SUMMER TRAINING PROJECT REPORT

ON

“Campus Network Design using Cisco Packet Tracer”

SUBMITTED TO

ALTENCALSOFTLABS Pvt. Ltd.

UNDER THE GUIDANCE OF

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ALTEN CALSOFTLABS
AN ALTEN GROUP COMPANY

ACKNOWLEDGEMENT

It gives me great pleasure in presenting the Project Report that gives the details of my project on “Campus Network Design on Cisco Packet Tracer”.

I avail this opportunity to express with immense sincerity, my thanks to ALTEN CALSOFTLABS for giving me the opportunity to work upon this project. It has been aver informative part of my academics.

This project wouldn’t have seen the light of the day without the immense support of my guide MR. Sumit Kumar for showing his keen interest, constant guidance and encouragement throughout, in the completion of this project without which it would have not been possible to fulfill the requirements of the project assigned to me.

Lastly, I would like to thanks to the ALMIGHTY and my parents for their moral support and my colleagues with whom I shared my dad-to-day experiences and received lots off suggestions that improved my work quality.

Sarthak Srivastava

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About Alten CalSoftLabs

ALTEN Calsoft Labs is a next gen digital transformation, technology consulting, enterprise IT and product engineering services company, that helps customers to become smarter, highly productive, nimble and better at predicting the future. Leveraging our extensive deep industry and business process expertise, passion for customer excellence, and proven global IT services delivery model and network – we offer best of the breed offerings for Industry verticals like Education, Healthcare & Life Sciences, Networking & Telecom, Hi-Tech, ISV and Retail.

ALTEN Calsoft Labs is a pioneer in delivering Business Innovation, Integration and Transformation through disruptive technologies like SMAC (Social – Mobility – Analytics – Cloud), IoT and Big Data. We have mastered the art of addressing enterprise business and technology challenges through our “Connected Customer framework” that:
(i)Enables enterprise business transformation, technology innovation and integration.
(ii)Facilitates customers thrive in the digital age by enhancing productivity and performance.
ALTEN Calsoft Labs has received accreditation certification of CMMI level-3, DEV-1.3version, ISO 9001:2015 and ISO/IEC 27001:2013 for Information security management system covering provision of resources, work environment for software design, development testing, implementation, maintenance, enhancement and support projects. This certifies that the Quality Management System of ALTEN Calsoft Labs has been audited and found to be in accordance with the requirements of the Management System standard.

Abstract

A group of PC's physically connected through a communication medium is called a '*Network*'. Computer Network is a communication system which links computers and their resources. The sharing of information and resources within a network is known as Networking.
Today a network is a part of the infrastructure at homes, small offices to huge enterprises. Training in the telecom sector can give us an idea how huge the industry earnings are from various networking technologies. This report provides the overview of various networking technologies used for designing a distributed network. The report also enumerates my role in the company during the training and briefly describes the experience gained in 'Network Design and Monitoring' .
This report also includes details of the project "Designing of Company's Computer Network", wherein I have designed a complete network.. The network design is without any references to the existing computer network being used in the company. The network design keeps in view services like (I) internet on each desk (ii)Wi-Fi enabled campus (iii) interconnectivity of computers of the same department (iv)network security via VLAN's, access lists.The proposed network design uses simulator software 'Cisco Packet Tracer 5.3'.
Details of 'Cisco Packet Tracer 5.3' have also been provided in this report. All the necessary networking basics and background information has also been provided for the sake of completeness.

Introduction

During the twentieth century, the key technology has been information gathering, processing and distribution. Among other developments, we have seen the installation of worldwide telephone networks, the birth and unexpected growth of the computer industry, and the launching of communication satellites.
As we moved towards the end of this century, these areas have been rapidly converging. The merging of computers and communication has had a deep influence on the way computer systems are organized. The old model of a single computer serving all of the organization needs, is rapidly being replaced by one in which a large number of separate but interconnected computers do the job. These systems are called computer networks.

Need for a network:-

Resource Sharing-
The aim is to make all programs, data and peripheral available to anyone on the network irrespective of the physical location of the resources and the user
Reliability-
A file can have copies on two or three different machines, so if one of them is unavailable (hardware crash), the other copies could be used. For military,banking, air reservation and many other applications it is of great importance.
Cost factor-
Personal computers have better price/performance ratio than microcomputers. So it is better to have PC's one per user, with data stored on one shared file server machine.
Communication Medium-
Using a network, it is possible for managers, working far apart, to prepare financial report of the company. The changes at one end can be immediately noticed at another and hence it speeds up co-operation among them.

Challenges

The challenges mainly lie in various areas of network design

- Designing a fault tolerant network topology

- Insuring minimum traffic and collisions.
- Allocating IP's according to requirement as well as keeping in mind network expansion.
- Designing a network with minimum number of hops to ISP.
- Establishing a LAN as well WLAN (Wi-Fi) network**.**
- Strengthen network security to insure immunity towards hackers and cyber attacks.
- And with the implementation of the Access Lists network becomes very strong, safe and secure.

Goal of this project

The goal of this project is to create a prototype of a working company network with the following features:
(i)Internet on each desk
(ii)Wi-Fi enabled campus
(iii)Interconnectivity between computers of the same department
(iv)Network security via VLAN's, access lists
(v)Maintaining cost effectiveness.

Implementation

Designing of Company's Computer Network

The basic design of this network consist of four segments:
1.ISP
2.Router and Layer 3 switch
3.Layer 2 switch
4.LAN of company

Summary

In this architecture the ISP is connected to a Router or a Layer 3 Switch. In the actual project preference has been given to Layer 3 switch instead of the router as it supports up to 24 LAN ports along with the features of routing. This helps in network expansion and makes the project more cost effective. The Layer 3 switch has been configured to contain VLAN of each department, in order to make it more secure. Then all the VLAN have been transferred on to a Layer 2 switch using a trunk link.
From the Layer 2 switch the network is further expanded to various LAN's of different departments. Access Lists have been enabled on the Layer 3 switch in order to avoid unnecessary data transfer of one department to another via the network.

The complete project is designed and simulated on Cisco Packet Tracer 5.3 which is a powerful network simulation tool

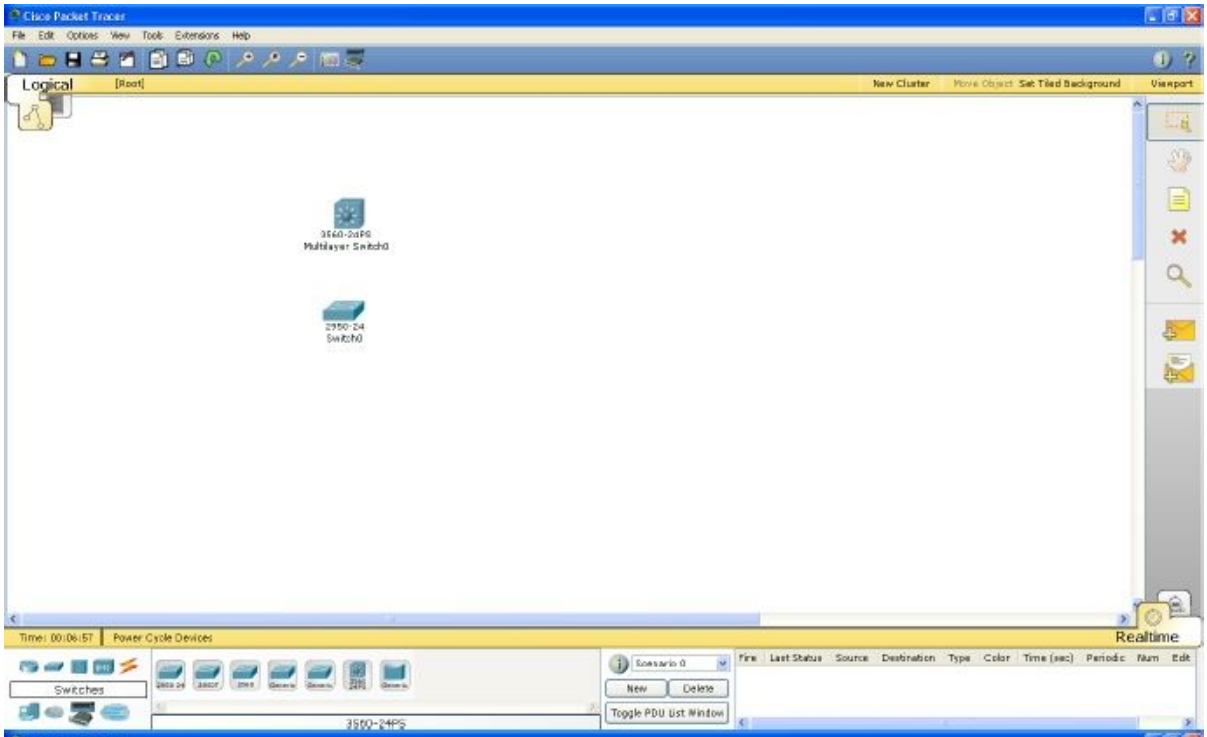
Planning

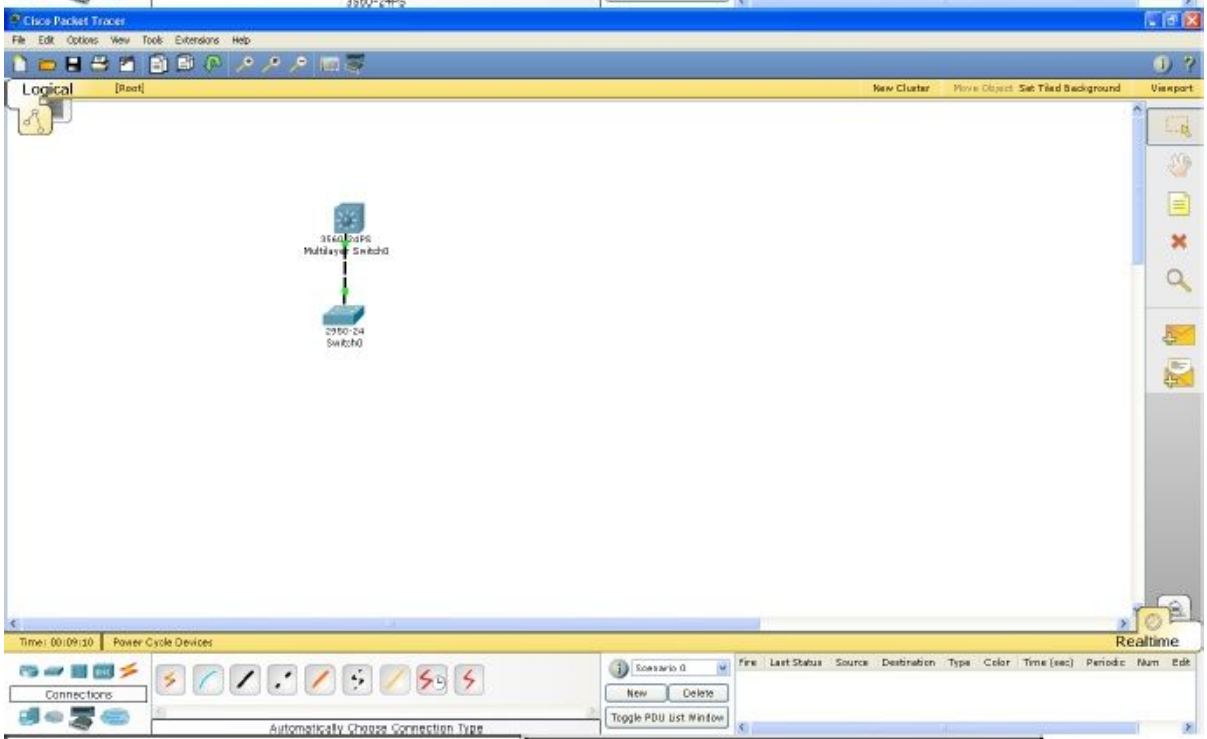
While designing a network a network administrator has to take consider the following aspects.

- Designing a fault tolerant network topology- Our company network topology is hierarchical in design and since LAN is a broadcast network, a tree topology has been implemented.
- Insuring minimum traffic and collisions- In order to achieve this goal switches have been used in network segments where heavy traffic is involved.
- Allocating IP's according to requirement as well as keeping in mind network expansion- Each department has been allocated a different network IP series with */24 subnet masks*. ***This insures network expansion as well as efficient segmentation.***

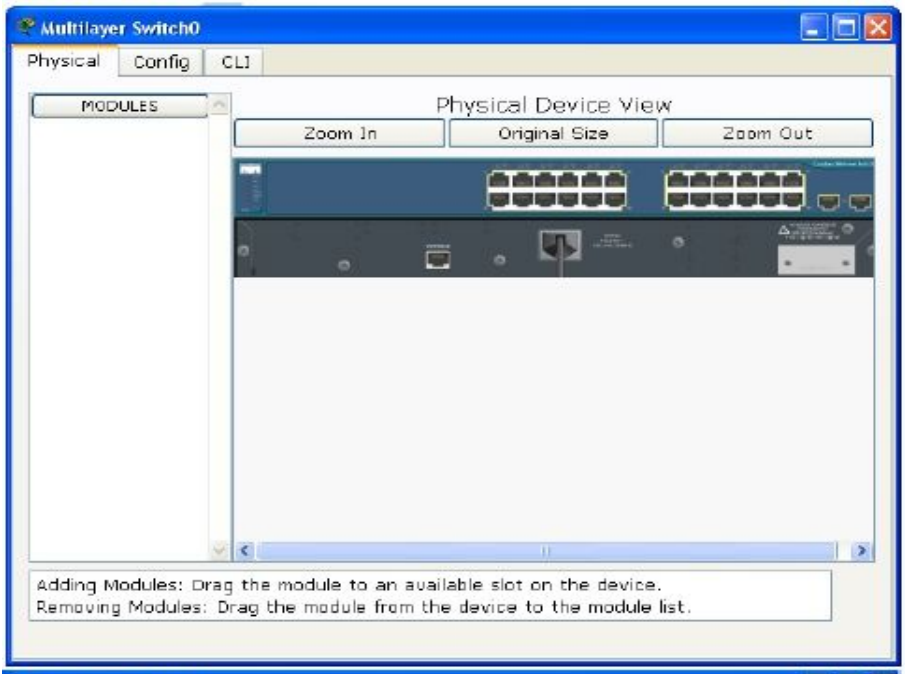
Designing of Company’s Computer Network

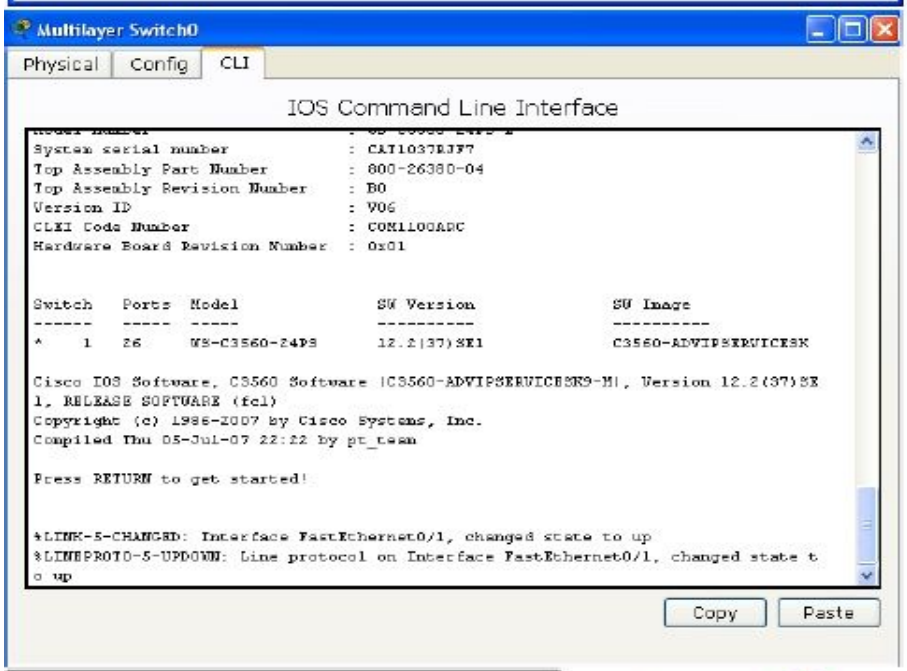
(i) Connect the devices by choosing a suitable cable by clicking on the lightning icon of the device selection box.The links will be orange initially and will then change to green-indicating that they are up.





(ii) The device can then be configured using the Cisco IOS provided in the device. Itcan be access by double clicking on the device and then clicking on to the CLI tab .

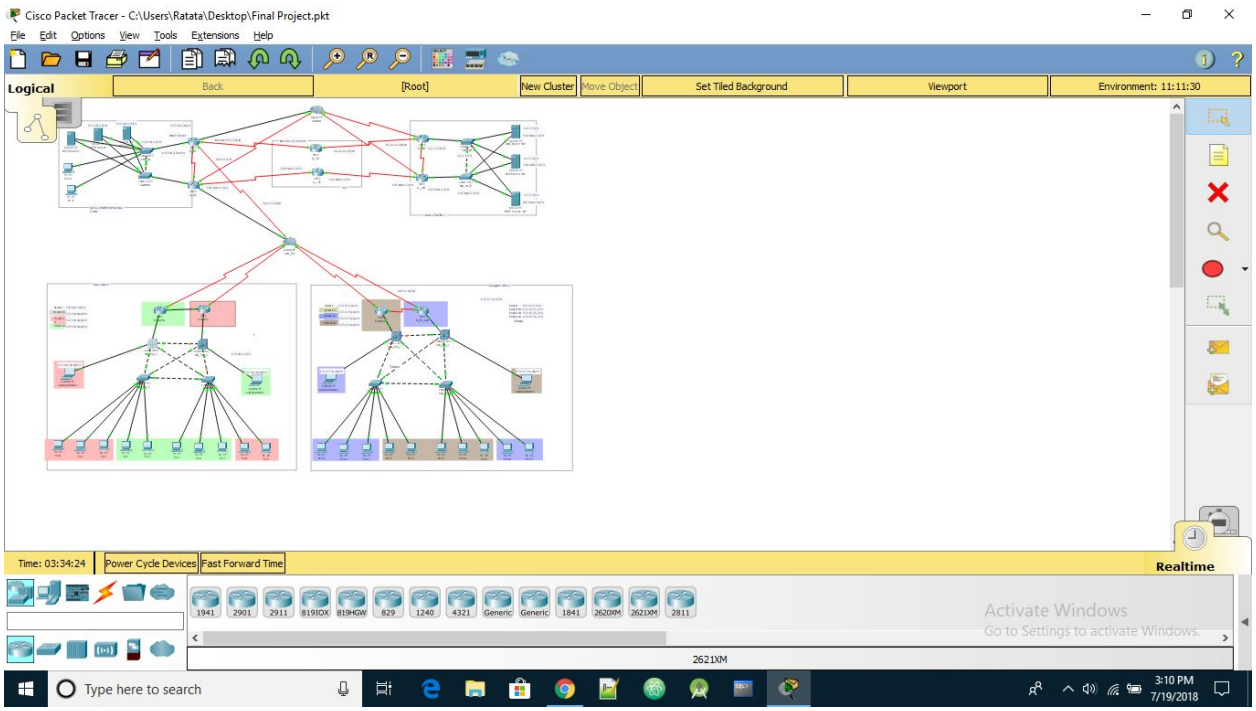




(iii) Using the above two steps we can design, develop and configure any kind of network that we want. The development also involved configuration of VLAN's and use of access lists .

The Final Network

The final network configured is shown below:



Network Testing

The ‘Packet Tracer’ is specifically designed for simulation and testing of networks. It has two modes:1. Real Time mode 2.Simulation mode The testing of network can be performed in both the modes. In

Real time mode

We can access any PC, switch or router and using its command line interface we can try commands like ‘ping’ and ‘tracert’ to check whether the network is working in the desired fashion.

Simulation mode

We can actually trace a complete packet from its source to destination using ‘Forward and Capture’ technology provided by the simulator.

Results of Testing

The complete network including all its features was tested under both the modes andall the problems faced were rectified. The tests were also carried out on physical devices such as switches for concept of access lists, as the packet tracer doesn’t support some of the security features. The network was found to be secure, strong and safe for use.

Conclusion & Future Works

Conclusion:-

The proposed prototype of network based on peer to peer model has been successfully implemented using the simulator. With the help of various security constraints security has been provided to the network. The attempt to achieve all goals of the network design has been successful. A secured communication between the various clients has been provided

Future Works:-

Although the proposed Network was developed successfully yet there is of scope for further enhancements and improvements. The project can be extended by adding features such as data warehousing and data mining specific to corporate offices. The features like Confidentiality, Integrity and Nonrepudiation, Role management and Rule Management can be implemented using Access control list(ACL) that will further make our network secure and free from active and passive attacks. We can implement a Network based firewall in IDS. Combining all these features it will act as a secured network for an organization. The network can also be extended to include other in premises and out premises companies which are sister concerns of the same management

Appendix

What is a network?

A **network** is a collection of computers, servers, mainframes, network devices, peripherals, or other devices connected to one another to allow the sharing of data. An excellent example of a network is the Internet, which connects millions of people all over the world. Below is an example image of a home network with multiple computers and other **network devices** all connected to each other and the Internet.

7 Layers of OSI Model

Layer 7: **The application layer**. This is the layer at which communication partners are identified -- Is there someone to talk to? -- network capacity is assessed -- Will the network let me talk to them right now? -- and where the data or application is presented in a visual form the user can understand. This layer is not the application itself, it is the set of services an application should be able to make use of directly, although some applications may perform application-layer functions.

Layer 6: The presentation layer. This layer is usually part of an operating system (OS) and converts incoming and outgoing data from one presentation

format to another -- for example, from clear text to encrypted text at one end and back to clear text at the other.

Layer 5: The session layer. This layer sets up, coordinates and terminates conversations. Its services include authentication and reconnection after an interruption. On the internet, Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) provide these services for most applications.

Layer 4: The transport layer. This layer manages packetization of data, then the delivery of the packets, including checking for errors in the data once it arrives. On the internet, TCP and UDP provide these services for most applications as well.

Layer 3: The network layer. This layer handles addressing and routing the data -- sending it in the right direction to the right destination on outgoing transmissions and receiving incoming transmissions at the packet level. IP is the network layer for the internet.

Layer 2: The data-link layer. This layer sets up links across the physical network, putting packets into network frames. This layer has **two sublayers:** the logical link control layer and the media access control layer (MAC). MAC layer types include Ethernet and 802.11 wireless specifications.

Layer 1: The physical layer. This layer conveys the bit stream across the network either electrically, mechanically or through radio waves. The physical

layer covers a variety of devices and mediums, among them cabling, connectors, receivers, transceivers and repeaters.

Protocols at each OSI Layer

Layer 7: **The application layer**:-

HTTP, TELNET, SMTP, FTP, BGP

Layer 6: **The Presentation layer**.

TLS, SSL, AFP

Layer 5: **The Session layer**.

NetBIOS, ISNS, NFS, PAP, RPC, SIP, SMPP, SHH

Layer 4: **The Transport layer**.

AEP, TCP, UDP, SPX, DCCP

Layer 3: **The Network layer**.

ARP, EGP, IGRP, IPv4/6, NAT, OSPF, RIP

Layer 2: **The Data Link layer**.

MAC, VLAN, CDP, ATM, ETHERNET, FRAME RELAY, PAP

Layer 1: **The Physical layer**.

ISDN, MODEM, WiFi, USB

Important components of a network

Hub

Hub is commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets. Hub acts as a common connection point for devices in a network.

Switch

Switch operates at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Model and therefore support any packet protocol. LANs that use switches to join segments are called switched LANs or, in the case of Ethernet networks, switched Ethernet LANs. In networks, switch is the device that filters and forwards packets between LAN segments.

Router

A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISPs network. Router is generally located at gateways, the places where two or more networks connect. Using headers and forwarding tables, router determines the best path for forwarding the packets. In addition, router uses protocols such as ICMP to communicate with each other and configures the best route between any two hosts. In a word, router forwards data packets along networks.

Subnetting in IPv4:-

A subnetwork or subnet is a logical subdivision of an IP network. The practice of dividing a network into two or more networks is called subnetting.

Class A:-

NNNNNNNN.HHHHHHHH.HHHHHHHH.HHHHHHHH

Range of class A IP Address: 1.x.x.x to 126.x.x.x

Therefore Class A default subnet is 255.x.x.x

Class B:-

NNNNNNNN.NNNNNNNN.HHHHHHHH.HHHHHHHH

Range of Class B IP Address': 128.0.x.x to 191.255.x.x

Therefore Class B default subnet is 255.255.x.x

Class C:-

NNNNNNNN.NNNNNNNN.NNNNNNNN.HHHHHHHH

Range of Class C IP Address': 192.0.0.x to 223.255.255.x

Therefore Class A default subnet is 255.255.255.x

How do we calculate no of subnets?

Total no. of bits=32

To calculate \n = 32 - no of host bits

Total no of hosts in the subnet= $2^{\text{no of host bits}}$

Ex:-

For Class C :-

No of host bits=8

To calculate \n= 32 - 8 = 24

Therefore subnet = 255.255.255.0/24

Total no. of hosts = 2^8 = 256

VLAN

A VLAN is a group of devices on one or more LANs that are configured to communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments. Because VLANs are based on logical instead of physical connections, they are extremely flexible.

VLANs define broadcast domains in a Layer 2 network. A broadcast domain is the set of all devices that will receive broadcast frames originating from any device within the set. Broadcast domains are typically bounded by routers because routers do not forward broadcast frames. Layer 2 switches create broadcast domains based on the configuration of the switch. Switches are multiport bridges that allow you to create multiple broadcast domains. Each broadcast domain is like a distinct virtual bridge within a switch.

VLAN can carry three types of data:

- Data.
- Voice.
- Native(Management Traffic).

Collision Domain and Broadcast Domain

Collision domain

A collision domain is, as the name implies, a part of a network where packet collisions can occur. A collision occurs when two devices send a packet at the same time on the shared network segment. The packets collide and both devices must send the packets

again, which reduces network efficiency. Collisions are often in a hub environment, because each port on a hub is in the same collision domain. By contrast, each port on a bridge, a switch or a router is in a separate collision domain.

Broadcast Domain

A broadcast domain is a domain in which a broadcast is forwarded. A broadcast domain contains all devices that can reach each other at the data link layer (OSI layer 2) by using broadcast. All ports on a hub or a switch are by default in the same broadcast domain. All ports on a router are in the different broadcast domains and routers don't forward broadcasts from one broadcast domain to another.

SPAN (Packet Analyzer)

SPAN is used for port mirroring or port monitoring.It selects network traffic for analysis by a network analyzer

Ex of a tool:- WireShark.

DHCP (Dynamic Host Control Protocol)

It is used to auto assigned IP addresses to TCP/IP clients. But we need to give static IP address to DHCP server manually. We can install DHCP only on Win NT server or Win 2k server. There may be any OS on client computer. There must be TCP/IP protocol on both sides. On client computers, in TCP/IP properties, we select 'Automatic IP address' instead of manually.

DNS (Domain Name Service/System)

First internet is used by US army, which is called ARPANET. It has maximum 100 clients. It is used only on CUI. There is a HOST file used to internet. DNS introduced in 1984. It is based on Hierarchical structure, which is introduced in MS-DOS 2.0.