04.05.2022

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Networking

Communication between two or more devices is called Networking

What is Communication?

Exchange of Information between two devices (Sender / Reciever)

Communication Terminology

Simplex - One way Communication (Radio / TV)

Duplex (Half / Full) - Two Way

Half Duplex - Communication Bidrectional (one at a time) - Walkie talki (Signalling)

Full Duplex - Communication Bidrectional (Both at a time) -

Telephone

Communication Speed : bits / sec - baud

Parity - Error Detection bit (used for flow control) - Checksum

Networking

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LAN / WAN - Local Area Network / Wide Area Network

LAN is limited to within a building or campus

WAN can communicte beyond campus / city/ State / Country

Networking Devices

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Switch - A device which interconnects within your network (LAN)

Router

When a node wants to talk with other node it places a request called as ARP (Address Resolution Protocol)

Protocol - Set of communication Rules

Functions of Switch: 1) Address Learning (MAC Address)2) Packet forwarding / Filtering

Router - Interconnects 2 or more networks

Functions of Router - 1. Packet Filtering 2) Packet Forwarding

3) Internetworking 4) Path Definition

NIC - Network Interface Card - Every Node / system has NIC

MAC Address - Hardware Address - Physical Address - Ethernet Address

assigned by Manufacturer ( 12 bit Hexa decimal Number)

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Hub - Old version of Switch - Totally outdated (lot of collisions)

Switch - speeds

Ethernet - 10Mbps (Ethernet), 1994-98

Fast Ethernet 100Mbps 2000

Giga Ethernet 1000Mbps or 1Gbps 2005

10G Ethernet 10G 2015

Bridge - Old version of Switch (Totally Obsolete)

LAN

WLAN - wireless Lan

Topology - Study of Networks

1. Client Server Model or STAR Topology

2. Peer to Peer or Bus Topology

3. Mesh Topology

4. Hybrid Toplogy

Open Systems Interconnection (OSI) model - ISO (Data Communications)

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Communication Protcol - (Rules)

7 - Application Layer - File, Message, database, print, email

6 - Presentation Layer - suite, browser,

5 - Session Layer - Interaction - handshake, Authentication

4 - Transport Layer - Path of packet flow / data flow, encapsulation, Acknowledments,

3 - Network Layer - Serivce Provider - Logical Addressing, ARP (Internet / Intranet), Routing

2 - Data Link Layer - Establishes connection to Network Layer (LLC), PHysical Identity/Addressing (MAC)

1 - Physical Layer - Devices, cables, connectors, topology

MAC - Media Access Control - Physical Identity ( 12 digit Hexa Number)

LLC - Logical Link Control

Physical Address / MAC Address / Ethernet Address / Hardware Address - 48 bit Binary or 12 digit Hexa

Logical Addressing / IP Addressing

ARP Address Resolution Protocol

Routing - Path Definition

Connection Oriented Protocol Connectionless Protocol

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More Reliability Less Reliability

Acknowledgement NO acknowledgments

Costly Less Cost

TCP UDP (User Datagram Protocol)

Internet - TCP/ IP Model Communication (4 layers)

7 - Application Layer

6 - Presentation Layer

5 - Session Layer - Application Layer

4 - Transport Layer - Host to Host Layer

3 - Network Layer - Internet Layer

2 - Data Link Layer - Access Layer

1 - Physical Layer

C:>\ipconfig - Report the IP configured

Ip Assignment can be done in 2 methods - Static / Dynamic

Static is manual and assigning IP from Router is dynamic

IANA - Internet Assigned Numbers Authority

IP Address Space - IP Addressing 1) IPv4 2) IPv6

IPv4 - 32 bits - 11111111.11111111.11111111.11111111 (8.8.8.8) 2^32 4Billion - 400Crores

255.255.255.255

IPv6 - 128Bits - 2^128

1. ARIN - American Region

2. APNIC - Asia Pacific

3. RIPE - Europe

4. LACNIC - Latin America

5. AFRINIC - AFrica

IP Addressing - Internet (from browser) / Intranet (Command Prompt)

Intranet / Private Networking

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10.0.0.0 - 10.255.255.255

172.16.0.0 - 172.31.255.255

192.168.0.0 - 192.168.255.255

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Network

Classification of IP Addressing

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255.255.255.255 (32 Bits - 8.8.8.8)

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Class A - (0-127) Very Large 2^24 Hosts 16Million or 1.6Crores

Class B - (128-191) Medium 2^16 Hosts 64K or 65536Hosts

Class C - (192-223) Small 2^8 Hosts or 256 Hosts

Not used in Internet / Intranet (Special Purpose)

Class D - (224-239) Multicasting (Routers Communication)

Class E - (240-255) Research (Future Use)

For Every Network

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Starting is called as Network Address

Range or Valid IP

Ending is called as Broadcast Address

192.168.1.0 - Class C - Network Address

192.168.1.(1 - 254) Range

192.168.1.255 - BC BroadCast Address

172.16.0.0 - Class B - Network Address

172.16.(0.1 - 255.254) - Range

172.16.255.255 - BC

10.0.0.0 - Class A - Network Address

10.0.0.1 - 10.255.255.254 - Range

10.255.255.255 - BC

10.0.0.1 2 3 ....10.0.0.255

10.0.1.0 1 2 3 ... 10.0.1.255

10.0.2.0.............

10.0.255.0.......10.0.255.255

10.1.0.0..

Router is a device which can communication to other Network and this called gateway.

Address given to Router is also called as gateway address.

Decimal Hexadecimal Binary(0,1)

0 0 0

1 1 1

2 2 10

3 3 11

4 4 100

5 5 101

6 6 110

7 7 111

8 8 1000

9 9 1001

10 A 1010

11 B 1011

12 C 1100

13 D 1101

14 E 1110

15 F 1111

16 10 10000 ........

17 11 10001

18 12 10010

19 13 10011

20 14 10100

Decimal to Binary

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50 (decimal) 110010 (Binary) 32(Hexadecimal)

110010 - 2^5 + 2^4 +2^1 = 32 + 16 + 2 = 50 (Hence Verified)

543210

75 - 4B

245 - F5

192.168.10.15 - convert into Binary

11000000.10101000.1010.1111

10101100.00010000.00010100.00110111

172.16.20.55

11011000.1011.0011110.0111010 (Convert to Hexa)

d8.b.1e.3a

216.11.30.58

d8.b.1e.3a

Subnetting - Introduction

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A Large Network dividing into Smaller Network is called subnetting

(----------------------------------TMF----------------------------------------------------)

(----ProjectA---) (--------Project B---)(----Project C-----)........................

Dept Requirement Block Network Range Broad Count subnet

Count Addr cast bits(Y) MasK(X)

Human Resouces 10 16 0 1-14 15 4 8.8.8.4 (255.255.255.240)

Sales 12 16 16 17-30 31 4 8.8.8.4 (255.255.255.240)

Personnel 20 32 32 33-62 63 5 8.8.8.3 (255.255.255.224)

Payroll 30 32 64 65-94 95 5 8.8.8.3 (255.255.255.224)

Stores 15 16 96 97-110 111 4 8.8.8.4 (255.255.255.240)

Finance 14 16 112 113-126 127 4 8.8.8.4 (255.255.255.240)

IT 80 128 128 127-254 255 7 8.8.8.1 (255.255.255.128)

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7 subnet 181 256

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Total Bits (TB) - 32

Network Bits(N) 24 + 8 Host(H) Bits

TB=H + N

TB = X+Y

Hosts = 2^y -2

Subnets - 2^X

192.168.1.0/24

Human Resources - 192.168.1.0 (1-14) BC - 192.168.1.15

SNM - 8.8.8.4 - 11111111.11111111.11111111.11110000 - 255.255.255.240

VLSM - Variable Length Subnet Masing

CIDR - Classless Inter domain Routing

Manufacturing Industry

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BlCount Y bits N VIP Br Ad SNM(X) SNM

Dept A 25 32 5 0 1-30 31 24.3 224

Dept B 14 16 4 32 33-46 47 24.4 240

Dept C 7 16 4 48 49-62 63 24.4 240

Dept D 30 32 5 64 64-94 95 24.3 224

Dept E 15 32 5 96 97-126 127 24.3 224

Dept F 5 8 3 128 129-134 135 24.5 248

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136 136

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Dept A - 192.168.1.0/27 (/27 - cidr )

Dept B - 192.168.1.32/28

Dept C - 192.168.1.48/28

Dept F - 192.168.1.128/29

10000000 - 128

11000000 - 192

11100000 - 224

11110000 - 240

11111000 - 248

11111100 - 252

11111110 - 254

11111111 - 255

Network

179.99.0.0

No. of Subnets 265 9sn +16 = 25 - X Y -7

255.255.255.128

VPC - Virtual Private Cloud

Intranet / Private Networking

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10.0.0.0 - 10.255.255.255

172.16.0.0 - 172.31.255.255

192.168.0.0 - 192.168.255.255

(--------------------------- VPC -10.0.0.0/16 (64K Hosts) -----------------------------------------)

(---sub1---) (---sub2....) (----Sub3---) (---sub4-----)...................

10.0.0.0/24 10.0.1.0/23 10.0.3.0/24 10.0.4.0/23

256H 512H 256H 512H

Terminology

VPC - Virtual Private Cloud

Subnet -

Gateway - Router

Internet Gateway - router

Route - Defining Path - 1) Attaching VPC with Igw 2) Communication between subnet and igw

3) From Subnet to internet using NAT

NAT - Network Address Translation - Address translation from Private to Public and vice Versa

#!/bin/bash

# Install Apache Web Server and PHP

yum install -y httpd mysql php

# Download Lab files

#wget https://aws-tc-largeobjects.s3.amazonaws.com/ILT-TF-100-TUFOUN-1/4-lab-vpc-web-server/lab-app.zip

wget https://aws-tc-largeobjects.s3.us-west-2.amazonaws.com/CUR-TF-100-RESTRT-1/52-lab-NF-vpc-web-server/s3/lab-app.zip

unzip lab-app.zip -d /var/www/html/

# Turn on web server

chkconfig httpd on

service httpd start

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Task -1

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VPC - Lab VPC

IPv4 - 10.0.0.0/16

Public Subnet 1 10.0.0.0/24

Private Subnet 1 10.0.1.0/24

Task -2

Public Subnet 2 - 10.0.2.0/24

Private Subnet 2 - 10.0.3.0/24

Go to Route Table

Task -3

Security Groups - Web Security Group

Task 4

public ip 34.218.48.241

private ip 10.0.2.84

Service - Port

FTP - 21

SSH - 22

Telnet - 23

SMTP - 25 (Simple Mail Transfer Protocol)

DNS - 53 (Domain Name System)

WWW or HTTP- 80

POP3 - 110 Post office Protocol (Mail delivery)

SNMP - 161 (Simple Network Management Protocol)

HTTPS - 443 Secure HTTP

RDP - 3389 (Remote Desktop Protocol)

TCP or Connection Oriented UDP or Connectionless Protocol

Networking diagnostics tool

Ping Tool - ICMP (Messaging Protocol)

Ping Performs the following

1) Verifies the remote IP / host / website is OK / Reply / alive

2) Traces the IP address of the URL

3) Also Display the Latency (Typically in ms)

DNS Managment Tool

nslookup

traceroute

C:\Users\star>tracert -4 www.google.com

Tracing route to www.google.com [142.250.195.68]

over a maximum of 30 hops:

1 <1 ms 6 ms 3 ms reliance.reliance [192.168.29.1]

2 2 ms 1 ms 2 ms 10.14.152.1

3 12 ms 10 ms 11 ms 172.31.2.18

4 11 ms 14 ms 11 ms 192.168.59.124

5 12 ms 9 ms 11 ms 172.26.74.70

6 11 ms 13 ms 12 ms 172.26.75.131

7 10 ms 12 ms 11 ms 192.168.60.226

8 13 ms 13 ms 11 ms 192.168.60.227

9 22 ms 22 ms 22 ms 172.31.2.63

10 26 ms 26 ms 25 ms 72.14.196.126

11 21 ms 24 ms 24 ms 209.85.251.159

12 23 ms 22 ms 28 ms 142.251.55.73

13 30 ms 23 ms 25 ms maa03s38-in-f4.1e100.net [142.250.195.68]

Trace complete.

Telnet

256 - 2 =254 (Network / Broadcast)

AWS Cloud subnet Minimum reserved IP (5) 256 -5 = 251 (Network / Broadcast /DNS / Router / Network Manangement)

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Network Security

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Security - Protection (No Dangers / risks / safety / no threats /)

Data Security - Confidentiality, Integrity & Availability

Confidentiality - Confidentiality, allows authorized users to access sensitive and protected data.

Integrity - Integrity is the practice of showing a consistent and uncompromising adherence to original data

Availability -

Threats -

Malware - A Software which damages or destruction Security

Computer Virus, spyware, trojans, Ransomware, Worms, Bot, rootkits

Social Engineering - Phishing, Shoulder Surfing, Dumpster Diving, Tailgating,

Network Attacks - DOS Attack (Denial of Service)

Anti- Malware - Protection / Security - Stops / prevents your malicious programs with further attacks

Encryption - Plain Text data coverting to cipher text is called Encryption

(Cipher is algorithm based logic)

PT + Cipher = Cipher Text ----> Encryption

CT - Cipher = Plain Text ----> Decryption

Cryptography deals with Encryption / Decryption

Firewall - Protection your system by defining rules for data networking

Intrusion Detection System (IDS) - Network Montoring

Mitigation is a detection and protection policy that is adopted to safeguard networks.

Penetration testing and vulnerability scanning are also essential.

IDS - Alert (Monitoring)

IPS - Firewall (Block)