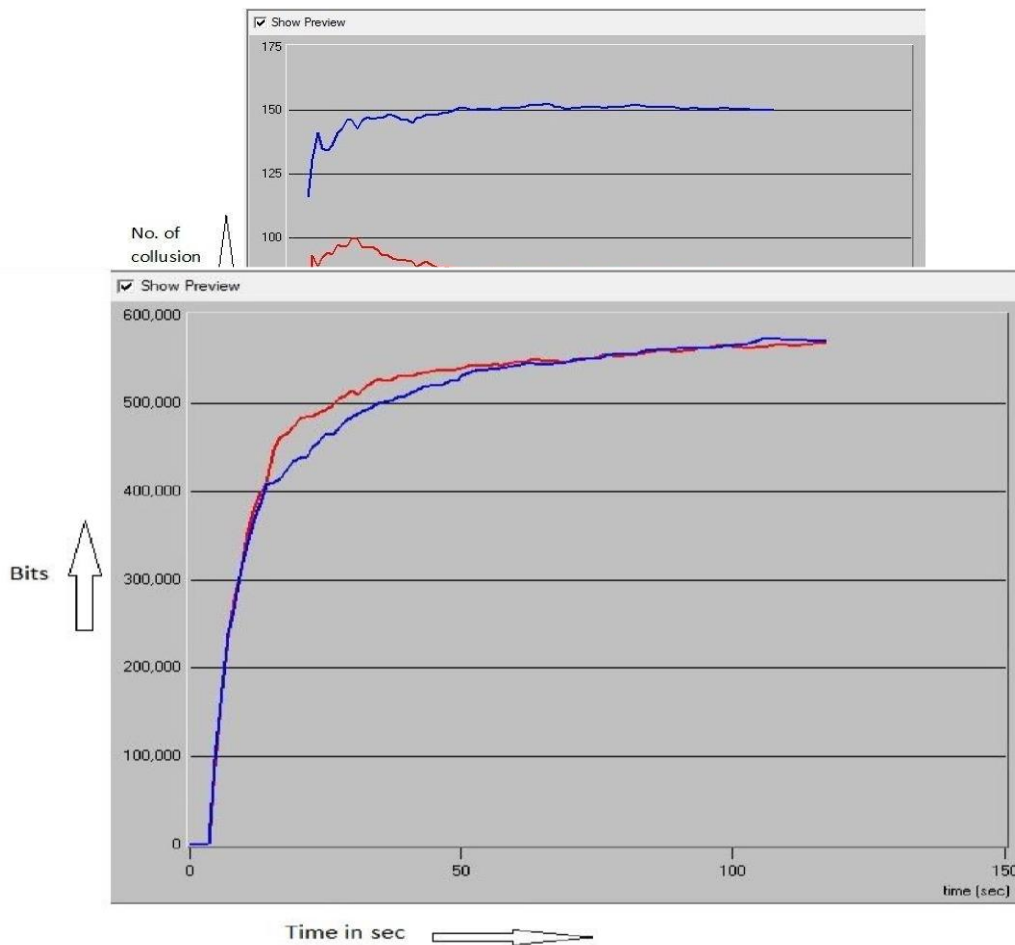
shows the conditions of the smaller number of expotential with the large number of collision count. As the expotential is smaller, the times of sending packets are larger than before. At the same time , numerous other machines try to send their own packets, as a result more conflicts happens.[3]

Load bit/s:

Fig 5.4: Load bit/s

Here is an exponential curve that focused the network load in bit per sec. After 50 sec above 5,00,000 bits are loaded through to the network. Where average curve shows above 5,50,000 bits are sending & received for this network in 50 sec.

Load packet/s:
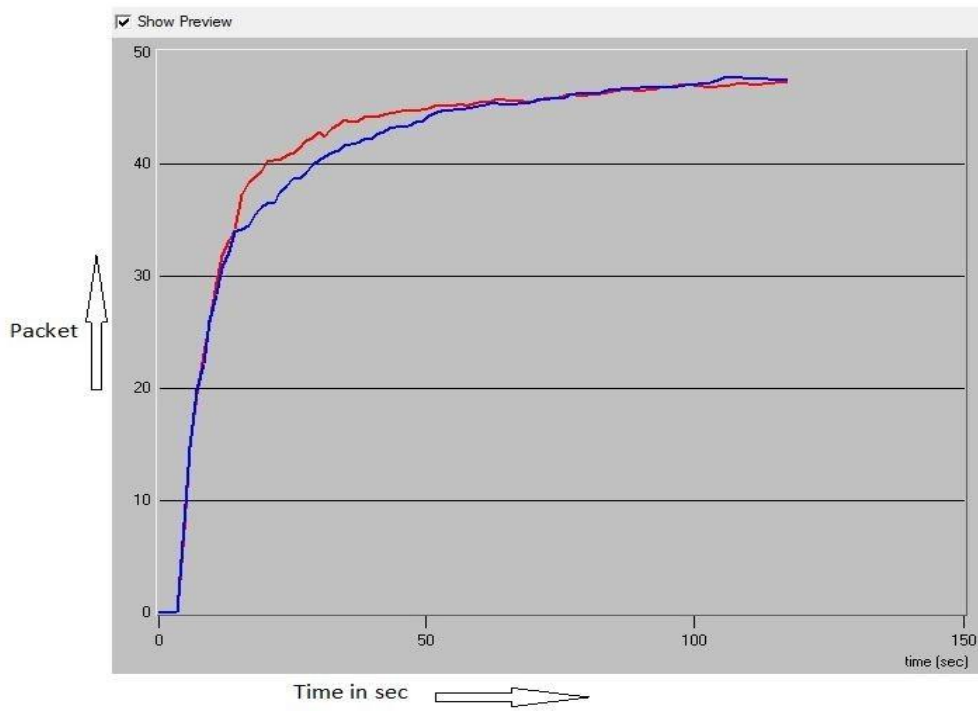
Fig 5.5: Load p/s

In this figure packet loaded performance focused in time. After 25 sec our network able to load over 45 packets also loaded after 1 min.

Ethernet load files with traffic:
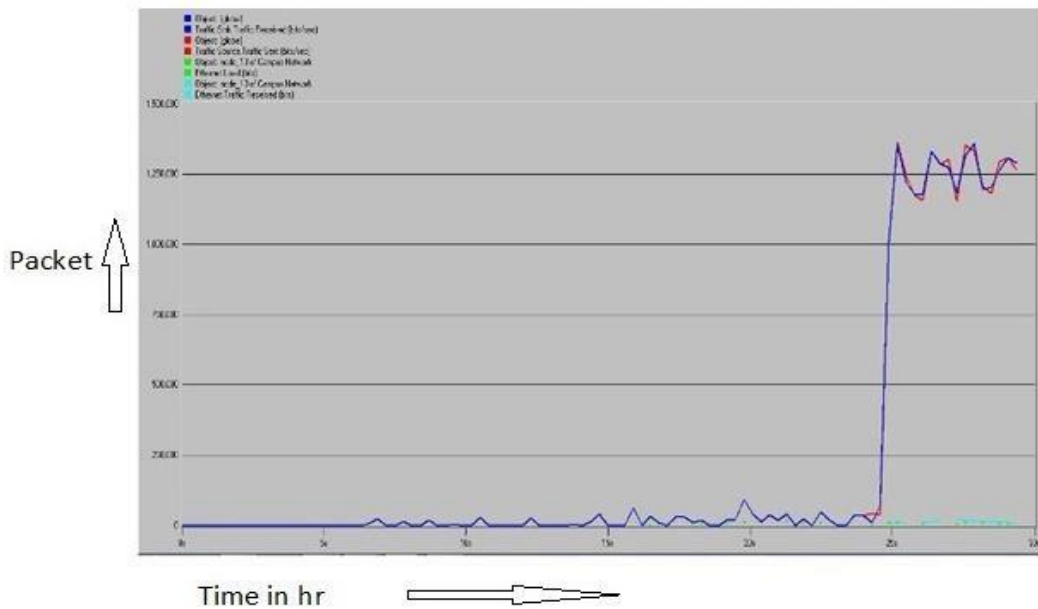
Fig 5.6: Ethernet traffic load

This figure for Ethernet point traffic loaded where full load condition loaded the packet with average load in hour. After 2.5 hours our traffic Ethernet load increase with 1,20,000 packets.

Point to point delay:

Fig 5.7: point to point delay

Each and every Ethernet point able to sending and receiving packets in a time. Where the curve shows full loaded Ethernet point to point delay in ms. where average delay may increase in time.

End to End delay:
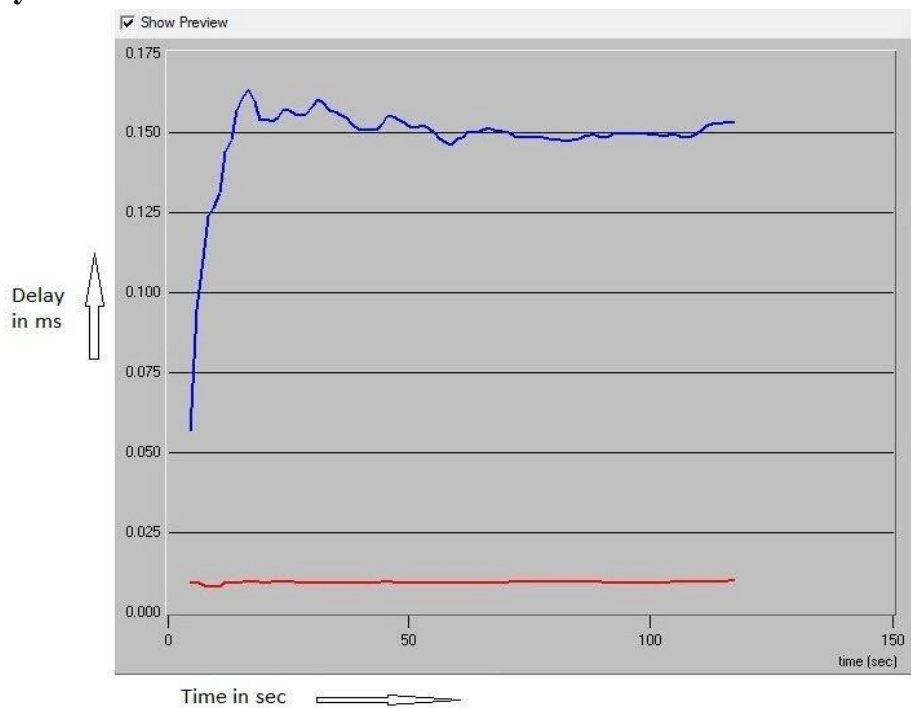
Fig5.8 End to End delay

This is our network source to destination delay. When our network in full loads the delay are increase with increase the uses packet sending and receiving. Our average delay from source to destination only 0.012ms in terms of time in second.

Traffic received packet/s
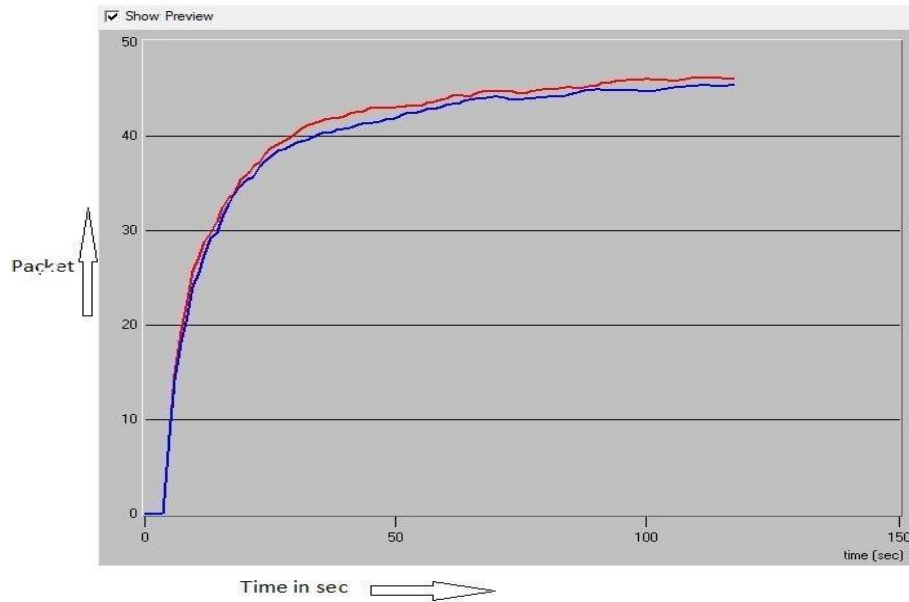
Fig 5.9:Traffic received packet/s

This figure shows traffic received the packet in second. There are 42 packets are received in 50 second where the average 40 packets are received in 30 second.

Traffic sent bit/s:
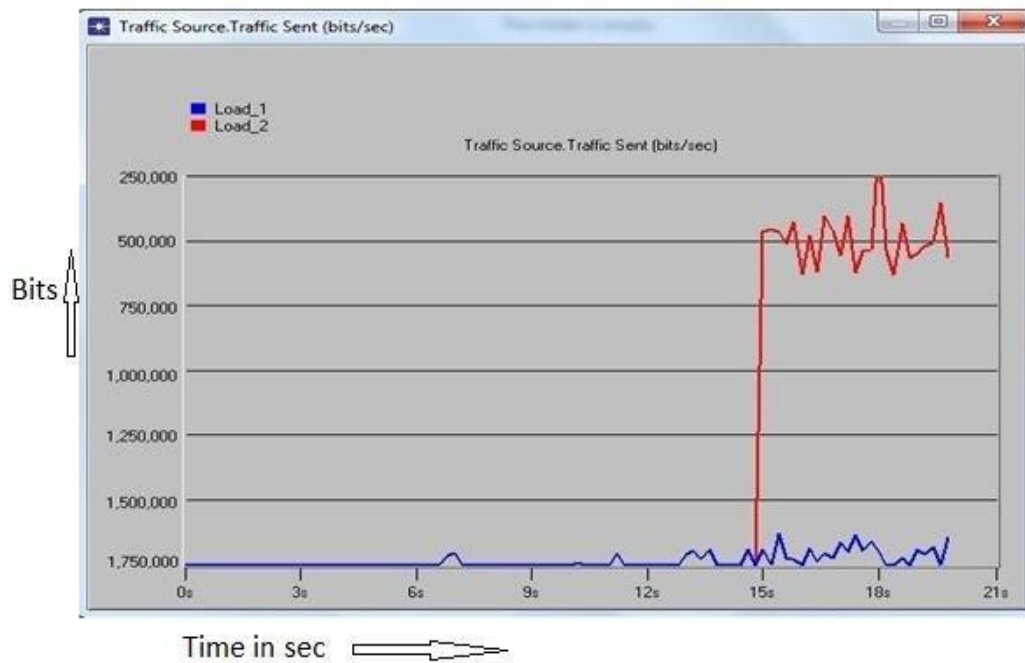
Fig 5.10: Traffic sent bit/s

In this Simulation we examined scenario for a node where there are 45 users are connected. In low load each user sending 100 packets and receiving 10 packets in every 0.1s. The result shows that when the network will get highest traffic all users will get a reliable speed.

And in high load with a great traffic if 100 packets are sent and 10 packets are received in 0.005s.

We did the simulation for 45 users. If the no of user reduced then speed will increase.

CHAPTER6:WI-FI

INSTALLATION

6.1 AP:

In computer networking, a **Wireless Access Point** (WAP) is a device that allows wireless devices to connect to a wired network using Wi-Fi, Bluetooth or related standards. The WAP usually connects to a router (via a wired network), and can relay data between the wireless devices (such as computers or printers) and wired devices on the network.[1]

6.2 How AP Works:

A station is a device by which 802.11 connectivity is accessible. Some station together make a basic service set connected to a Access Point.

Access Point is such a device that itself is a station and also gives connectivity to the stations under it BSS to access the distribution system via wireless. The distribution system can be a wired or wireless network, which is connected with several Access Point and portal. To integrate the IEEE 802.11 architecture with a traditional wired LAN a portal is used.

Portal devices are Bluetooth device, Bridge, Router etc. A portal logic is implemented in those devices. Together all these devices described in upper lines forms a single extended service station (ESS).

When an access point (end user device) come access to wireless converge it try to get access to the distribution system. In between the station and DS there is an access point.

The access point is housed some central co-ordination function and authentication process, by which it can determine eligibility of the station to access the distribution system as well as to WLAN . If the access point allows the station then the station will be able to stay connect until the wireless coverage area.[10]

6.3 Access point configuration:

There are some basic steps that must be done which are as follows:[14]

❖ Change the default wireless ❖ network name or SSID ❖ Change
the default password ❖ Enable MAC address filtering ❖ Enable
encryption

1) **SSID Setup:**

To access the web-based utility, launch the web browser on the computer, and then
entering the Router's default IP address, **192.168.1.1**, in the Addressfield. Then,
press **Enter**. After that the following window will appear and the first time opening
the Web-based utility, we used the default password **admin**.[13]

Fig 6.1:SSID setting

1) Setup > Basic Setup:

The following window allows changing the Router's general settings.

Fig 6.2 Basic setting

2) Internet Setup :

Internet Connection Type**:** Select the type of Internet connection your ISP providesfrom the drop-down menu. The available types are:

- · Automatic Configuration - DHCP

- · Static IP

- · PPPoE

- · PPTP

- · L2TP

- · Telstra Cable

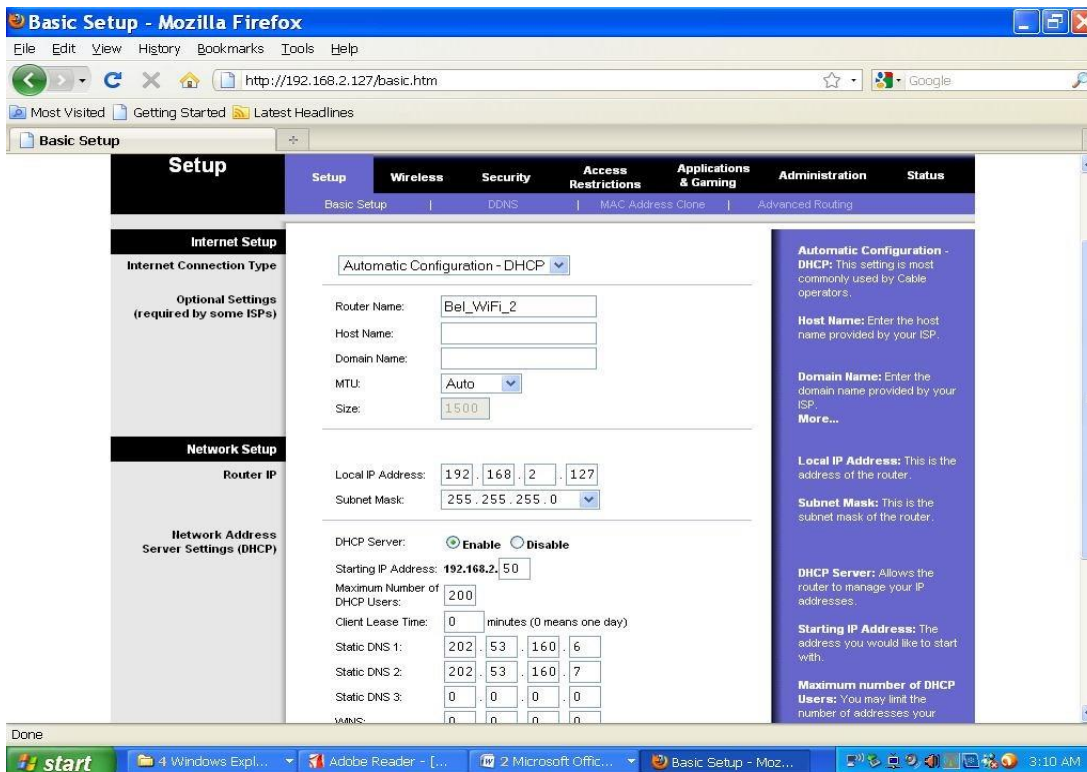- · Automatic Configuration - DHCP

Practical screen shot of the AP configuration:

Fig 6.3: practical configuration

From the above figure we may see the following information while the first step of configuration:

Router Name: Bel_WiFi

Local IP Address: 172.168.20.10

Subnet Mask: 255.255.255.0

DHCP Server: Enable

Starting IP Address: 172.168.20.11

Maximum Number of DHCP Users: 10

Static DNS 1:202.53.160.6 Static

DNS 2:202.53.160.7 **3) Wireless**

Configuration:

To manually configure my wireless network, we select **Manual**. Proceed to the "Basic Wireless Settings" section.
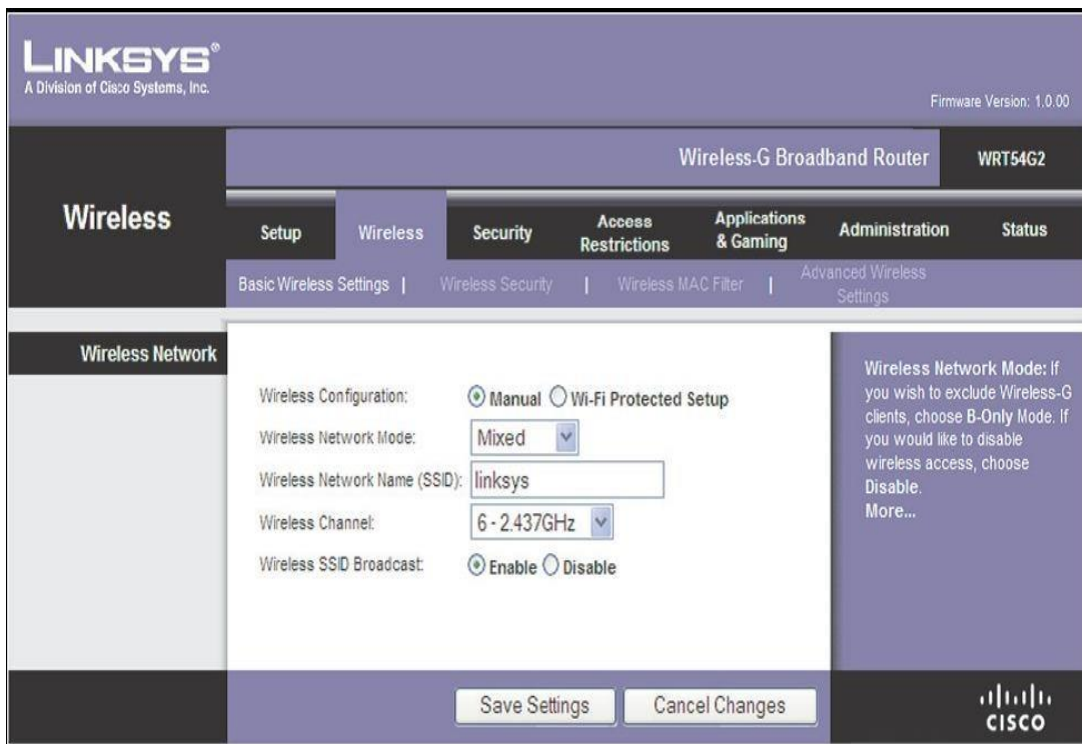

Fig 6.4: wireless configuration

After saving the configuration it will be fully functional. And the users can get connected with wireless internet.[5]

CHAPTER: 7 CONCLUSION

Conclusion:

Internet is the most valuable thing now-a-day. Without internet it is not possible to run a single day. Network planning is also the obvious part of using internet.

The status of this project is to show network architecture for DIU science faculty and library for both wireless and wired. Here the designed topology has been designed with some software's. From the simulations we are now in a decision that our designed wired network will support 320 users. We know that demand will be higher day by day. It is very easy to install any types of update any time.

In future we will reduce collisions and delay and also increase the number of user with better speed. We will also design wireless network in our entire campus.

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