

LAN (Local Area Network)

LAN is a logical explanation of how big network should be called as local. LAN is a logical explanation that define size of network.

Definition :

Two or more computers or communication devices which are in a room, on a floor, in a building in a campus if are connected are said to be connected to the LAN.

Characteristics :

LAN cannot be define without its characteristics.

- I] LAN should be capable of provide high speed high bandwidth, high capacity communication

Bandwidth :

→ Bandwidth is bits per sec

→ Bandwidth is matrix of speed - communication - speed



wire

Jab human ek-dusre se communicate karte
he to wo language ko English kehte hai
English ek express krne ka Tariya hai. Human
Communicate krne ke liye jo character use
kerte hai usse ALPHA-NUMERIC-SPECIAL
CHARACTER kaha jata hai.

ALPHA yani Alphabet Jo hai A to Z
NUMERIC yani Number Jo hai 0 to 9
SPECIAL character yani #.*.! etc.

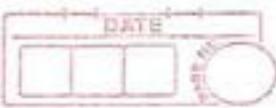
Machine ko jab ek-dusre se communicate
krna hota hai to wo bits ka istamal
karte hai. machine ko English Languages nahi
Samjata.

Machine to machine communication in the
form of bits.

2 Types ke bits hote hai 0 or 1

0 means 0 Volt

1 means 5 Volt



1 byte mein 8 bits hote hain to har character, number, special character ka ekay byte hota hai.

Jab ham koi use krte hain to uska byte value computer pe store ho jata hai.

A - 01010010

R - 01000001

M - 01001101

Agar communication mein receiver side 1 sec pe 1 bit leta hai to Jab 1st A ko bhejne ke time O bheja Jayega yani O apply kiya Jayega. Receive side 1st sec se kuch nahi milega to wo samaj Jayega O diya hai.

Similarly Jab 1 bhejna hoga 1st pc sv apply karEGA jisse electrical current receiver ko milega aur wo 1 gaya hai ye Samaj Jayega 8 sec complete hone ke baad yani jab pura byte aa Jayega tab receiver Samaj Jayega Kya aaya hai karke.

Communication mein Bandwidth / speed / capacity / Frequency all are same thing.

Agar mere bhejne ka Aur receiver ke sunne ka speed same nhi hai to ~~any~~ mur bhi Jaye dono ke bich communication nhi ho sakta.

Both Sender or Receiver ki speed / bandwidth capacity / Frequency same honi chahiye.

Agar mein 1 sec mein 1 crore bit bhej raha hu toh receiver ko bhi 1 sec mein 1 crore bit sunne honge. Agar receiver Jyada ya kam bits sunega toh delay ke bich communication nahi hoga.

Bandwidth mein hum bits bheite hai usse bits/sec kaha jata hai.

Bandwidth = speed = Capacity = frequency = bits/sec

English :- Alpha - Numeric - special character
A - Z , 0 - 9 , # * !

Binary 1 byte = 8 bits

0 - 0v

1 - 1v

10 mbps = 1000000 bits/sec

Characteristics of LAN :

- 1] LAN is capable of providing high speed, high bandwidth, high capacity communication.
- 2] Owner of premises is owner of LAN. Two connect two computer on LAN we do not lease a link from service provider.
- 3] Cost of deployment of LAN is cheap. Equipment which used in a LAN is compact & powerful enough to provide high speed, high bandwidth, high capacity communication.
- 4] Size of the campus is a size of LAN. For the largest LAN campus wide LAN is used.
- 5] Next generation campus wide architecture is Converge Architecture. It should be capable of carrying voice, video, data, Triple play services over single converge infrastructure.
- 6] LAN's Administrative control should be centralized.

Use Case :

HDFC ki lottery lag gaye. Ham HDFC mein bharti ho gaye. Hamare manager ne hamko ek task diya 40000 employee ke liye hame 3 service provide karne thi : voice, video, data.

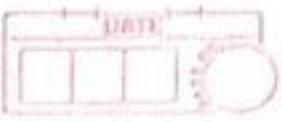
Sabse pahle ham data service provide karne ke liye market gaye 40000 PC kharid laya. Har ek desk par 1 PC mount kiya. Har 1 PC se 1 set of wire nikala aur Data ke centralize device switch ke saath connect kar diya. Hamne data ke liye ek network banaya.

Similarly,

phir ham Voice service provide karne market gaye. Aur 40000 phone kharid laye. Har desk pe 1 phone ko mount kar diya. Har phone se set of wire nikala aur phone ke centralized device PBX (Private Branch Exchange) ke saath connect kar diya.

Similarly,

Video Service provide karne ke liye hum market mein gaye aur 40000 video Conferencing kit kharide aur usse jake har ek desk pe mount kar diya. Har kit se ek set of wire nikala aur video ke centralized device MCV (multimedia convergence unit for multiparty video conferencing) ke saath connect kiya. Is tarah se hamne video ka aayi network banaya.



ye alag alag network ko ham Dis-parate Architecture yani separate Architecture kehte hai. Ham mar bhi jayenge lekin ye Architecture ham use nahi karenge. Iski jagah ham Triple play services use karenge. Usme ham bas 1 centralize unit use karte hui ja hui switch. Ham log switch ko IP Phone ke switch port se or IP phone ke PC port ko PC se connect kar lenge Aur Aagar PC ko internal camera nhi hoga toh USB ke through connect karenge.

Characteristics No 5 of LAN :

Next generation campus wide Architecture is Converge Architecture. It should be capable of carry Voice, video, & data Triple play Services over single converge infrastructure.

Dis-parate Architecture Industry mein kyun use kiya nhi jata uske 2 drawback hai.

- 1] Cost of wire & cable is 3 time higher
- 2] PBX, MCU, switch are inline device in dis-parate Architecture If 40000 log ek dusre se ek time pe baat karenge to PBX, MCU, switch kharab ho Jayega. Jab PBX, MCU, switch ye device low CPU, low memory, low processing power wale honge. Aagar Ache device use karne haito uska Device cost Bohot bahar jaye.



IP Communication (Incomplete)

IP Communication is a communication in which each device has its a unique IP address. Communication between them happens in the ~~form~~ form of packet.

what is packet ?

Each thing which has mark of IP address called as packet.

DATE
10 6 29

IP Communication Kacm kaise karta hai?

→ Voice over IP & video over IP ka example

Jab IP Phone IP address ko leke up hogा sabse pehla step ye jayega aur khud ko PBX ke saath register karenge. Register karne ke liye ek control packet bhejega aur control packet mein bolega ye bhai jo koi bhi PBX hai mera IP address 10.0.0.1 hai. Mujhe extension number de. Ab PBX wahi device hai jiske paas sare device ke IP address or Extension number store hota hai. phir PBX reply mein batayega tera Extension no hai 101.

Similarly,

Jab 2nd IP phone IP address ko leke up hogा sabse pahle jayega aur khud ko PBX ke saath register karega. Aur register karne ke liye control packet bhejega aur packet mai bolega ye bhai jo koi bhi PBX hai mera IP address 10.0.0.2 hai. mujhe ek extension no de. Ab PBX wahi device hai jiske paas sare device ke IP address or extension number ka mapping store hota hai. phir PBX reply mein batayega tera extension no hai 102.

Jab ye IP phone register ho gaye aur agar mein human dusre human se baat karna chahi toh phone ghumunga aur samne wale ka phone no dial karunga 102. To wo directly eake baat karega? Nhi, kyuki mein human hu mein dusre human ko uske naam, phone No, mail id se janta hu lekin mera IP phone tere IP phone ko tere IP address se janta hai. mujhe tera IP address pahle se malum nhi hai kin yahi ek device hai jo IP address janta hai wo hai PBX.

Jab ham dial karenge 102. Hamare IP Phone PBX ko ek control packet bhejega aur bolega ye hain 102 extension no wala IP Phone ka IP address bhej. Jab IP address de raha hoga usi wajh yaha ringtone baiayega. Shakalaka boom boom boom boom Aur yaha dial tone baiayega turr... turr... Ab Jaise samne wale band ne phone uthaya yaha hum human jo bolte hai analog voice ko IP phone digital voice mein convert karenge aur phir usko packetized karenge matlab uspe IP address ka mark lagayega aur IP world pe packet release karega. Ye packet direct IP phone 1 se IP phone 2 ke paas chala gaya via PBX nhi gaya matlab PBX jo hai wo in-line nhi on-net device hai. means koi bhi sasta PBX software use karenge tab bhi sab makhon chalega koi bhi problem nhi hoga ye power IP communication ka hai.

Similarly,

Jaise voice over IP kaam karta hai video over IP bhi kaam karega. Agar mein human Sashin@hotmail.com se baat karna chahata hu toh mujhe aur sab machine dono ko Teams ke MCU pe jake khud ko register karna hoga. Jaise hamne register kiya MCU jaan Jayega Sashin@hotmail.com ka IP address hai 10.0.0.20 ek baar ~~team dono register~~ ~~team~~ ~~team~~ ~~team~~ mein ~~team~~ ~~team~~ ~~team~~ application pe ~~team~~ ~~team~~ ~~team~~ aur Shivam@gmail.com ka IP address hai 10.0.0.10 ek baar ham dono register hue toh mein teams ke application pe jaunga. Sashin@hotmail.com pe click karunga to woh samne aa Jayega

Nahi mai mai human hu mein isku kare human ko usske naam, phone no, mail id se janta hu lekin mere PC tera PC ko tere IP address se janta hai. Muje tera IP address Pata hai? Nahi, lekin yaha 1 device hai jo tere IP address ko janta hai wo hai MCU. Jab mai jaunga aur sachin@hotmail.com ko double click kozunha mere PC Se aye aur teams ke MCU ko control packet bhejega aur bolega ye bhai jo koi bhi sachin@hotmail.com ko IP address de. Jab wo IP IP address dega usi wqt waha ringtone aur mere yaha dialtone balyege. Ek bar jab sachin@hotmail.com ne job call ~~kiya~~ request accept kiya to ab jo meru image camera ~~capture~~ capture karega wo usko cub packetize karega matlab real time packet mai convert karega. source IP address mere PC ka lagega aur destination IP address Sachine ke PC ka lagega.

Source IP	Destination IP	RTP
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ye bhi packet direct jayega via MCU nahi jayega matlab MCU ek in-line device nahi on-net device hai kyuki wo communication ke bich mai nahi sakte. Yeh pe bhi Sasta MCU software use kar sakte hai phir bhi sab makhan ki tarah chalega. Koi problem nahi hoga ye power IP communication ka hai.

TP World Ka Niyam :

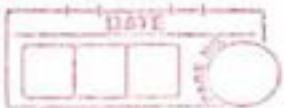
1] bhole signal sabko milega but Accept wahi karega jiske liye aaya hai baki sab discard karenge like phone ke liye Signal Aaya hai toh sirf phone accept karega baki sab discard karenge. Bhale PC ko signal mila but wo accept nhi karey kyuki uske liye nhi aya hai.

2] video communication mai video jo Camera se milta hai Aur Audio jo ki speaker, mic se Capture hota hai dono PC ke Pass chale Jayenge lekin PC ko kaise pata chalga Kaunsa video hai Kaunsa voice hai. ye saara takot IP communication ke Pass hai. ye jab packet bana raha hota hai tab he uspe mark kar deta hai ki ye video wala packet hai. ye audio aur ye data packet hai.

RTP - Real time Packet

CNTRL - Control Packet

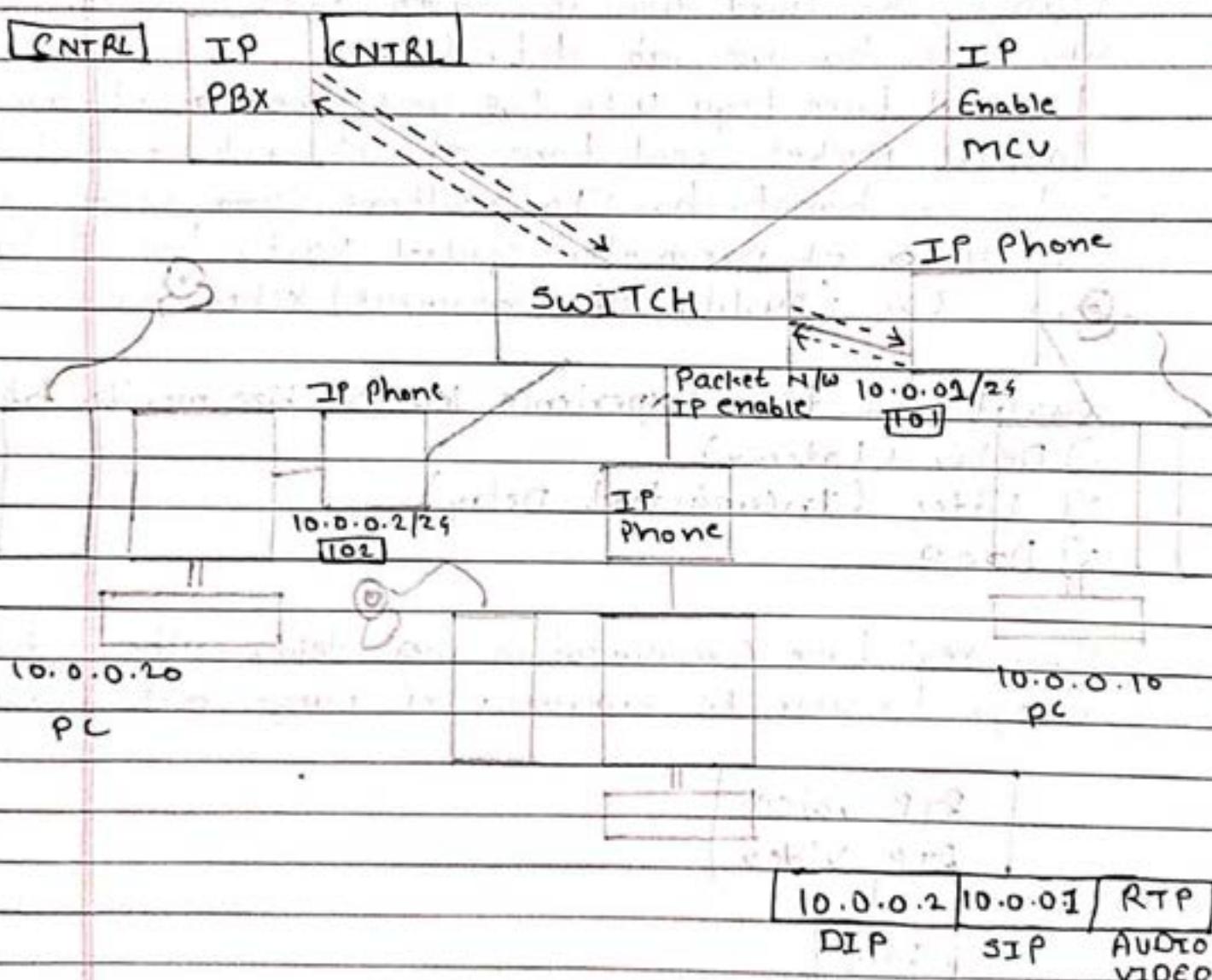
IP during ~~Communication~~ creation of packet mark the packet whether it is Audio, video or Data packet, so depending upon marking PC Samaj Jayega ye video ka packet hai aur ye audio ka packet hai.



Define IP Communication

IP Communication is a communication in which each device has its unique IP address. Communication between them happens in the form of packet and IP has the capability of classifying services by marking at source.

on - net Device



If user (IP Phone 1) dials extension 102, phone will send control packet request for IP address of 102.



* Real time communication kya hota hai? (Service)
→ machine ke harddrive mai store audio or video file real time nahi hai ye sab data hai. Jo bhi aaval hamare mukh se nikalte hai aur phone ke credel ke through pass hoke samne wale ke credel ke speaker se ussi waqt pohodta hai usse real time kehte hai. Jo image mere camera ne capture kiya ussi waqt is tere screen pe present hua ye real time video hai. machine ke hard drive mai video, audio file real time nahi hota hai ye sab data hai. . .
Jo real time hogा uske liye real time packet banaye jayenge packet real time ek toh audio nahi toh video ko banata hai. To realtime communication hota hai usko ek parameter control karta hai. Jisko hum QOE (Quality of Experience) kehte hai.

(Quality of Experience ko 3 chize monitor krdi hain)

- 1] Delay (Latency)
- 2] Jitter (Inconsistent Delay)
- 3] Drop

Agar real time communication mai delay, jitter, drop aayega to user ke experience ki pungi baj jayegi

RTP Voice
RTP video

QOE

- Delay (Latency)
- Jitter (Inconsistent Delay)
- Drop

* IP world Communication Aur Real time Communication
World mai difference kya hai?

→ Real World ye ek world hota hai waha sare services
alag alag alag frequency pe kaam krti hai aur
IP world ye world hai waha sare services ek
he yahi single yani same frequency pe kaam
karta hai.

Real world ka example hai FDM & TDM

FDM - Frequency Division multiplexing

1 wire par 1000 channels cye lekin har channel
alag alag frequency pe aaya. ye Frequency Division
Multiplexing hoke aaya. ye example real world ka ha

TDM - Time Division multiplexing

1 wire par 32 logo ka aavaj 1 sec mai gaya
lekin har aavaj ek alag alag alag time slot mai
gaya. ye example real world ka hua kyu?
kyuki real world ye world hota hai jaha sare
services alag alag alag frequency pe kaam karta hai.
IP world ye world hota hai jaha sare services singl
yani same frequency pe kaam krti hai. Jab tak
mere bhejne ka speed, bandwidth, capacity &
frequency aur tere sunne ka speed, bandwidth,
capacity same nahi hoga mar bhi jayega lekin
IP world mai communication tere mere bich mai
communication nahi hoga.

Agar mai 1 sec mai 1cr bit bheja toh tuhe
bhi 1 sec mai 1cr bit sunao padega. Agar kam ya
Jyada sunega mar bhi jayega tere mere bich mai
communication nahi hoga.

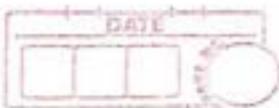
IP world mai user ke paas freedom hai agar wo 1 sec mai 1 cr bit bheja toh usme se kitne bit voice, video aur data rahega. Jitna bit bheja samne wale ko utna sunna padega.

Isko counter krne ke liye MTNL Tri band service laya. 1 wire par voice, video, data laya lekin shi laya? nahi 1 wire par voice, video, data aya par sab alag alag alag frequency pe laya. ye example real world ka bhang gaya. kyuki real real world ye world hota hai jiski saari service alag alag alag frequency mai chalti hai. Agar IP world hota toh saari service same frequency pe kaam karti.

Q. Voice Communication kya hota hai?

→ Ham Human jo bhi bolte hai analog voice hota hai. IP phones ko analog voice Samjata nhi hai. Wo is analog voice ko Digital Voice mai convert karta hai yani digitize karega. phir usko packetize karta hai. Packetize matlab uspar IP address ka mark lagayega. phir IP world ya packet world per usko release kar dega.

Suppose maine phone uthake bola "HELLO" To meza IP phone jayega aur "HELLO" ke multiple sample honayega. manle ekhadu sample drop ho gaya isse experience kharab nhi hoga. moreover in chote flouse ko dur karne ke liye IP Phone per ek Artificial Intelligence chalta hai jo ki hai



VCP - Voice Consilement program

VCP dekhega kaha sample drop hua hai aur usko fill karne ke liye previous sample ko Replicate karke lagayega ya toh next sample ko replicate karke laga dega. Kuch bhi laga dega lekin kan ko drop Samjne nhi dega.

- 1] packet size of voice should be between 8 byte to 64 byte
- 2] Voice is delay sensitive communication.
Real world ho ya IP world ho Delay, Jitter,
Drop Nahi chalta
- 3] In IP world 1 in 10000 voice packet agar drop hua toh Consilement program Consile karke kaam chala lega.

Voice Communication ke andar 3 type ke voice Sunai deti hai

- 1] Best quality voice :- (3D quality voice)
Human ka Sunne ka range 20 Hz - 20 kHz. Best quality voice pure range ko capture karta hai
Best quality voice delay < 50 ms
- 2] Telco quality voice :- (It ~~captures~~ captures narrowband)
It takes less time for encoding & Decoding than best quality voice. Remain time used in long transmission yahi extra time ki wajah se Jyada dur tak transmit kar sakte hai. Delay < 150 ms
- 3] Internet quality voice :- Delay < 200 ms

* Video Communication kaise hote hui ?

→ H323 MPEG standard ke part no 10 mai ye pahle se define kiya hua hai ki Video Communication mai jo standard definition (SD) video hote hai usko packet size 2.5 mb aur jo high definition video hote hai usko packet size hota hai 8.5 mb Video Communication ke andar sabse critical parameter hota hai Sequencing of video frame. Kis frame ke baad konsa frame dikhana hai ye video ka sabse important parameter hai. Isko control karne ke liye 3 type ke frame banaye gaye hain I frame, B frame, P frame.

I frame - Index frame

Jo 1 sec ka video mai screen par dekh raha hu usme konsa chiz kaha display hoga. ye information I frame mai store hoga.

B frame - Bearer frame

Actual Content Jo hamne dikhana hai or uska information B frame mai store hoga.

P frame - padding frame

Pad karna yani fill karna kabhi agar koi frame corrupt hua to padding frame pehle bearer ko replicate korega. Content ko keval fill karne ka kaam karega.

Video is drop sensitive communication. Isme delay aur Jitter bhi nahi chalta. real world ho ya IP world ho delay, Jitter, drop nahi chalta because ye IP world hai uske kuch fayde hain.



1 in lakh video packet agar kabhi drop hua toh usko padding karke kaam chala liya jayega har dusra packet drop hoga toh nahi chalega. Video communication ke andar delay hona nahi chahiye lekin agar aya toh 200ms se Jyada hone nahi chahiye. (Delay always should be less than 200ms 200ms ka delay video frame ke bich mai nahi ana chahiye agar aya toh home video moving nahi stationary dikhai dega. Video communication ke andar kai baar Content glitch ho jata hai. Glitch kyu ho jata hai? Kyuki waha ka bearer frame drop hua ~~hota~~ hota hai. Koi baar video chalke rukta hai phir kuch se baad wahi se chalne lagta hai. Yaha Index frame current ho gaya hota hai.

* Data Communication kya kehta hai?
→ Data is insensitive

Data communication best communication hota hai. Data communication mai koi bhi chiz ki guarantee nahi hoti ki ye data kab pohchega. Kitne transmission ke baad pohchega ya kitne drop ke baad pohchega. Ek he chiz ki ~~guarantee~~ guarantee hoti hai data jab bhi pohchega ekdam satik yani perfect pohchega.

700 mb ki Aishwarya wire par ek saath nahi js sakti. Mere PC ka koi ek software file ke chote chote segment karega. Koi ek software user mai lagayega. koi ek software CRC code chalayega. Koi ek software niche wali Technology ko ~~pass~~

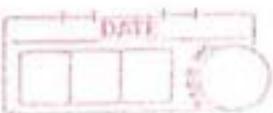
laat marke kahega leja aur deliver karke aa. Dusre end per koi ek software niche ke technology se receive karega. koi ek software CRC code check karega. satik hai perfect hai toh accept karega phir acknowledgement bhejega for next segment.

Jaise is acknowledgement oya, mere PC ka koi ek software dusra segment Uthayega. koi ek software segment par mark karega. koi ek software segment per CRC code lagayega koi ek software niche wali technology ko lauth marea aur kahega leja aur deliver karke aa.

Suppose ye segment jate jate current ho gaya hai jab dusre end par pohchega koi ek software CRC code check karega agar current hai toh discard karega aur acknowledge karega for ~~retrans~~ retransmission of segment

Jaise he acknowledgement oya mere PC ka koi ek software dusra segment Uthayega. koi ek software segment par mark karega. koi ek software segment per CRC code chalayega aur koi ek software niche wali technology ko lauth marea aur kahega leja aur deliver karke aa.

Dusre end par koi ek software technology se receive karega. koi ek software CRC code check karega. satik hai perfect hai toh accept karega. Aur acknowledgement bhejega for next transmission.



Jaise hi acknowledgment aaya mere pc ka koi ek software Teesra Segment Uthayega. koi ek software user mark karega. koi ek software segment per CRC code lagayega koi ek software niche wali technology ko laath marke kahega ja aur deliver karke aa.

Dusre end par technology se koi ek software receive karega. koi ek software CRC code check karega. sahi hai perfect hai toh accept karega aur acknowledgment bhejega for next segment lekin manle acknowledgment raste mai collide ho gaya toh sender ko nahi mila. sender ek stimulated time tak wait karega. Agar acknowledge nahi aaya toh.

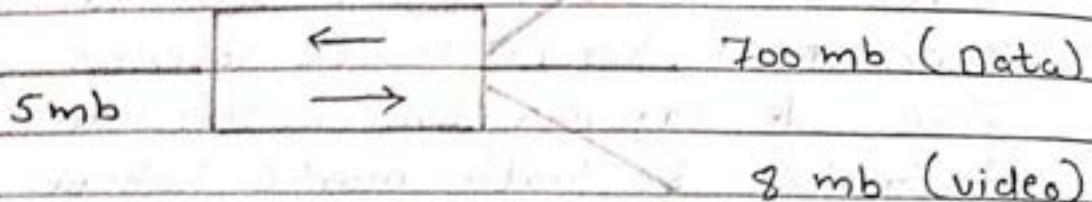
mere pc ka koi ek software teesra segment ko Uthayega koi ek software segment ko mark karega koi ek software CRC mark lagayega. koi ek software niche wali technology ko laath marega aur kahega leja aur deliver karke aa

Dusre end par koi ek software niche ke technology se receive karega. koi ek software CRC code check karega satik hai perfect hai lekin ye mere pass already hai toh mai isko overwrites karunga aur phir mai acknowledge bhejunga for next segment transmission.

Ek baar receiver ke pass suare ciiswonya ke segment aa Jayenge toh sender ne jaise toha hai receiver waise jodye aur user ko de dega. Tsk ^{ye} matlab hai data communication mai koi guarantee nahi hai kab pohochega. kitne retransmission ke baad pohochrega ya kitne atm ke baad pohochega. Jab bhi pohochega satik hai perfect pohochega.



64 Bytes (voice)



Q. mere pass 5 mb bandwidth hai aur 3 service aage
Jone ke liye aayi hai 8mb ka video, 64 Bytes ka
voice, 700 mb ka data. In teeno mein se sabse
aage kaun jayega?

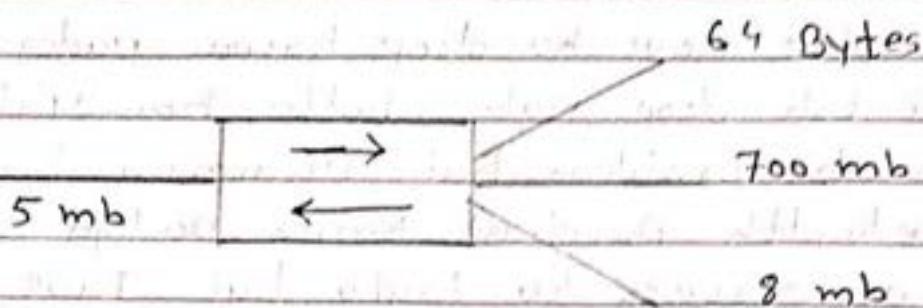
→ 1st Data toh nahi he jayega kyu?
kyuki pura 5mb data occupy kar lega aur us
waqt aya hua voice aur video ko rakna padega.
Agar voice ko rokhunga toh delay aa jayega
isiliye sabse pehle voice he jayega.

yaha video kyu nahi ja saka tha?
kyuki yaha Bandwidth hai 5mb aur video
packet aaya hai 8mb. 8mb ek baar mai nahi
ja sakta. ek baar mai 5 mb chala gaya aur 3
mb bach gaya, ye 3 mb buffer mai jayega
buffer yani secondary storage. 3mb buffer mai
hai aur 8 mb data piche hui toh $3 + 8 = 11$ hui
buffer mai 11 hua jaise hi Bandwidth milega
buffer mai 6 bachege. 6 mb + 8 mb ka packet
aaya 14 hua. 14 mai se 5 khali hua 9 bache
gaya. Naya 8 mb ka packet aaya 17 mb buffer ho
jayega. suppose mere buffer ka size 16 hui agar
wo full ho gaya toh naye content ko rakhne ke
liye existing content ko drop karna padega.



ya phir naye ko drop karna padega. but video mai toh drop nahi chalta hai. yaha question mai hi problem hai. minimum hume itna bandwidth purchase karna padega jitna real time services ko lagta hai. Taise yaha minimum 10 mb bandwidth liya hota toh 9 mb per voice video chale jate aur bache hue 1 mb per data jata.

Isiliye subse pehle voice Jayega. Phir video aur agar kuch bacha hoga toh last main data Jayega.



Is example mai 2 problem hai

- 1] Hame kaise samjata hai inme se konsa packet video, voice aur data ka hai?
- 2] Device ko ye kaise samjata hai ki voice ka quality requirement kya hai. Voice is delay sensitive. Video ka quality requirement kehta hai Video drop sensitive. Data ka quality requirement kehta hai data is insensitive ye kaise samjega device ko?

→ 1] IP, IP mai ye takat hoti hai wo jab bhi koi packet banata hai banate waqt he packet ko mark kar dega ki ye packet voice ka hai, video ka hai ya data ka hai.

2] Quality of Service (QoS) yani classification & prioritization If classify the services kaunsa service voice ka hai video ka hai ya data ka hai.

prioritize kaise karta hai?
voice over video over data

* Characteristics No. 6 of LAN :-

LAN's Administrative control should be Centralize



* MAN (Metropolitan Area Network)

Two or more computers or communicating devices or Network which are geographically separated but within same metro city if one connected are said to be connected on MAN.

* WAN (Wide Area Network)

Two or more computers or communicating devices or Network which are geographically separated but not in same metro city if one connected are said to be connected on WAN.

Use Case of MAN & WAN :

HDFC ke 2 branch hai ek mulund mai ek thane mai. HDFC ko agar apne 2 branch ke bich mai communication karna hai to Tamin khodkar khud ka wire nahi dal sakte. market mai bohot sare service provider hai. service provider se 2 branch ke liye 1 dedicated leased link lega. Service provider is line ke liye bohot premium charge karega. Jab itna mehangaa wire liya jata hai to is wire par kaunsi service chalti hai uske liye kitna Bandwidth lagta hai iski planning karna padega.

For e.g. mulund aur thane milake 1000 employees kaam karte hai. But Sab 1000 log Voice Service use nahi karega. Agar 10-10 log Voice use karega. Toh voice ke liye 100 log

chahiye aur unhe 64 kb ka voice lagega hai
 Toh $100 \times 64 \text{ kb} = 6.4 \text{ mb}$

Similarly, Jo ~~log~~ 100 log voice use kar raha hai
 sab log video service use nahi karenge. Aagar
 10+ log video use karte hai. Toh video
 service use karne ~~wala~~ wale 10 log aur unhe
 640 kb ka video lagega
 Toh $10 \times 64 \text{ kb} = 6.4 \text{ mb}$

Data ke liye current requirement hai 1 mb lekin
 future ko�yan mai rokh ke 10mb data ke
 liye de diya. voice, video, Data ye tino milake
 approx requirement hue 23 mb ye 23 mb
 requirement puri karne ke liye market mai bahot
 sare 3 circuit hai. Jaise

$$T_1 \text{ (North America std)} = 1.544 \text{ mb}$$

$$E_1 \text{ (European std)} = 2 \text{ mb}$$

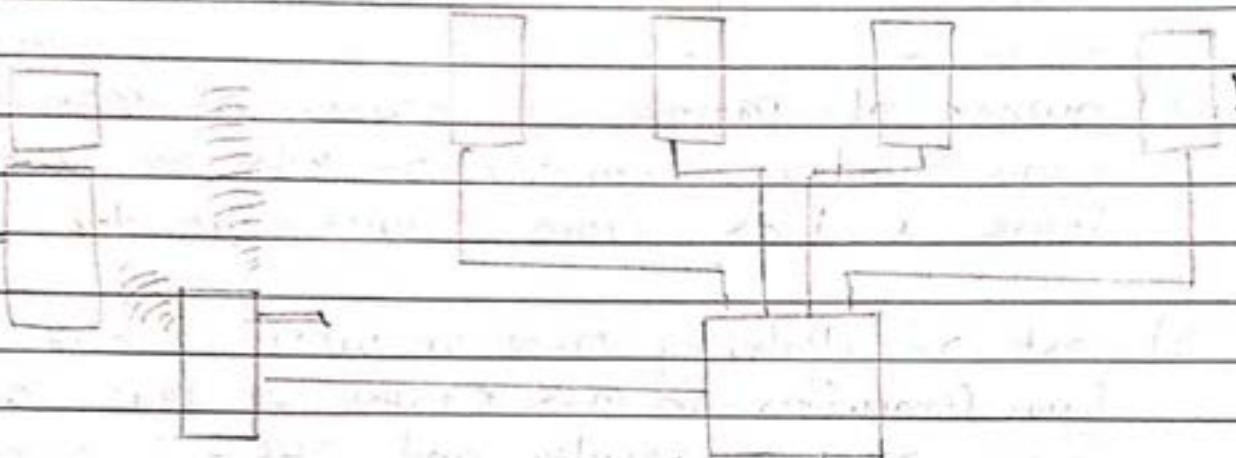
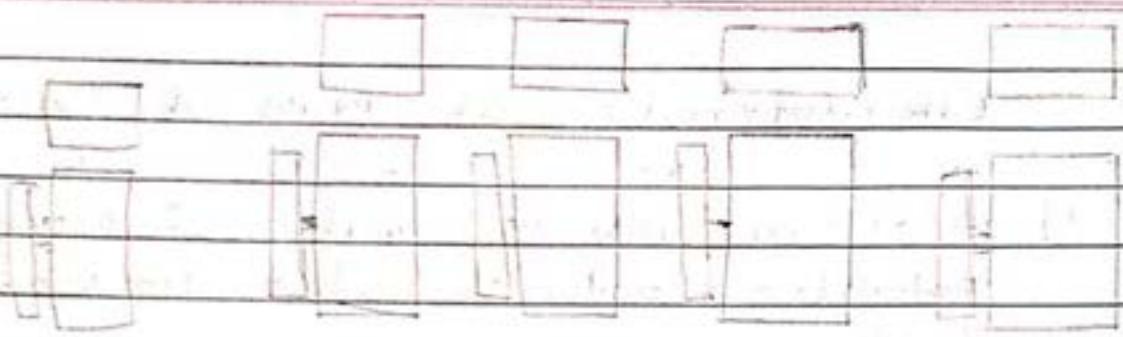
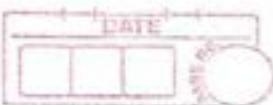
$$E_3 = 34 \text{ mb}$$

$$T_3 = 45 \text{ mb}$$

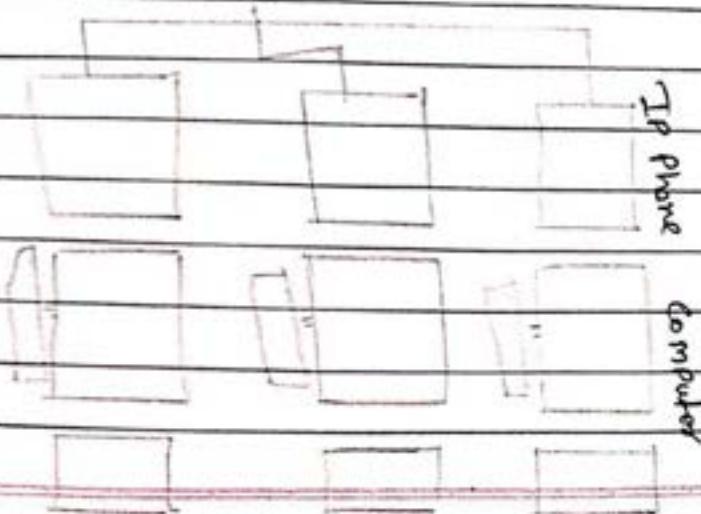
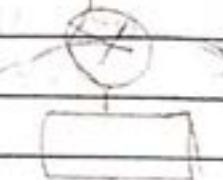
$$STM_1 / OC_3 = 155 \text{ mb}$$

$$STM_64 / OC_192 = 10 \text{ gb}$$

Hmare kaam E3 wire se bhi ho sakta hai
 OC3, OC192 wire se bhi kaam ho saktu hai but
 Jitna jyada bandwidth wala wire utna cost
 jyada hoga. Isse characteristics 1 define hota
 hai

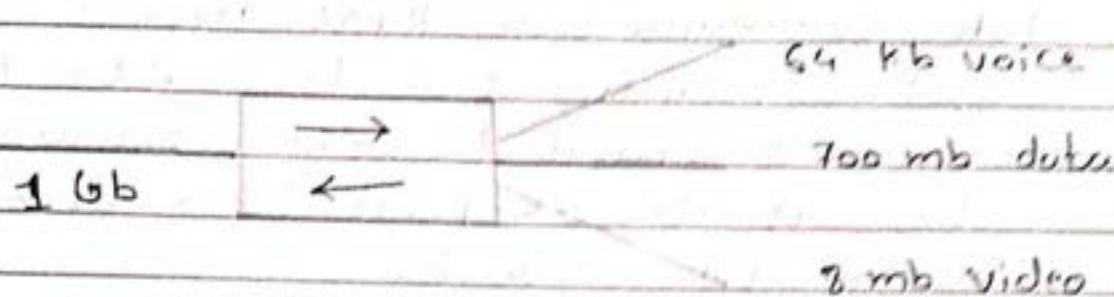


SP
Dedicated
leased line



Characteristics of MAN & WAN

- 1] MAN or WAN is capable of providing high to moderate bandwidth where limiting factor is cost.
- 2] Owner of premises is owner of MAN or WAN to connect two computers on MAN or WAN we lease a link from service provider.
- 3] Cost of deploying MAN or WAN is high. To connect two computers on MAN & WAN we lease a link from service provider and CPE - customer premises equipment on which this lease terminates. Can we lease or own by the owner of premises.
- 4] MAN administrative control either be centralised or distributed depending upon the mission criticality of service but for WAN it should be distributed.



Q. Mere pass 1 Gb bandwidth hai aur 64 kb voice 700 mb data, 8mb video hai toh sabse pehle kaunsi service cage jayegi?

→ Mai pehli dhar ka tha isliye bolo pehle voice phir video aur last mai data service jayegi ye galat hai. Tero service ek saath jayegi kyuki Tero service milake 710mb hota hai aur humara bandwidth 1Gb hai.

QoS - Quality of Service

QoS waha check hoti hai jaha bandwidth capacity crunch hoti hai. LAN mai nahi hoti.

Similarly, QoS MAN aur WAN mai hota hai. LAN mai nahi hota.

Q. India se leke newyork tak ka communication kaise hota hai?

→ India se Newyork communication via copper wire se toh nahi ho hogा kyuki copper per electrical signal chalta hai. Copper wire se long distance communication nahi ho saktा kyuki long distance communication mai noise add ho jata hai aur at the receiving end noise aur actual signal ko separate karna mushkil hai.



Toh communication kaise hogा?

Satelite communication ho saktा hai but satelite se point to point communication nahi hota. Satelite se point to multipoint communication hota hai.

India se ~~newyork~~ newyork communication via submarine subsea cable se hogा. Subsea cable kuch aur nahi optical cable hota hai. Optical cable par signal in the form of light chalta hai.

Communication ke liye jo technology use karte hai iska matlab South east asia - middle east - west European circuit.

Q. private aur public network kya hota hai?

→ LAN, MAN, WAN ye private network ke type hain waise he Internet ye public network ke type hain. LAN, MAN, WAN hum hamare gharo mai 2 branch ke bich mai ya hamare private communication ke liye use karte hain. Taise LAN, MAN, WAN hamare private network hui waise he Internet hamara public network hui kisi ke baap ka nahi hain. Internet doesn't belongs to the single entity. It belongs to the interconnection of service provider. Internet hame apni suvidha deta hai toh dusri suvidha leta bhi hain. Internet 1 global network hui & uskiye usse largest WAN bhi kaha jata hai.



Use Case :-

HDFC ke 2 branch hai 1 mumbai mai 1 delhi mai Agar HDFC ko apne 2 branch ke bich mai direct communication karna hai toh woh direct Jumkin khodke wire nahi dal sakte market mai bahot saare service provider hai . Service provider se woh apne 2 branch ke liye dedicated lease line lega . Service provider dedicated lease line ke liye bahot hi premium charge karega . Tab bhi itna mehenga service diya jayega kisi ki bhi bande ko koi bhi service chalane denge ? nahi wahi service chalayenge jo hamare organization ke liye bahot mission critical hai .

Aise critical service chalegi toh uski guarantee nahi chahiye hogi ? chahiye hogi isiliye mere aur mere service provider ke bich mai SLA hoga . SLA - Service Level Agreement . Agreement mai hum hamari sare request likh lenge . Ek baar agar agreement sign ho gaya toh isme se chukega toh usko penalty lagegi kyu ? Kyuki agreement clause mai ye pehle se embedded hota hai . Aapki aisi stringent requirement ko deliver karne ke liye jab service provider apna network banayega woh make sure karega ki uska network robust , highly available , fully redundant .

NSPof - No single point of failure hona nahi chahiye . Toh aise network service provider free mai dega ? nahi usko bahot premium charge karega . Is prakar se 2 branch ke bich mai private communication ke liye dedicated lease line

istamal kiya jata hai. Itna important private communication hai utna hi important important public communication hai. Agar public communication karna hai Internet service provider se internet lease line lena hoga. Internet hain best effort service. Chale toh chand tak nahi toh shaam tak. iski koi guarantee-warranty nahi hoti. kaise hogi ISP - Internet Service provider khud internet ko own karta hai kya? Nahi. Jo Sah own karte hai woh ek shared network hata hai uska koi 1 band guarantee nahi de saktu.

Internet service provider

Internet service provider aur service provider ke bich mai farak kya hota hai?

→ Service provider services ki guarantee deta hai. Internet service provider services ki guarantee nahi deta kyuki service provider services guarantee deta hai toh service provider aur mere bich mai SLA Sign hota hai. mero mere ISP ke saath koi SLA Sign nahi Karta. Agar service provider SLA violet kiya toh muhe penalty dega lekin ISP se liya hua wire aaj he kota kuch penalty milta nahi hai

TMP Point :-

Jo service provider hoga woh Internet service provider bhi Jarur hoga but jo Internet service provider hai woh service provider bhi hoga ye jaruri nahi hai.

Is prakar se har bade organization apne ek branch ke andar private communication ke liye dedicated leased line aur public communication ke liye Internet leased line dono ko co-axis karega ye 2 branch ke bich ka communication tha.

Ab branch ke andar kei communication kaise hogi?

Device which we used for communication called as Edge device. My edge device want to communicate with your Edge device. My edge device we need to connect to the switch. The device that gives us the access to our network is called as switch. Switch is an device access device.

Foundation Rule :- switch switching within the subnet. Router routes between the network.

Ab privat communication karna hai ya public communication karna hai toh communication karne ke liye IP lagega. IP koun control karta hai? Internet assigning numbering authority (IANA)

IANA Ne pure Internet ka charge liya hua hai. Internet Pe kitne address hai?

0.0.0.0 to 255.255.255.255

IANA same ye phale se define kiya hai ki private communication ke liye private IP use kiya jata hai aur public communication ke liye public IP use kiya jata hai.

Private aur Public IP kya hota hai?

IANA ne pahle se batla diya hai ki private IP ka range kya hai.

1] 10.0.0.0 - 10.255.255.255

2] 172.16.0.0 - 172.31.255.255

3] 192.168.0.0 - 192.168.255.255

Ye IP address ke aлава jo bhi IP address bache hai wo saare public IP address hai.

Aagar koi device ko private aur public dono communication karna hai toh usse dono IP denge.

Nahi har device ko 1 he IP milta hai. Jo ki private IP address hota hai. Private IP leke private communication hota hai. Lekin Internet pe ye IP leke jayenge to ISP discord kar dega. Private IP ko Internet pe use karne ke liye Router par 1 feature chalta hai Jo hai NAT - Network Address Transmission. Jab internet pe jayenge toh NAT private IP ko public IP mai transmit karega aur internet pe bhejega. Jab return ayeega tab public IP ko wapis private IP main transmit karke aye forward kar dega.

Aagar 2 branch ke bich mai private communication karna hai toh har bina dedicated leased-line afford nahi kar sakte.

Internet pe ham private communication kar sakte hai?

Nahi. Lekin phir bhi karna hai toh hamare router par 1 aur featur hai jisko ham VPN - Virtual private network kہte hain. Iska kaam hai to provide private communication over public infrastructure.

IP Phone

Access device

Internet

Tel

Internet leased line
QoS - Efficient service

IP Phone

IP Phone

Switch

CR/CE
Router

SP

DL

Dedicated lease line

IP Phone

IP Phone

IP Phone

SLA based Service
Uptime - 99.9%

Delay < 50ms

Drop < 5/hrs

Jitter < 200ms < 3/hrs

Mumbai

Delhi

Availability :-

If a network is unavailable for 15 min in a year because of outage. Then percentage availability is as follows :

$$\text{percentage Availability} = \frac{[\text{No of min year} - \text{Down time in min}] \times 100}{\text{No. Of min in year}}$$

$$= \frac{\{(365 \times 24 \times 60) - 15\} \times 100}{(365 \times 24 \times 60)}$$

$$= \frac{[525600 - 15] \times 100}{525600}$$

$$= 99.997 \%$$

$$\% \text{ Availability required 99.9} = \frac{\{(365 \times 24 \times 60) - 525.6\} \times 100}{(365 \times 24 \times 60)}$$

$$= \frac{(525600 - 525.6) \times 100}{525600}$$

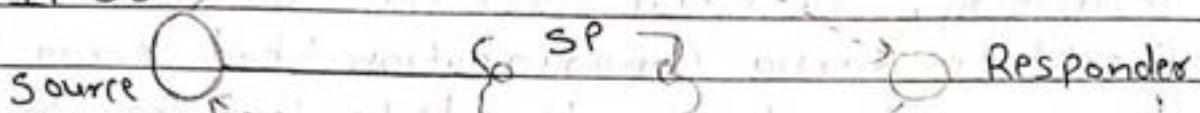
$$= 99.9 \%$$

IF 525600 minute (365 days) is 100%. then for 99.9% uptime link can be down only for 525.6 minutes in a year (8.76 hrs a year)

There are many tools available to calculate downtime. Cisco router & switches provide a tool called "IPSLA" that can be configure on cisco devices to calculate downtime, latency, jitter, Drop, etc.

ICMP

IP SLA



- Q. Uptime Routers actually calculate kaise karte hai?
 → Jab 2 router ke bich mai IP SLA wala tool chalate hai. Toh apne jo router hai woh bahot chote chote size ke hai. Very small size of ICMP echo packet bhejta hai. ICMP echo packet size mai bahut chote hote hai. ICMP echo packet mai 2 chees important hoti hai Echo request aur Echo reply. Jab mai request bhejunga immediately reply aayega. ye request within ms.us mai jata hai aur reply bhi within ms.us mai wapas aata hai. Yahi request reply aur raha hai ja raha hai yahi SLA packet parameter calculate karne mai use hota hai.

Echo packets are very talkative in nature. Jab packet wire par se challenge toh wire par kitna delay hai. kya jitter mila unko, kitna drop aaya ye sab khud se calculate kar leta hai. Mai request bheja aur reply aayega matlab link UP hai.

Mai request bheja but reply nahi aya matlab link down hai. Tab tak reply nahi aayega down timer on rhega aur jab reply aaiayega down timer band karke up timer on kar dega.

Echo packet size mai bahot chote hote hai. 100 bytes ka packet bhejta hai ki jo link hai uspe impact nahi hota yahi reason hai jiski wajah se ham packets ko use karte hai to check SLA parameter.

* Technology ka kaam hota hai communicate facilitate karna. Communication khud karna nahi.
 [someone has to use the technology for the communication. Technology can never ever ever communicate at its own] kisi na kisi ko technology ko use karna padta hai communication karne ke liye. Technology khud communication nahi karta.

Duniya mai jitni bhi technology hai har technology ke 2 part hote hai, layer 1, layer 2
 Layer 1 - Hardware.

Layer 2 - Software, logic, Protocol
 Software logic protocol which drives communication over this hardware.

Hardware ya layer 1 kya hota hai?

Aise koi bhi jo chiz jo physical ya physical in nature hai. Jo 2 communication devices ke bich mai 1 communication channel form kar dete hai isi ko ham ~~ya~~ layer 1 ya Hardware keh dete hai. E.g. wire, cable, connector, pinout, Voltage Signal boosting devices.

* Technology 2 type ka hota hai Ethernet aur serial Technology.

100% LAN mai Ethernet technology use hota hai. 4 Most off MAN aur WAN par serial Technology use hota hai. Kabhi kabhi ethernet technology bhi use hota hai.

Ethernet Technology :-

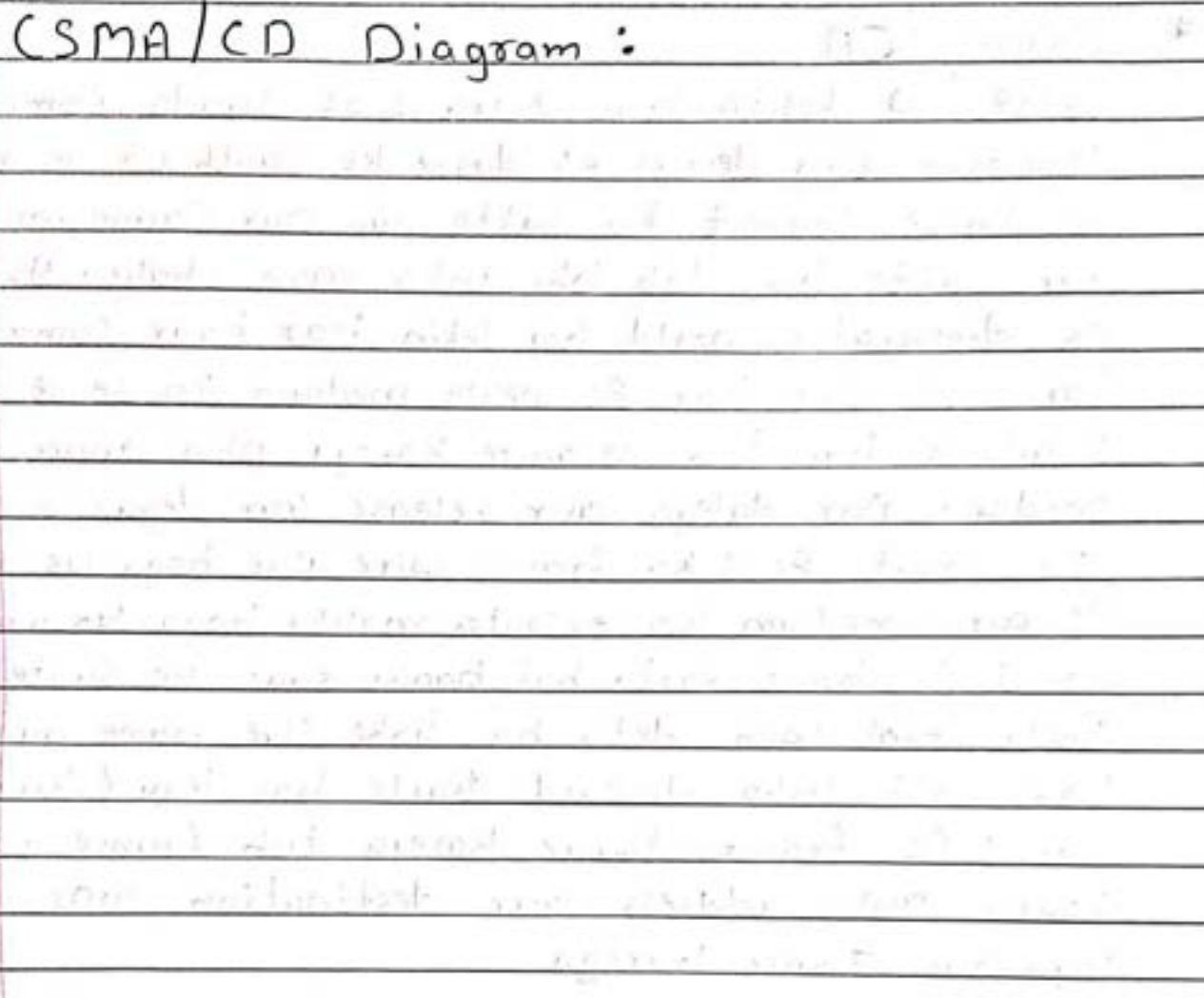
Fundamental ---; - CSMA/CD

Standards -----; - IEEE 802.3

Protocol ←---; - ARPA



CSMA/CD Diagram:



The CSMA/CD diagram illustrates a bus-based network topology. Two nodes, Node A and Node B, are connected to a single horizontal bus line. The bus line features a vertical dashed line in its center, which serves as the collision point. From this collision point, the bus line branches into two segments. The left segment connects to Node A, and the right segment connects to Node B. Both nodes have vertical dashed lines extending downwards from the collision point, indicating their transmission ranges. The entire bus line is labeled 'B' at the bottom. This diagram represents a shared medium environment where multiple stations can access the same physical link simultaneously.

* CSMA / CD

CSMA / CD kehta hai 2 ya 2 se jyada computer or communicating devices ek dusre ke saath ek hi medium ke joriye connect ho sakte hai our communication kar sakte hai jab bhi inka man chahi. As if ye ek democratic world hai lekin har baar communication karne se pehle har PC pehle medium ko sense karega Available hai toh acquire karega phir apna frame medium par dallega our release kar dega.

Tis waqt PC 1 ka frame wire par hogा us waqt w PC pure medium kei eklouta malikा hogा. ~~us waqt~~ Jab koi 1 PC baat karta hai baaki saare PC sunte hai.

Reply keval wohi deta hai jiske liye frame aya hai. baki sab usko discard karte hai kyu? Kyuki Jab bhi 1 PC frame tayar karega toh frame par source MAC address our destination MAC address laga kar tayar karega

Q. MAC Address kya hai?

Duniya ke har ek ethernet network card ke ROM ke andar 6 byte - 48 bits - Hexadecimal data pehle se store hata hai. ye hamesha unique hota hai koi 2 network card par bhi same nahi hota.

Ye MAC address unique kaise banega?

MAC Address ka 1st 3 byte IEEE control karta hai IEEE isko "OUI - organizational unique Identifier" yani "manufacturer code" kehte hai Jab manufacturers koi bhi network card manufacture karunga toh 1st 3 byte IEEE se



lunga Jo IEEE ne aur kisi ko assign nahi kiya
hai phir baad ke 3 byte apne end se unique
baneguna Is prakar se jo mai MAC Address
dalunga wo hamesha unique rahega. yahi MAC
Address ko BIA - Burn In Address Hardware
L2 Machine , physical address ko bolta hai

Q. How will Collision is happen?

Aise ho sakte hai 1 he instance par 1 se Jyada PC ka baat karne ka man kar jaye. Dono PC ne medium ko ek saath sense kiya. Medium available hai toh dono ko ek saath acquire kiya. Ek saath Apna frame wire par dalenge toh jais he frame ek saath aayega. Taki si baat hai Collision ho jayega.

CSMA/CD kehta hai it is democratic world because of this collision mount to be happen.

CSMA/CD ke pass Collision Detect karne ka our Collision ko avoid karne ka mechanism hai mai collision se deal kar sakte hu.

Q. Collision Detection :-

Because there are 2 parts of technology (Layer 1 & 2) hence collision should be evaluated from both layer perspectives. Layer 1 is a hardware & layer 2 is a software.

Collision Detection from Layer 2 perspective : When 2 computers Layer 2 software will create frame it will apply smac & dmac to the Data at the same time. it will also apply CRC code for Data integrity check. when 2 computers will put their frame on wire at same instance. The frame will get converted to Electrical Signal & get collide on wire.

~~Electrical signal is a form of energy that can not be created nor destroyed. but will get distorted on colliding. This colliding signa~~



will not vanish but will be resonated back to all computers. On receiving side Layer 2 software will convert it to frame & check integrity & discard if it is current frame.

Collision Detection from Layer 1 perspective : When 2 computers put their frame on wire at same instance, this frame will get converted to electrical signal & get collided on wire. Electrical signal is a form of energy that can not be created nor destroyed but will ~~not~~ get distorted on colliding. This collide signal will not vanish off but will be resonated back to all computers. Computers that were sending signal will suddenly start realizing that whatever they are sending is getting corrupted & they will immediately back off & the one that detected corruption 1st will immediately start pumping jamming pattern on wire. On receiving jamming pattern all computers will back off & release medium in this way Layer 1 will react to the collision.

Collision Avoidance :

On multiple access medium if there are multiple communicating pairs, wanting to send multiple segments. It will never so happen that on acquiring the medium computer will put all their frames at one shot, for every segment that computer has to send it will have to sense

sense the medium for next frame it will again have to sense the medium if available acquire it & put the next frame, in this way computer will never push all its segment at one go. If there are multiple communication pair with multiple segments to be delivered then to deliver these segment they will keep bidding to acquire medium & keep colliding again & again. So just detecting collision once will not help. There has to be some collision avoidance mechanism.

Q. How collision is avoided :-

After collision computers will enter integral wait state. Computers calculate their wait state on their own & it has nothing to do with neighbours wait state. This wait states are in us & ms. They are in multiple of 51.2 us. As this wait state are integral computers can increase & reduce their wait states depending on collision a second it will understand that there are too many communicating devices wanting to communicate. So as a good citizen it will increase it's wait state thereby providing more time to other communicating devices to finish off their communication. If lesser communication is happening the computers can also reduce its wait state. When computers are waiting they can't talk but they listen.

In our ex. after collision computers will enter respective wait state. after collision 1st opportunity provide to DDD as its wait state expires in 51.2 us, for next 51.2 us. AAA & CCC will also come out from their wait state & now all three computers can communicate on medium. with 2, 20, 30, 50 Computer collision will seldom occur, but if it reoccurs then computer will again follow same process & back off even BBB will back off & all computers will enter new wait state. If collision does not occur then after 153.6 us democracy return & all computers can communicate at their will. In this way by entering into wait state & providing other computer more time to finish off communication computers try to avoid future collision.

CSMA/CD ke 2 Clause hai

- 1] Tab 1 baat karta hai us waqt baki sab sunte hai.
- 2] Taise 2 log ek ~~sath~~ sath baat karte hai toh collision ho jata hai.

Dono clause ko switch khetam kar ~~sektar~~ raha hai.

- 1) Switch ke pass khasiyat hai. [It allows simultaneous communication between multiple communicating pairs connected on different parts.]

Jab port no 1 ka banda port no 2 se baat karta hai usi waqt port no 3 ka banda chahe to port no 4 se baat kar sake hai.

2) Switch 2 type ke communication ko support karta hai.

Half Duplex & full Duplex

Half Duplex - Jab 1 bolega us waqt dusre keval sunega.

full Duplex - Dono device saath main bol sakte hai aur sun bhi sakte hai.

How is it possible? Dono saath mai bol sakte hai aur sun sakte hai?

Ham To wire use karte hai wo twisted pair hai. Usme 8 Pin hote hai. Communication karne ke liye hamne bas 4 pin chahiye. Pin 1,2,3,6. Agar device 1 Pin no. 1,2 Par transmit karega toh agar dono ne saath mai bhi transmit kiya kar raha hai toh device 2 Pin no 3,6 par transmit karenge toh agar dono ne saath mai bhi transmit kiya phir bhi collision nahi hoga. Isi ko ham full Duplex communication kehte hai. Switch full Duplex communication support karta hai.

* wired LAN aur wireless LAN both are 802.3 LAN & work on Fundamentals of CSMA/CD & will use same frame with MAC, CRC etc.

On wired LAN computers are connected using wires & in wireless LAN communication is on the ~~in~~ air. In wired LAN communication takes places on ~~on~~ confined medium & collision are immediately detected. Communication in air is not confined & collision are not be immediately detected on same channel. Hence collision ~~are not~~ should be avoided as it cannot be detected. So on wireless LAN we used Ready to send (RTS) & Clear to Send (CTS) control signal to avoid collision. This proves that collision avoidance is mandatory part of CSMA/CD.

i. * Communication 3 type ka hota hai Unicast, multicast & Broadcast.

Unicast yani 1 ke liye

Multicast yani group ke liye

Broadcast yani sab ke liye

Isi prakar se communication 3 type ke frame & packet ko accept karega.

1] Jo uske khud ke IP address ya MAC address ke liye aaya hai toh usse accept karega.

2] Wo jis group ko belong karta hai toh wo group ke IP ya MAC address ke liye aaya hai toh accept karega.

3] Jo Sab ke IP ya Sab ke MAC address ke liye aaya hai usse accept karega.

* Dudh ka Dudh Paani ka Paani

Taise maine apne machine mai ethernet network card install kiya toh technology ka layer 1 install ho gaya. Kyuki Technology ke 2 part hote hai Layer 1 & Layer 2. Layer 1 yani Hardware. Layer 2 yani software, logic, protocol, which drives communication over this hardware. Layer 2 software logic protocol kya hota hai? Driver ke wahi 802.3 standard ke tahet CSMA/CD Fundamentals par koom karne wala ARPA Protocol wala software logic protocol hai jo is hardware par communication karata hai. EK baar hum successfully Layer 1 & Layer 2 install kar diya toh microsoft ka PC hoga toh niche se pop-up aayega notification aayega. Technology is ready for communication. Isi prakar se hum data chalta hain ki technology khud is ready for communication. Technology khud communicate karta hai nahi. Kisi na kisi ko technology ko use karna padega communication karne ke liye technology kabhi bhi khud communicate nahi karta. Mai 1 end par wire food ke information dalta nahi hu. Dusre end par wire food ke information nikalta nahi hu. Mere aur mere technology ke bich mai koi mediation layer chahiye hogा ya koi agent chahiye hogा? Jo 1 end par user se information lega niche technology ko dega. Aur dusre end par technology se information lega aur user ko dega. Aise mediation layer ko ya agent ko hum Upper layer protocol stack kہte hain. Upper Layer protocol stack 3 type ka hota hai. IP, TCP, TPX. Apple torch, TPX, Apple torch ko ab koi use nahi karta hai. Ab jo bhi communication hota hai woh



Sacara koi sacra IP Communication hota hai.
IP ka hota hai matlab kya? IP koi single tool
hai? nahi. single software hai? nahi. IP is ~~tool~~
Collection of tools & softwares. Jaise file bhejne
ke liye FTP, Remote access ke liye TELNET,
HTTP, SSH aise alag alag tool ka collection hai
IP.

IP Communication kaam kaise karta hai? Jaise is
PC pe baitha hua banda FTP 10.0.0.4 bolega toh
IP ka FTP wala tool active ho Jayega, phir user
bolega put Ash-Tpeg. put ye command ko pehle se
he pata hota hai ki machine ke hard-drive mai
kaha par ye 700mb ki Aishwarya file store hai.
Direct ye file wire pe dalega nahi. mere PC ka koi
1 software is file ke chote chote tukde karega. Koi 1
software in segment ko mark lagayega koi 1
software is par CRC code lagayega. Koi ek software
niche wali technology ko laat marke kahega leja aur
deliver karke aa. Dusre end par koi ek software iske
niche ke technology se receive karega koi ek software
CRC code check karega. Satik hai, perfect hai toh
accept karega nahi toh reject / discard karega. Aur
acknowledge karega for next ~~to~~ segment transmission.
Iska ye matlab hai technology Jyada se Jyada
Layer 1 aur Layer 2 samji hai aur layer 2 par bhi
MAC address aur CRC code check karke frame ko
accept / discard karega.

End to End, Error free, Successful communication ki
guarantee technology nahi deta. Guarantee IP
Upper layer Protocol stack koi hota hai.

IP ye guarantee deta kaise hai? Acknowledgment & Retransmission ki madad se.

yaha par punch statement kya banu?
communication IP ka hai, user ke behalf par
hota hai Underline technology ko use karke hota
hai.

Reverse Gear mai humne kya sikha?
Machine mai 1 baar agar ethernet technology
install kar diya toh technology ko ye kaise
Samjega ki usko jo communication karna hai woh
Saare IP ko karna hai, IPX, Apple talk ka
nahi karna hai. Administrator jab network card
ke properties mai Jayega TCP / PPT ko double
click karega toh administrator ne bind kar diyo
is network card par jo bhi communication hoga
IP ka hoga. IP ka communication hoga matlab
ham IP PC ko dete hai? nahi. Ham IP PC ke
network card ko dete hai. Agar PC Par 10 network
Card hai to IP assign karna hoga. Joh IP ham
assign karte hai woh store kaha hota hai? Duniye
ke har OS ke andar etc. naam ki directory hoti
hai uske ander anek IP associative table hote
hai. Jinme 1 table hota hai ARP table, wo
table hota hai jaha Saare IP address aur
uska MAC Address ka mapping store hota hai.
Aise hi ek Routing table hota hai. Machine mai
kitne network card hain aur usko IP address
kya hai. Yahi ~~one~~ table hain aur 1 hota hai
host table Jo batata hai Tera PC 1 host hai aur

Uska IP address kya hai yahi wo table hai
Jisko IP ~~and~~ associative table khte hai.
Yahi IP ka Information store ~~to~~ karte hai
Retain karte hai.

Full final flow khta hai Taise ~~it~~ is PC Par bait
hua banda : FTP 10.0.0.4 bolega toh IP ko
FTP Tool active ho Jayega. Phir user bolega
Put. Ash. JPEG. put ye command pehle se Janta
hai ki 700 mb ki Aishwarya machine Ke hard-
drive mai kaha store hai. Direct ye file wire
par dalega ? nahi, koi ~~any~~ software is file ke
chote segment karega. koi 1 Software in segment
ko mark karega koi 1 Software CRC o Code lagayega.
koi 1 Software niche wali technology ko laath
mark bolega Ja cur 10.0.0.4 IP ko deliver
karke ga. Toh technology bolega ghanta nahi
Jaunga. kyu ? Kyuki Technology yani Layer 1
& Layer 2 . Tyada se Jyada technology ko kuch
samjata hai toh woh layer 2 yani MAC address
samjata hai IP Address nahi samjata. Agar
10.0.0.4 ka MAC address batalega toh main MAC
tak pohoch ne ki koshish karunga. mujhe agar kisi
IP ka ka MAC chahiye toh mai ARP table ke
Pass Jata hu. her PC apne ARP table mai Jayega
kyuki ARP table ye woh table hai Jisme IP
Address aur MAC address ka mapping Pehle se
store hota hai. Start mai bas khud ka IP
aur MAC store hota hai Mai pehle se 10.0.0.4
ka MAC nahi Janta hu. Toh mere PC ka ARP
Software Activate hogा Aur ARP broadcast

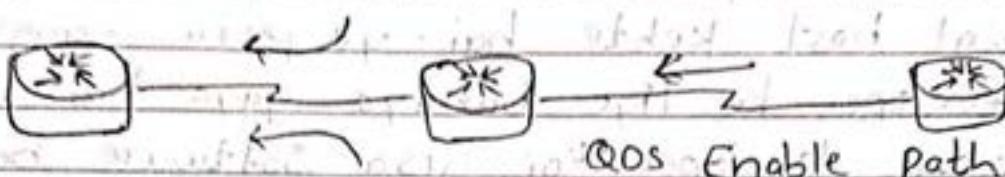


Karega ARP broadcast sent TP request
For MAC Address.

Ab mera PC bolega Jo koi bhi 10.0.0.4 hai
Apna MAC address de na Yaar. Joh koi ~~10.0.0.4~~
hoga wahi isko accept kare & reply
Karega baki sub isko discard Karega. Ek baar
reply mile toh apne PC ARP Table mai Jayegu
aur likhega 10.0.0.4 TP ka MAC Address
DDO hai phir Jayega aur technology ko bolega leja
aur ab deliver karke aaja.

Yeh hai dudh ka dudh paani ka paani

* Ping



Ping is a tool or application of IP Upper Layer protocol stack, that is used to get network layer / IP layer / layer 3 status.

Ping sends ICMP echo packets to get network layer status, ping is also used for following:

- To check connectivity
- To calculate Latency (Delay)
- To verify link quality (Drops)

Results of ping may not be relevant for real time packets used over QoS enable path.

For QoS enable path we can use IP Packets with different size & ~~TOS~~ TOS marking (184 For voice packet & 136 For video packet)

TOS - Types of Service

Q. Prove kaise karenge ki ping ye command Connection checks karne ke liye nahi banaya hai?

→ kya tumne kabhi Universal Loop back address ke baare mai suna hai? kya kabhi local host ke baare mai suna hai? so 127.0.0.0 se lekar ~~127~~ 127.255.255.255 ye pura range universal loop back address ka range hai aur ye range ka

Jo Sabse pehla IP hai 127.0.0.1 isko ham local host kehte hai. ye pura range Software developer ke liye banaya gaya hai.

Aagar developer koi aisa Software banaya hai Jiska ek copy printer par aur dusra copy usike harddrive ke local storage mai store karna chata hai. Toh wo machine ka address pehle se janta ~~hui~~ nahi hai. Toh waha par wo duplicate copy store karne ka address dalega.

127.0.0.1 Jo ki har pc ka khud ka address hota hai. Ab ye software Jis bhi pc par chalega us pc ke liye 127.0.0.1 khud hogा.

Ts wajah se hamesha duplicate copy wahi par store hogा. Kisi aur store nahi hogा.

Aagar tu ye samajta hai ~~th~~ toh take sare wire, cable, adapter, ko disable karke aur ab apne command prompt mai Take 127.0.0.1 ko ping karega toh ye 100% ping hogा. Aagar ye ping huai toh ye prove kar dega ki ping command wire cable check korne ke liye banaya nahi hai.

IP layer / Network layer / layer 3 in Formation Status lene ke liye ping ye tool banaya gaya hai.

Delay, Jitter, Drop, Connectivity ye sab by product hai secondary purpose hai.

* IP FLOW

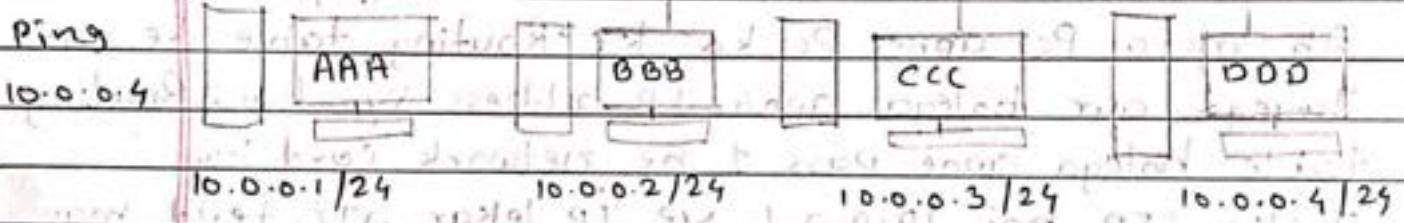
Routing table (L3)

ARP table (L2)

10.0.0.1 - AAA

LAN 1 - 10.0.0.1/24 first subnet entry in router

data link layer check result, no route found
no entry in L3 table, forward to L2 table
start bit (last) 9th source mac 10.0.0.1 add to ARP table
switch



DATA 10.0.0.1 10.0.0.4 AAA Broadcast
SIP DIP SMAC DMAC
L3 L2
L2 Broadcast address FF-FF-FF-FF-FF-FF

ARP Broadcast Send IP request to MAC
DATA 10.0.0.1 10.0.0.4 AAA FFF Broadcast address 255.255.255.255

SIP DIP SMAC DMAC
L3 L2
L2 Broadcast address FF-FF-FF-FF-FF-FF

* IP Flow :

Taise is PC par baitha hua banda bolega ping 10.0.0.4 yani usko 10.0.0.4 network layer status chahiye. Ab ye PC ek frame tayar karega Jisme sabse pehla field hoga Data. Jis par likha hoga mujc tera network layer status chahiye. Jab ye data Jayega tabhi status aayega. Aagar data bhejna hai toh uske aage aneko header hote hain. aneko header mai Sabse pehla field hoga Source IP (SIP). SIP hone toh khud ka IP. IP hone toh layer 3 information. Ab mera PC apne PC ka ke Routing table ke pass Jayega aur bolega apna IP address kya hai. Routing table bolega apne Pass 1 he network card hai. Jiska IP hai 10.0.0.1 ye IP lekar SIP feild mai likh dega. Next feild hai Destination IP (DIP). Taha Jana hai us chiz ka IP. IP hone toh layer 3 information. Command se uthake likhne se pehle kahani mai twist hai. Ab mera PC apne routing table ke Pass Jayega aur puchega kya ham 10.0.0.0 network tak pohoch sakte hai toh table bolega ha hamare pass ek he network card hai wo isi network ko belong karta hai. Toh hum pohoch Jayenge us Jagah Ja Sakte hai. Toh DIP likh dega 10.0.0.4. Next field hai source MAC (SMAC). SMAC matlab source IP ka MAC. MAC hone to layer 2 information. Mere PC cipne layer 2 ke ARP table ke Pass Jayega aur puchega 10.0.0.1 ka MAC address kya hai. ye bolega AAA. Uthakar likh dega AAA. Next field hai Destination MAC (DMAC) Jaha Jana hai us chiz ka MAC address. MAC hone



toh layer 2 information. Ab mere pc apne layer ke ARP table ke pass Jayega aur puchega 10.0.0.4 ka MAC kya hai? ARP table bolega malum nahi.

yahi ~~kethoni~~ par 1 punch statement hai. agar layer 2 ka destination MAC address malum nahi hai toh mera PC ARP broadcast karne ke liye tayar hoga. Jaha sabse pehla feild hoga Data. yani mai Frame Uthake Side mai park kar doge Aur naya broadcast frame tayar karega. Tisme Sabse pehla feild hoga Data. Jaha likha hoga Jo koi bhi 10.0.0.4 hai apna MAC address de na yaar. Source IP (SIP) Jo IP hoga jiska MAC address chahiye. 3 Destination IP Jo IP hoga jiska MAC address chahiye. Source MAC matlab Source IP ka MAC. Aur layer 2 par broadcast message hota hai FF-FF-FF-FF-FF-FF. Layer 3 ka broadcast address hota hai 255.255.255.255. Broadcast address dalega. Jab jaise ye broadcast frame wire par Jayega electrical signal mai convert ho Jayega Sabhi ko ek sath milega lekin accept aur reply wahi karega. Jiske liye signal aya hai baki sab usko discard kar lenge. Aur 1 baar reply aya toh mera PC Apne ARP table mai Jayega aur likhega 10.0.0.4 ka MAC address hai DDD. Phir mai frame ko dubara picture dikhayega. ARP table dikhayega aur bolega Destination MAC (DMAC) hai DDD. Is prakar se broadcast Tata hai aur MAC learn karke aata hai.

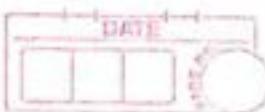
IP flow continued.....

* Broadcast Jata kaise hai aur reply kaise ata hai?
 → Jaise ye Broadcast Frame wire par Jayega electrical signal mai convert ho Jayega sabhi ko ek saath milega. Ham samajne ke liye 1-1 karke samjenge. Jaise ye frame BBB ke pass Jayega layer 1 se layer 2 par aayega. BBB ko layer 2 software layer 2 information kholega aur puchega kaha jana hai ye bolega FFF lekin mai toh BBB hu tu mere liye nahi aya hai isiliye mai ~~tu~~ ~~tu~~ lekin tu broadcast hai tu sabke liye aya hai isiliye mai ~~tu~~ accept karta hai. BBB ka layer 2 software layer 2 information uthakar side mai rakh dega aur bacha hua information layer 3 ko dega. layer 3 software layer 3 information kholega aur puchega kaha jana hai ye bolega 10.0.0.4 lekin mai 10.0.0.2 hu tu mere liye nahi aya hai. isiliye mai ~~tu~~ discard karta hu lekin discard karne se pehle hai ye PC ne is frame ko layer 2 aur 3 information khola toh PC ko layer 2 aur layer 3 ke baare mai pata chala yani ye Jaan gaya 10.0.0.1 ka MAC address hai AAA. ye immediately Jayega aur apne ARP table mai likh dega 10.0.0.1 Ka MAC hai AAA.

Similarly, for CCC Some above process follow:

Similarly, Jaise ye frame wire broadcast frame wire par Jayega electrical signal mai convert ho Jayega Sabko ek saath milega. Ham samjane ke liye 1-1 karke samjenge.

Jaise ye frame DDD ke pass Jayega layer 1 se



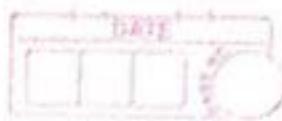
layer 2 par aayega. DDD ke pass jayega ko layer 2 software ya layer 2 information kholega aur puchega kaha jana hai ye bolega FFF. lekin mai DDD hu tu mere liye nahi aya hai kyuki tu FFF broadcast hai. tu sabke liye aya hai isiliye tu jisne accept karla hu. Layer 2 software layer 2 information side mai rakh dega aur bacha hua information layer 3 ko dega. layer 3 software layer 3 information kholega aur puchega kaha jana hai ye bolega 10.0.0.4. Toh ye bolega mai he 10.0.0.4 hu tu mere liye aya hai. layer 3 software layer 3 information side mai rakh dega bacha hua information upar ke software ko dene se pehle yeha par bhi ek twist hai. ye pc ne frame ka layer 2 aur 3 information khola toh pc ko layer 2 aur 3 ke baare mai pata hai. ye bhi Jayega opne ARP table mai likh dega 10.0.0.1 ka mac address AAA hai. Uppar ka software ab Data kholega dekhega mera mac address manga hai toh wo ab reply frame tayar karega usme sabse 1st feild hogा data. usme likha hogा mera mac address hai DDD. Request mai jo source IP hota tha reply mai wo destination IP aur destination IP source IP ban jata hai. Source mac matlab source IP ka mac aur Destination mac matlab jaha jana hai waha ka mac. isko jana hai 10.0.0.1 toh mere pc ARP table mai jakar puchega Iska mac kya hai. Jo free ka mapping mila tha usko refer karke likh dega AAA.

Taise he frame wire par jayega electrical signal mai convert ho jayega. Sabhi ko ek saath milenge lekin samjane ke liye 1-1 karke samjenge.

Taise ye frame DDD se CCC ke pass jayega. layer 1 se layer 2 ke pass gayega. layer 2 software layer 2 information kholega aur puchega kaha jana hai ye bolega AAA. ye bolega lekin mai toh CCC hu isiliye mai tujhe discard karta hu. idhar layer 2 information he samaj gaya ye mere liye nahi aya hai toh layer 3 information nahi khula. yaha kuch bhi mapping nahi mila.

Similarly, For BBB: same above CCC process Follow

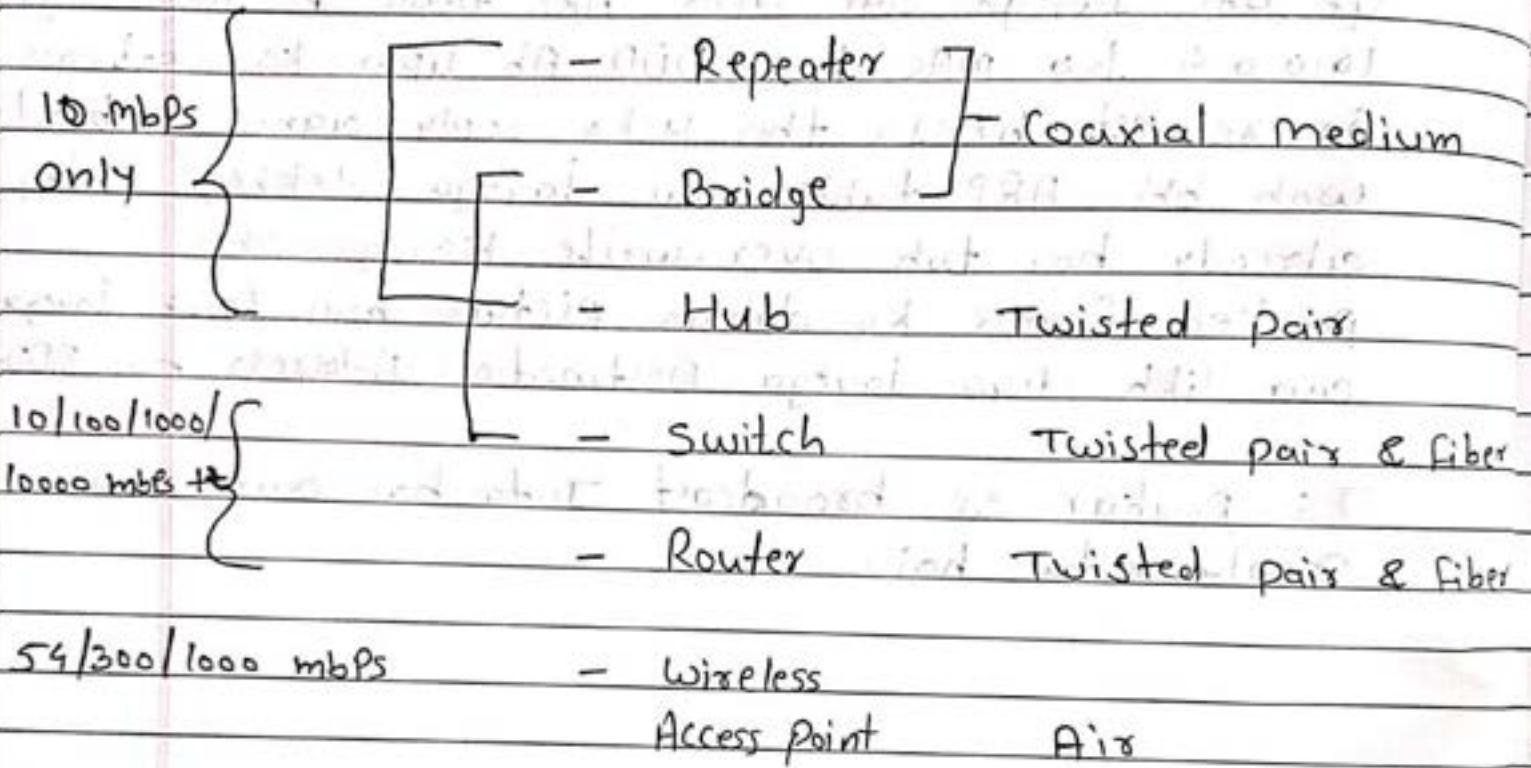
Similarly Taise ye reply Frame wire par jayega electrical signal mai convert ho jayega sabko ek saath milenge samjne ke liye 1-1 karke samjenge. Taise ye frame AAA ke pass jayega. layer 1 se layer 2 ke pass gayega. AAA ka layer 2 software layer 2 information kholega aur puchega kaha jana hai. ye bolega AAA toh mai he hu AAA tu mere liye aya hai. layer 2 software layer 2 information side mai rakh dega aur barcha hua information layer 3 ko de dega. layer 3 software layer 3 information kholega aur puchega kaha jana hai. ye bolega 10.0.0.1 toh mai he hu 10.0.0.1 tu mere liye he aya hai. layer 3 software layer 3 information uttarakar side mai rakh dega. barcha hua data upar ke software ko dene se pehle yaha par bhi 1 twist hai. PC ne Frame ko



layer 2 aur layer 3 information khola . pc ko
layer 2 aur 3 dono ke baare mai pata hai .
ye bhi Jayega aur apne ARP table pe likh dega
10.0.0.4 ka MAC hai DDD . Ab upar ka software
jo request bheja tha uska reply came ke baad
woh bhi ARP table mai jayega . checkega entry
already hai toh over-write karega . phir
parked frame ko dubara picture mai loya jayega
aur likh diya jayega Destination Address hai DDD

TS prakar se broadcast Jata hai aur uska
reply aata hai .

* Networking Devices





* Switch

Switch is an intelligent device. As soon as switch receives frame on its port. It will check MAC address refer MAC table then take forwarding decision. Because MAC address is layer 2 address. MAC table is layer 2 table. Hence switch is an layer 2 device. Upon receiving a frame on its port. Checks destination MAC address refer MAC table & forward frame to relevant port only & not to all other ports. Switch segments the network. Hub extend the network.

Because switch does self learning of MAC address in MAC table. Hence MAC table size can become huge.

Huge MAC table has 3 issue; Following:

- 1] High memory utilization
- 2] High CPU utilization
- 3] Frame Forward Delay.

To overcome this issue following solutions are created.

- Cisco define a limit of 4096 MAC entries in its MAC table.

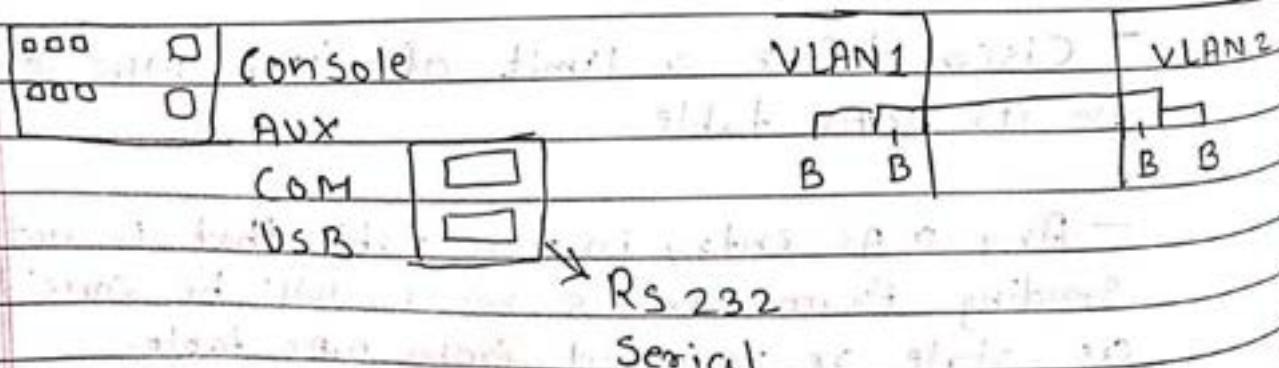
- Any MAC entry in MAC table that is not sending frame in 5 mins will be considered as stale or removed from MAC table.

- switch creates multiple copies of broadcast Frame received on port & forward it to all other ports.
- switch cannot broadcast but will forward broadcast frame receive on a port to all other ports.
- L2 switch is a technology device that facilitates communication & does not participate in broadcast.
- Hence on Layer 2 switch port we do not configure IP/MAC address.
- On Layer 2 switch all ports are initially member of some VLAN (VLAN1)
- VLAN 1 is default VLAN management VLAN
- On layer 2 switch we cannot configure IP address on ports but can configure IP address on VLAN using following command

Telnet VLAN 1

IP address 10.0.0.100 255.255.255.0

- This IP address is measurement IP used for Telnet purpose only.



Switch Operation :-

Operation no 1 :-

When switch receive broadcast frame on its port. It will create multiple copy of the frame & forward it to all other ports not on the same port.

Operation no 2 :-

When the sender & receiver both are in same port switch will discard the frame. switch switches between the port not within the port.

Operation no 3 :-

Switch receives the frame whose destination mac address is not known. It will create multiple copies of the frame & forward it to all other ports which means that switch will create multiple copies in 2 scenario.

- 1) when it receives a ~~broadcast~~ broadcast frame.
- 2) when switch receives the frame whose destination mac address is not known. It will create multiple copies of the frame & forward it to all other ports.

Operation no 4 :-

When the sender & receiver are on the same port switch will bridge information to relevant port only & not to all other port whereas hub will forward it to all other ports.

Operation no 5 :-

Switch allow simultaneous communication between multiple communicating pairs which connected on different ports.

It works exactly as per CSMA/CD Fundamental but with the help of intelligent hardware. It is the Flause of CSMA/CD which is also a software

Operation no 6 :-

Every port of a switch has its own dedicated Bandwidth. Switch is a dedicated Bandwidth device whereas Every port of a HUB Shared the same bandwidth. HUB is a shared Bandwidth device.

Operation no 7 :-

Every port of a switch is a member of separate Collision Domain. Switch is a multiple collision domain Device.

Every Port of switch is a member of same broadcast domain. switch is single broadcast domain device

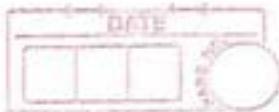
* IP Communication ke 2 Type hote hain :-

- 1] TCP
- 2] UDP

TCP yani Connection oriented. UDP yani connection less transmission.

TCP mai delivery ki guarantee hoti hai. UDP mai delivery ki guarantee nahi hoti.

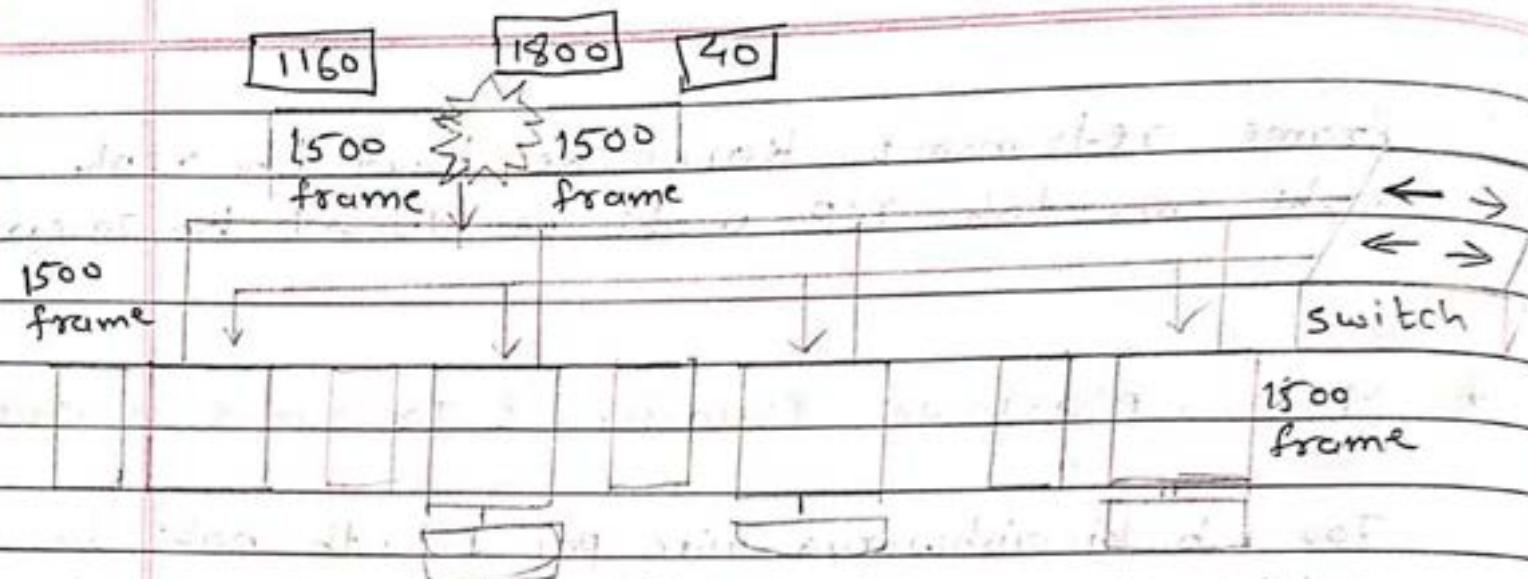
TCP guarantee deta hai with the help of acknowledgment & retransmission. UDP koi guarantee nahi deta hai. Aagar 3 successive



Frame retransmit karne ke baad bhi reply nahi aya toh TCP wahi pe discord ho Jayega.

* MTU - Maximum Transfer & Transmission Unit

700 mb ki aishwarya wire par 1 saath nahi ja sakti. Hamne Sikha hai koi software 700 mb ki aishwarya ke chote segment banayega. koi ek software Segment mark karega. koi ek software uspar CRC Code lagayega koi ek software niche ki technology ko laath marke kahega leja aur deliver karke aa. wire par jo segment chalta hai uska size MTU batata hai. MTU matlab maximum Transfer & Transmission Unit. By default MTU ka size 1500 byte hota hai. pura Data ya frame 1500 bytes ka nahi hota. MTU is everything excluding Technology header. Kya MTU 1500 byte tak limited hai? Nahi. Jab ye MTU wire par jata hai toh uska size 1518/19 bytes tak hota hai. MTU ka size utna hi rahta hai? nahi. MTU yani maximum Transfer & Transmission Unit. kai baar App. khud ke header ko add karte hai jisse Frame ka size bulky ban jata hai. Aise bulky frame ka size hota hai 1564 199 bytes. MTU udhar tak bhi nahi rahta. Gigabits ya uske above yani 1gb ya uske above par MTU ka size 9004 16 byte tak ho sakte hai.



TYPES OF COLLISION FRAME

RUNT < 64 bytes

GIANTS > Port MTU

If port MTU is ~~good~~ 9000 bytes then 1800 bytes frame will be considered as normal frame & its CRC will be checked & frame will get discarded as an Unrupted frame.

If you have application that creates Jumbo frame then you should buy switch that support Jumbo frames; switches that support jumbo frame allow you to change its port MTU using following:

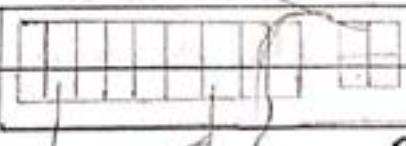
```
# Int Fa 0/1    #conf +    #Int Fa 0/1  
# IP MTU 1599  #system MTU 1599 # MTU 1599
```

Uplink Ports

Uplink ports are high Bandwidth ports created for up-linking purposes, up-linking to other switches and servers. If I have 10 ports of 10 mb then minimum required of Uplink Port Bandwidth is 100 mb.

If I have 10 Ports of 100 mb then minimum required of Uplink Port Bandwidth is 1 GB.

19004



Port MTU 1500

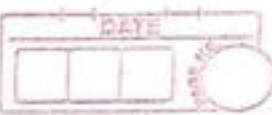
- Higher MTU to lower MTU Port
- Switch may have Fragmenting capability
- Application can send trace packet to learn path MTU & use lowest MTU of Path.

* Router [TP Flow Continue]

Jaise PC par baitha huu banda bolega Ping 20.0.0.4 yani usko ~~20.0.0.5~~; 20.0.0.4 ka network layer status chahiye. Ab ye PC sabse pehle ek frame toyar karega usme sabse pehla feild hogा Data jaha likha hogा mujko tera network layer status chahiye. Jab ye data Jayega tabhi toh status aayega. Agar Data bhejna hai toh uske aage aane ka header lagenge. Header mai sabse pehla feild hogा Source IP. Source IP matlab khud ka IP. IP matlab layer 3 information. Ab mera PC apne routing table ke pass jayega aur puchega. Apna IP kya hai. Woh bolega apne pass 1 he network card hai. Jisko IP hai 10.0.0.1 utheke likh dega 10.0.0.1. Next feild hai Destination IP. Tahan jana hai uska IP Command se uthakar likhne se pehle kahani mai 1 twist hai. Mere PC apne layer 3 routing table ke Pass Jayega aur puchega kya ham 20.0.0.4 network tak pochoch sakte hai. ye bolega nahi apne pass 1 he network card hai ~~ye~~ 10.0.0.0 ham yahi network mai ja sakte hai.

Funch statement :-

Aagar layer 3 par destination IP reachable nahi hai toh packet ko discord kiya jata hai. By default computer can communicate within same subnet if you want to get away from your network & communicate with computers in other network you take help of gateway device. Gateway device is a router or a proxy server that routes between the network.



Mera gateway mere network mai hoga ya dusre network mai hoga?

Mera gateway mere network mai hoga kyuki uska kaam hai mere network se uthakar dusre network tak kaun leke jayega isiliye.

— II —

Next feild hai destination IP. Destination IP matlab Jaha jana hai uska IP. IP matlab layer 3 information Command se uthakar likhne se pehle kahani mai 1 twist hai. Ab mera PC apne routing table ke pass jayega cur puchega kya ham 20.0.0.0 network ko pochoch sakte hai nahi. hamare pass 1 he network card hai jo 10.0.0.0 network ko belong karta hai toh nahi pochoch sakte. Ab mera PC dusra question puchega Default gateway configure hai ye bolega ha ha toh PC bolega PC. Agar ham direct nahi toh gateway ki madat se pochoch sakte hai.

Command se uthake IP likh dega 20.0.0.4.

Next feild hai Source MAC. smac bole toh SIP ka ~~MAC~~ MAC. MAC bole toh layer 2 information. Ab mera PC apne ARP table ke Pass Jayega cur Puchega 10.0.0.1 ka MAC address kya hai ye bolega AAA. Uthakar likh dega AAA. Next feild hai Destination MAC. ~~MAC~~ MAC bole toh layer 2 information.

yaha par 1 punch statement hai.

Agar source IP cur Destination IP Dono alag alag network mai honge tab destination mac gateway ka mac hoga yani router ka mac hoga.

Toh Ab mera pc pehle apne layer 3 routing table ki pass Jayega aur puchega apne gateway address kya hai ye bolega 10.0.0.10 ab mera. PC apne layer 2 ARP table ke pass jiskar puchega 10.0.0.10 Network address kya hai agar malum hai toh very good aur nahi malum toh ARP broadcast karega jab learn karke aagega tab likh dega RRR.

Ab jaise ye frame wire par jayega electrical signal mai convert ho jayega switch ke layer 1 se lekar layer 2 par aayega layer 2 software layer 2 information kholega aur puchega kaha se aya hai ye bolega AAA switch bolega rukija apna MAC table dekhega entry hai to refresh karega. Ab puchega kaha Jane hai woh bolega RRR. dekhega port no 3 par RRR baat kar raha hai.

If a sender & receiver are on different port then switch will bridge the information to relevant port only not all other port.

Ab jaise ye frame wire par jayega electrical signal mai convert ho jayega Router ke layer 1 se lekar layer 2 par jayega Router ka layer 2 software layer 2 information kholega aur puchega kaha Jane hai. ye bolega RRR. ye bolega mai he RRR hu tu mere liye aya hai. layer 2 software layer 2 information utthakar side mai rakh dega baki information upar ke layer 3 ko dega. layer 3 software layer 3 information kholega aur puchega kaha Jane hai ye bolega 20.0.0.4. Router bolega lekin mai tab 10.0.0.10 hu tu mere liye nahi aya hai kyuki mai router hu mera kam hai hai router routes

between the network. isiliye mai teri madat karta hu. Router apne routing table ke pass jake puchega kya ham 20.0.0.4 ko pochoch sakte hai. ye bolega ha. hamare pass 1 interface hai woh usi network ko belong karta hai toh ham pochoch sakte hai.

Aagar router destination tak pochoch saktu hai toh router Frame ko modify karta hai. For end to end IP traceability Source IP & Destination IP will never change. But every hop in ethernet communication ke andar source & destination mac badalta hai. Yaha par data, source & destination IP change nahi hoga. Yaha par source, mac Router khud ka lagayega aur Destination MAC router Jaha jana hai uska lagayega 20.0.0.4 Par router apne ARP table ke pass jayega aur puchega 20.0.0.4 ka mac kya hai phir toh very good nahi toh router ARP broadcast bhejega mac learn karke chayega phir apne ARP table mai likh ke wahi se uthakar Frame mai likh dega DDD.

Router communication mai participate kartu hai toh woh ARP broadcast kar saka hui lekin switch layer 2 device hai uska koi port IP nahi samjata woh ARP broadcast nahi karta. ek baar mac learn hua toh same flow router se destination tak rahega.

Routing table

Etho - 10.0.0.1

10.0.0.10

20.0.0.16

C 10.0.0.10 is directly

DFG - 10.0.0.10

E0/0

~~E0/1~~

Connected on E0/0

RRR

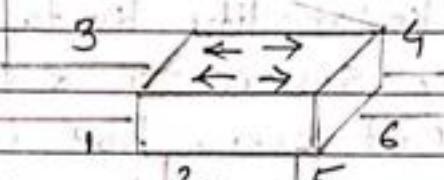
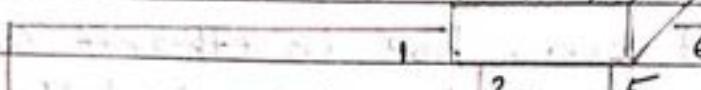
C 20.0.0.10 is directly
Connected on E0/1

ARP table

10.0.0.1 - AAA

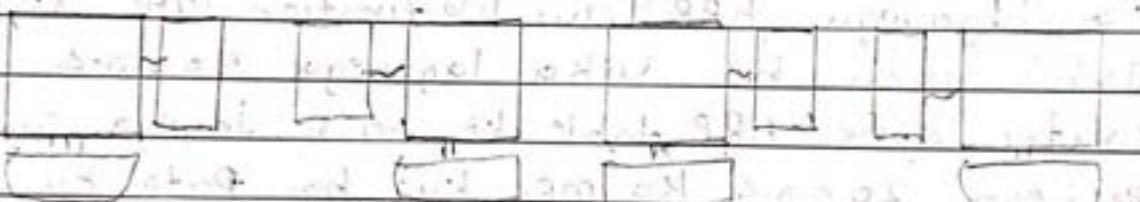
10.0.0.2 - BBB

10.0.0.10 - RRR



Ping

20.0.0.4



AAA

BBB

CCC

DDD

10.0.0.1/24

10.0.0.2/24

20.0.0.3/24

20.0.0.4/24

dfg - 10.0.0.10

dfg - 10.0.0.10

dfg - 20.0.0.16

dfg - 20.0.0.10

Date

10.0.0.1

20.0.0.4

AAA

RRR

SIP

DIP

SMAC

DMAC

L3

L2

- Routers can broadcast but switch cannot broadcast.
- we required IP & MAC address on routers port but we don't require IP & MAC on L2 switch port.
- Routers will discard packets if DIP is not reachable.
- Router modify packets but L2 switch will not modify frame.

Router

Router is an intelligent device. As soon as router receive a packet on its port. It will check IP Address refer routing table & take forwarding decisions. Because IP Address is Layer 3 Address.

Routing table is layer 3 table. Hence Router is a layer 3 device. Upon receiving a packet on its port Router will open layer 3 information. Check destination IP Address refer routing table & forward the packet only if there is Route to reach destination or else it will discard the packet.

Ek router routing table dekhta hai. Forwarding decisions lena ke liye Isliye routing table mai route ka boote mai bhara hua jaruri hai.

Ek Router ke routing table mai ham route 3 prakar se kar sakte hai:

- 1] Jo directly connected routes hote hain unki entry routing table mai apne aap aa jaati hain. Directly connected routes entries will automatically reflect in a router routing table.
- 2] Administrator can make static route entry in routers routing table.
- 3] with the help of dynamic routing protocol routers can self learn route in its routing table.

Router routes between the network because router routes between the network. Hence no two port of the router should be in same network. Always ports are belong to different network.

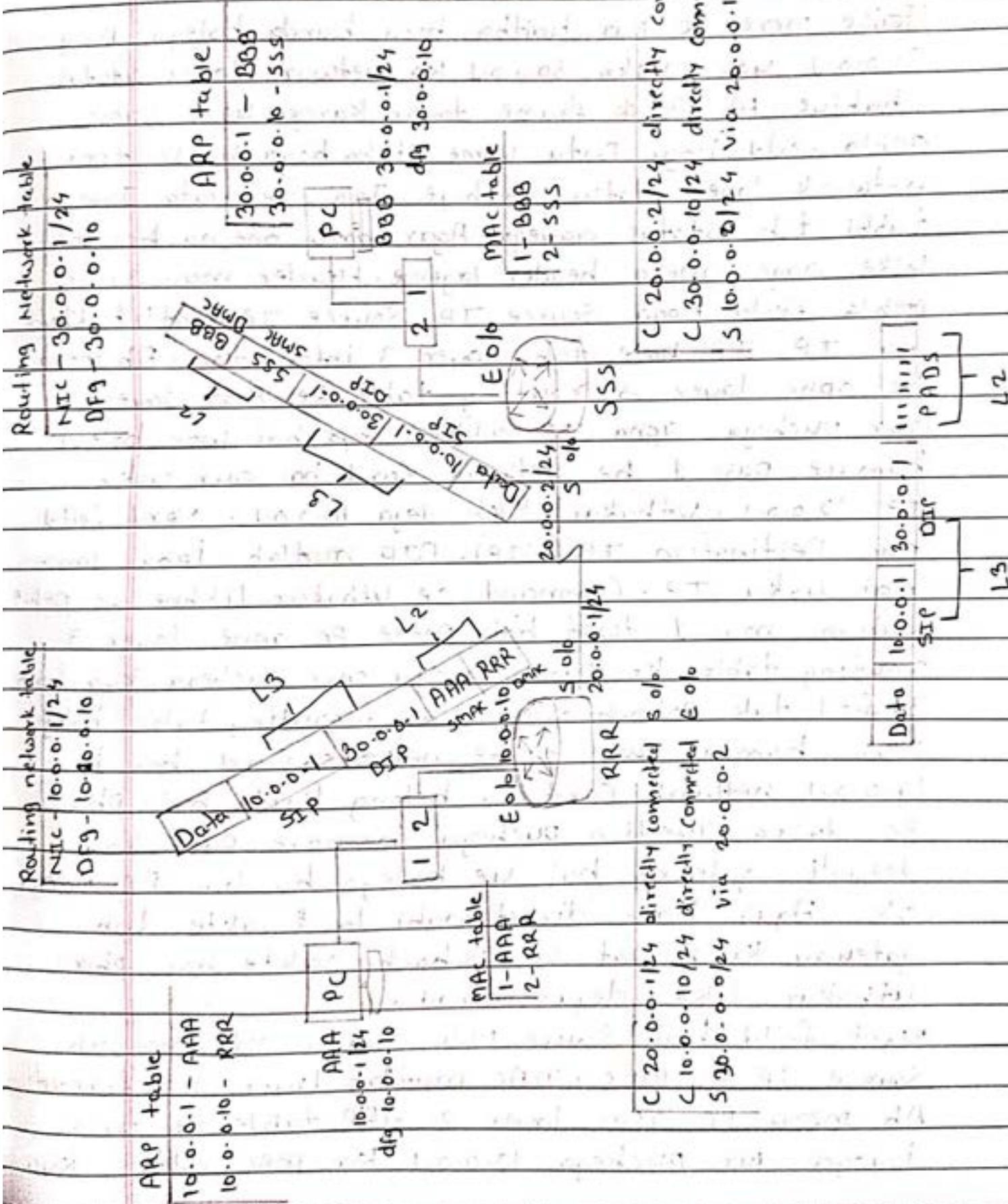
Every Port of a router is a member of separate broadcast domain as well as collision domain.

Router is a multiple broadcast domain device as well as collision domain device.

Router :-

- Every upper-layer device do lower level function also router refers routing table to take forwarding decisions (Layer 3 functions). It will also modify the frame & change MAC addresses (layer 2 Function) & restore signal level before Forwarding the frame (Layer 1 function)
- Multiple Ports of router can have same MAC Address or multiple MAC Addresses

* MOTHER DIAGRAM



* Mother diagram explanation :

Taise mere PC par baitha huu banda bolega ping 30.0.0.1 yani usko 30.0.0.1 ka network layer status chahiye. Ab PC ek frame tayar karega usme sabse pehla feild hoga Data. usme likha hoga mujie tera network layer status chahiye. Jab ye data jayega tabhi toh status change hoga. Agar data bhejna hai toh uske aage aneko header lagenge. Header mai sabse pehla feild hoga Source IP. Source IP matlab khud ka IP. IP bole toh layer 3 information. Ab mera PC apne layer 3 routing table ke pass jayega aur puchega apna IP address kya hai. woh bolega hamare pass 1 he network card hai aur uska IP 10.0.0.1. Uthakar likh dega 10.0.0.1. Next feild hai Destination IP (DIP). DIP matlab jaha jana hai uska IP. Command se uthakar likhne se pehli kahani mai 1 twist hai. Mere PC apne layer 3 routing table ke pass jayega aur puchega kya ham 30.0.0.1 tak pohoch sakte hai. routing table bolega nahi. hamare pass 1 he network card hai jo 10.0.0.1 network card ko belong karta hai. phir PC dusra question puchega hamare pass koi default gateway hai ye bolega ha hai PC bolega ok. Agar ham direct nahi ja sakte toh gateway ki madat se pohoch sakte hai. phir uthakar likh dega 30.0.0.1.

Next feild hai Source MAC. Source MAC bole toh Source IP ka MAC. MAC matlab layer 2 information. Ab mera PC apne layer 2 ARP table ke pass jayega aur puchega 10.0.0.1 ka MAC address kya



hai.. ye bolega AAA. Uthakar likh dega AAA.

Next field hai & Destination MAC (DMAC). Jaha jana hai uska MAC. MAC bolo toh layer 2 information yaha par 1 punch statement hai :-

If a Source IP & Destination IP are in different network then the destination MAC is gateways MAC or routers MAC.

Ab mere PC Apne layer 3 routing table ke pass jayega aur puchega apna gateway address kya hai? ye bolega 10.0.0.10. ab mera PC apne layer 2 ARP table ke pass jayega aur puchega 10.0.0.10 ka MAC address kya hai. ye bolega RRR. Uthake Frame mai likh dega RRR agar nahi malum toh ARP broadcast karega MAC learn karke gayega phir likh dega RRR.

Jaise ye frame wire par jayega electrical signal mai convert ho jayega. Switch ke layer 1 se layer 2 par aayega. layer 2 software layer 2 information kholega aur puchega kaha se aya hai. ye bolega AAA. switch bolega ruk ja.

Apne table mai dekhega entry hai toh refresh karega. phir puchega kaha jana hai. ye bolega RRR. switch dhekega Port 2 par RRR Connected hai.

* If a sender & receiver are on different port then switch will bridge information to relevant port only, not all other ports.

Ab, jaise ye frame wire par jayega electrical signal mai convert ho jayega. Router ke layer 1 se layer 2 ke pass jayega. layer 2 software

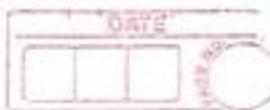


layer 2 information kholega aur puchega. Kaha jana hai ye bolega RRR. Router bolega mai hi hu RRR tu mere liye aya hai. phir layer 2 Software information side mai rakhega aur bacha hua information upar ke layer 3 ko de dega. Router ka layer 3 software layer 3 information kholega aur puchega kaha jana hai ye bolega 30.0.0.1 Router bolega mai toh 10.0.0.10 hu tu mliye nahi aya hai. kyuki mai router hu mera kaam hai to routes between the network isiliye mai teri madat karne ki koshish karunga Router apne routing table ke pass ja rege aur puchega kya ham 30.0.0.1 ko poch sakte hai ye bolega ha hamare pass 1 he route / path hai via 20.0.0.2 toh ham poch sakte hai.

Router tabhi Puchega 20.0.0.2 tak kaise poch chalegi tab ye bolega 20.0.0.2 tere se directly connected hai tere serial o/o se.

Aagar router destination tak poch sakte hai to woh khud ko modify karega aur End to End IP traceability. Source IP & Destination IP will never change but at every hop in Ethernet communication Source MAC & Destination MAC change hogi.

To bhi serial link use hota hai usme point to point communication hota hai usme MAC layer 2 ko pad kar dete hai. pad karna matlab fill kar dete hai.



Data	10.0.0.1	30.0.0.1	
	SIP	DIP	.Pad	

Ab joise ye frame wire par jayega electrical Signal mai convert ho jayega router ka layer 2 Software layer 2 information kholega chekhega pads hai toh Uthakar side mai rakh dega. Bacha hua information upar ke layer 3 software ko dega. layer 3 software layer 3 information kholega cur puchega ye bolega 30.0.0.1 lekin mai toh 20.0.0.2 hu tu mere liye nahi aya hai. Kyuki mai routers hu mera kaam hai to routes between the network isiliye mai tesi madat karne ki koshish karunga.

Router apne routing table ke pass jayega cur puchega kya ham 30.0.0.1 par pochoch sakte hai ye bolega ha hamare pass ek interface / port hai jo usi network ko belong karta hai to ham pochoch sakte hai.

Agar router destination tak pochoch sakta hai toh ye frame ko modify karega. For end to end IP traceability source IP & destination IP will never change but at every hop in ethernet communication source MAC & destination MAC change hoga.

Da	Data	10.0.0.1	30.0.0.1	SSS	BBB
		SIP	DIP	SMAC	DMAC

Router jayega apna MAC lagayega SSS aur destination MAC jo MAC hota hai jaha iska hai 30.0.0.1 ka MAC kya hui pata hai Lst par. toh router apne routing table ke pass jake puchegi 30.0.0.1 ka MAC kya hui pata hai toh very good nahi malum toh ARP broadcast karega learn karke clayega phir likh dega BBB. phir jaissa flow AAA se RRR tak bana similar flow SSS se BBB tak banega.

* 10.10.10.10 what is this?

It is just a set of numbers. IP address without network mask is just a set of numbers.

10.10.10.10 /24

IP address is a 4 octet, 4 byte, 32 bit decimal addresses.

Without /24 or mask it is just a set of numbers.

10	.	10	.	10	.	10
111111		111111		111111		111111

2411	5262
↔	↔
Area code	Subscriber no.

10	.	10	.	10	.	10	/24
111111		111111		111111		111111	
Network bits				Host bits			

* Mask is a no. of bits on network side from left to right.

Step 1 :- Sabse Pehle mask dekhte hai. mask batata hai no. of bits on network side from left to right.

Step 2 :- network bits ko same likhenge aur baki ke bits ko o karke last mai mask laga kar likh denge toh network address mil jayega.

Step 3 :- Host address ke liye network bits ko as it is likh denge aur last mai host bits ko bhi as it is likh denge. last mai mask laga denge toh host address mil jayega.

Network Address :- 10.10.10.0/24

Host Address :- 10.10.10.10/24

* Decimal to Binary conversion :

0.0.0.0	128	64	32	16	8	4	2	1
255.255.255.255	$\frac{1}{2^7}$	$\frac{1}{2^6}$	$\frac{1}{2^5}$	$\frac{1}{2^4}$	$\frac{1}{2^3}$	$\frac{1}{2^2}$	$\frac{1}{2^1}$	$\frac{1}{2^0}$
0	0	0	0	0	0	0	0	0
10	0	0	0	0	1	0	1	0
130	1	1	0	0	0	1	0	0
255	0	0	1	0	0	0	0	0

10.10.10.10 /24 → Prefix mask

11111111111111111111111100000000
255.255.255.0 → Net mask

$$18 = 255.0.0.0$$

$$16 = 255.255.0.0$$

$$24 = 255.255.255.0$$

* Class of Address

		Subnet mask	Prefix mask	Host Per subnet
Public IP for Distribution Purpose	Class A	1 - 126	255.0.0.0	18 2^{29}
	Class B	128 - 191	255.255.0.0	16 2^{16}
	Class C	192 - 223	255.255.255.0	24 2^8
Multicast Purpose	Class D	224 - 239	1 - 32	
Research Purpose	Class E	240 - 255	11 - 32	
			Private IP	
127 - Universal Loopback Address			10.0.0.0 - 10.255.255.255	
			172.16.0.0 - 172.31.255.255	
			192.168.0.0 - 192.168.255.255	

* Host Per bit

256	128	64	32	16	8	4	2	1
2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	0	0	0	1	0	0	0	0
0	0	0	0	1	1	0	0	1
0	0	0	0	0	1	0	1	0
0	0	0	0	0	0	1	1	0
1	0	0	0	0	0	0	1	1
1	1	0	0	1	0	1	0	1
1	1	1	0	1	1	1	0	1

* How will you read this?

130.20.20.0 / 16

Class B address with default mask of 16 bits

130.20.20.0 / 24

Class B address with subnet mask of 24 bits

If mask is more than given mask it is called subnet.

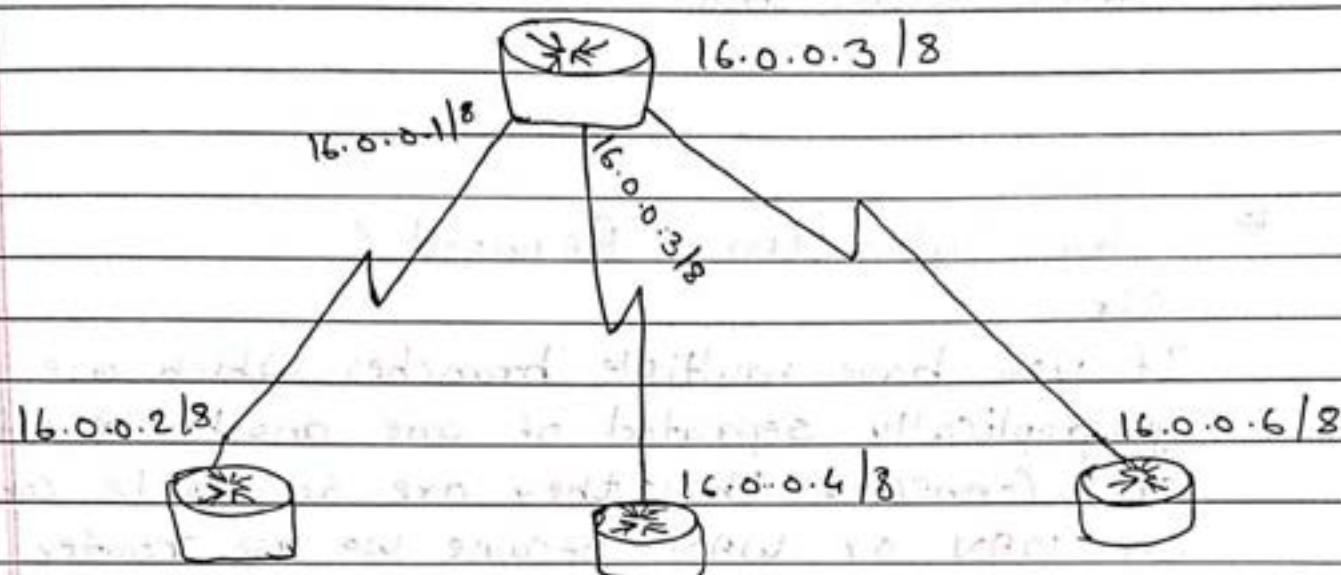
130.20.20.0 / 8

Class B address with supernet mask of 8 bits

If mask is less than given mask it is called Supernet ..

* Design Rule

Use Case No. 1



HP ki lottery lag ejayi. HP ne pure vishwa mai elag elag kone mai apne branch offices open kiye aur unme kuch lakhs employee unke liye kaam karte hai.

Har employee ko communication karna hai toh sabko IP address lagega. Toh HP TANA ke pass jayega aur lakh IP ki demand karega. TANA ne HP ko 16.0.0.0/8 ye class A address with default mask of 8 bit assign kar diya.

Agar ye address ham kuch is prakar se configure karenge toh ye configuration wrong hogा kyuki hamne ye padha hai router routes between the network.

Because router routes between the network. No. 2 port of router can be never be in same subnet.

Each port of router should be in different Subnet.

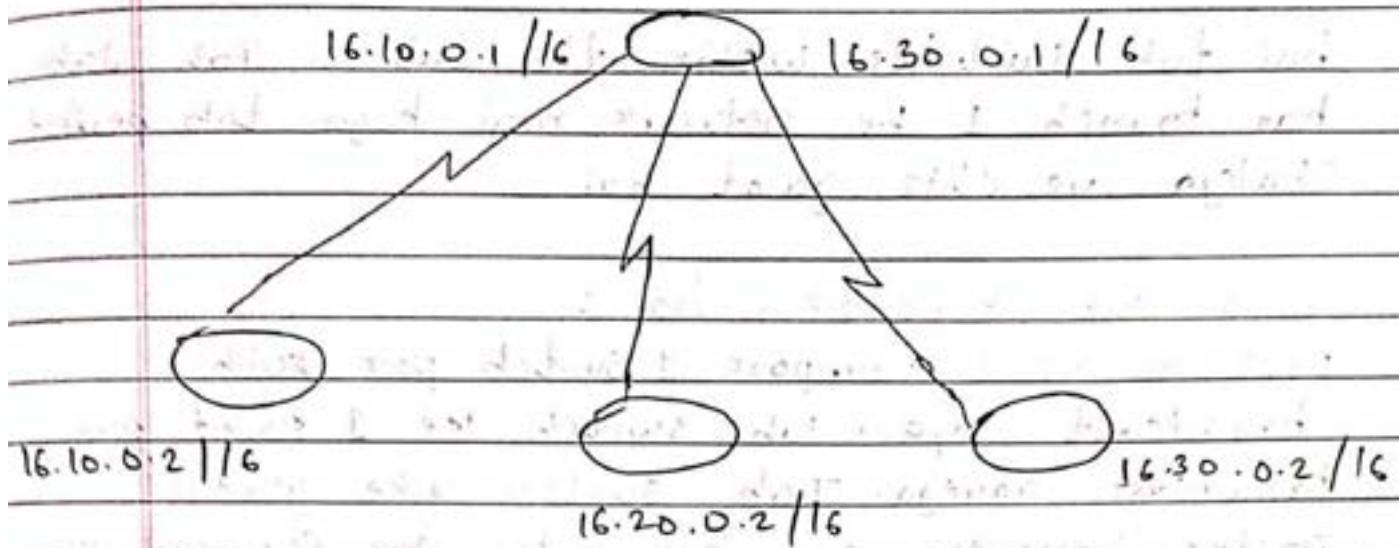
Toh yaha par 3 router ke ports hai aur 3 ports ke Network address same hai. Isliye ye configuration wrong hogा. Hamko TANA ke diye hue address ko

Chote chote subnet mai divide karna hoga.
Division karne ko tadne ko ham Subnetting
Karna kehte hai.

* Why Subnetting Required ?

Sir,

If you have multiple branches which are geographically separated of one another & if they are connected then they are said to be connected on MAN or WAN. Because we use router on MAN or WAN & router routes between the network. Hence no 2 part of router should be in same subnet. Every port of router should be in different subnet. Hence Subnetting is required.



Design Rule :-

Rule No 1 :- Subnetting is nothing but game of mask (mask manipulation)

Rule No. 2 :- Two directly connected communicating devices should be in same subnet.

Rule No 3 :- Router routes between the subnet.
 because router routes between the network.
~~No 2~~ No 2 Port of a router can be in
 same subnet. Every Port of a router can be
 in different subnet.

* If interviewer ne puchha IF Problem is on
 router them i will replace all router with switch?
 → Aagar mai har router ko switch ke saath replace
 kar dunga. Aur long distance communication ke liye
 Ethernet over SDM yani long distance ethernet
 link laya dunga. Aagar har branch mai switch

hai toh switches within the subnet. Toh jab har branch 1 he network mai hoga toh perfect chalga. ye chiz galat hai.

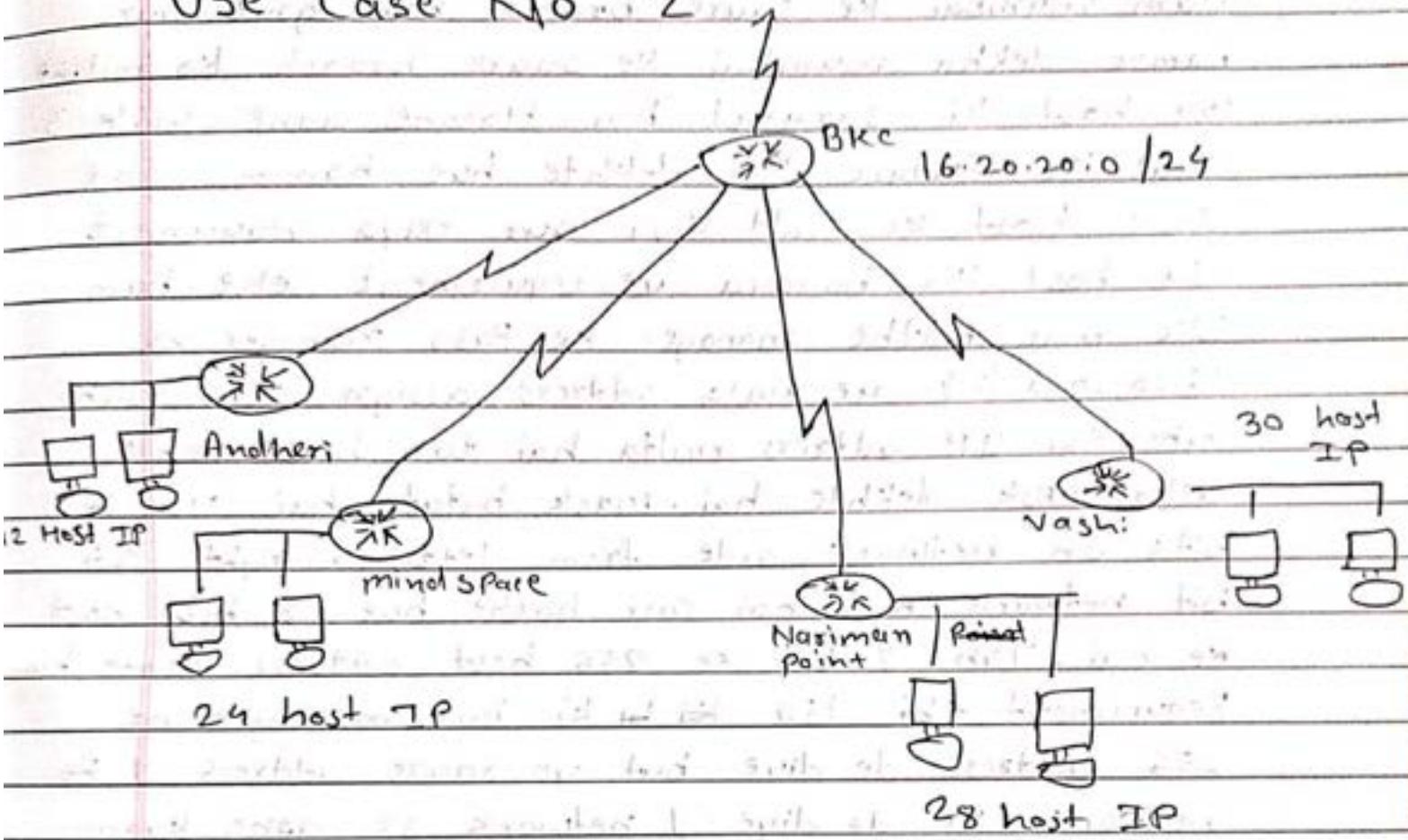
yeha par 3 problem hai :

problem No 1 - Suppose 1 switch par kabhi broadcast aya. Toh switch ke 1 point par broadcast aayega. Toh switch uske multiple packet banayega aur har switch par forward kar dega. Us switch par aya hua broadcast har dusre switch par Jayega. Har switch uska multiple copies banayega phir har Port pe bhejega. Aise toh 1 port pe aya hua broadcast. Har Country ke Har switch par Jayega. Toh har switch ka high memory, High CPU, High processing power, our utilization high ho jayega.

problem No 2 :- ye jo lakh, crore rs ke wire 2 branch kei bich mai lagaya hai uska 50% bandwidth keval broadcast carry karne mai jata hai yani bandwidth utilization high ho jata hai.

problem No 3 :- Tab switch itna broadcast kar raha hogya toh us waqt aaye hue data packet ko wo drop kar dega. Aage Forward nahi karega. Toh frames ke forwarding mai delay ari jayega.

Use Case No. 2



24 bits on network side

8 bits on host side

$$2^8 - 256 \text{ Host}$$

$$\begin{array}{c} 16.20.20.0 \\ \quad \quad \quad \boxed{ } \\ 16.20.20.255 \end{array} \quad] \quad 256 \text{ Host}$$

Part 1 :

HP ki lottery lag gayi ham hp mai bharti ho gaye. Hamare manager ne hamko 1 task diya ki jo mumbai ke saare branch ka IP address ka requirement samaj ke aa aur cane wale 3 saal ke liye branches ka IP address planning / schematic Samaj ke aa.

Ham mumbai ke saare branch mai gaye aur hamne dekha mumbai ke saare branch ko milakhe 100 host ki jarurat hai. Hamne aane wale jo Saal ke Future ko dekhte hue hamne isme 50 + host ko add kiya aur naya requirement 150 host ka banaya. ye requirement leke ham Bkc mai baithe manager ke Pass manager ne 16.20.20.0 /24 ye wala address assign kiya. Jab bhi koi IP address milta hai toh sabse pehle uska mask dekhte hai. mask batata hai No. of bits on network side from left to right. 24 bit network mai hai aur bache hue 8 bit host ke hai. Toh 8 bit se 256 host address bante hai Requirement thi 150 ki ki but manager ne 256 address de diye but ye saare address 1 he network ke de diye. 1 network ge apna kaam nahi hogा. Hamare pass yaha 4 branch hai aur har branch ke andar router hai. Router ka koi bhi port same network mai nahi hota. yeh requirement hai 8 network ki. Toh ja kar ke 256 ke 1 bade network ko 8 chote chote network mai todna hogा. Todne ko division karne ko subnetting kehte hai.

Subnetting mai 2 chiz important hai :-

1] Tukda kitne address ka hogा.

2] Uska mask kya hogा.

Part 2 :-

Subnetting mai 2 chiz important hai :

- 1) Tukda kitne addresses ka hogा.
- 2) Uska mask kya hogा.

Kaisa bhi subnetting kar host point of view se ya network point of view se 2 he chiz mangta hogा. 1) Tukda kitne addresses ka hai 2) Uska mask kya hogा.

Yaha ham network point of view se subnetting ka long method samaj raho hogा.

Sabse pehle hame 8 network ki requirement thi aur manager ne hamko 256 address ka 1 network diya. 256 addresses ke 1 baree network ko 8 se divide karna hogा.

$$\begin{array}{r}
 32 \\
 8 \boxed{256} \\
 -24 \\
 \hline
 16 \\
 -16 \\
 \hline
 0
 \end{array}$$

Divide Karne ke baad samai Jayega 32 addresses
ke 1 - 1 tukda banega

8 tukde 32 addresses ke banenge

16.20.20.0

16.20.20.31

16.20.20.32

16.20.20.63

16.20.20.64

16.20.20.95

16.20.20.96

16.20.20.127

16.20.20.128

16.20.20.159

16.20.20.160

16.20.20.191

16.20.20.192

16.20.20.223

16.20.20.224

16.20.20.225

16.20.20.0 se 16.20.20.255 tak ke 1 bade network
ko 8 chote chote tukde mai divide kiya isi ko
ham Subnetting kahte hain.

Ye subnetting incomplete hai kyuki tukde banta
hai toh uska mask bhi nikalta hai

32 host = 5 bits on host side ($2 \times 2 \times 2 \times 2 \times 2$)

Total bits	32
Host side	- 5
Network side	27

So mask hai /27 kyuki mask batata hai no of bits on network side from left to right.

* Subnetting from Host point of view.

Step 1 :- Jaha kahi bhi maximum no. of host ki requirement hai wahi par Tukar 2 aur address add karne hai. Kyuki ye address cage system yani router ko lagega. Hamare example mai Maximum requirement vashi mai thi 30 host ki toh hamne usme 2 address add kar diya Toh new requirement 32 host address ki.

Step 2 :- Jo new requirement hai usko bits mai convert kardo.

Toh agar 32 host hai toh uske liye kitna bit lagega ($2 \times 2 \times 2 \times 2 \times 2$) 5 bits lagega on host side 5 bit se kitne host banenge ($2 \times 2 \times 2 \times 2 \times 2$) 32 host ka subnet banega hoga.

Subnetting mai 2 chiz lagta hai. Tukda kitne addresses ka hoga aur uska mask kya hoga.

Tukda 32 addresses ka hoga (host addresses)

Step 3 :- Mask kaise nikalna hai?

Total no. of bits = 32

Host side = -5

(mask) Network side = 27 bits

Mask hoga 127 bits

Har tukde mai 32 host address honge

* Subnetting from Network Point of view

[16.20.20.0.127]

Step 1 :- Jitne bhi network ki requirement
hai uska bits mai convert kardo hamare
example mai hamne 8 network ki requirement
hai

8 network ke liye kitna bit lagega $(2 \times 2 \times 2)^3$
bit lagega 3 bit on network side. mask already
bata raha hai hai 24 bits network mai hai. toh
ye 3 bits ko usme add karne ka

24 bits + 3 bits = 27 bits

new mask 127

Step 2 :- 1 IP mai total 32 bits hote hai

Total no. of bits = 32

(mask) Network side = -27

Host side = 5 bits

5 bits on host side

5 bits jo host mai hai usse kitne addresses
banega $(2 \times 2 \times 2 \times 2 \times 2)^5$ 32 addresses hante hai.

32 host address ka 1 subnet hoga

sabka mask 127 hoga.

* Size of your subnet is defined by mask & Hence subnet will be only of 2 addresses or in its powers
 we should not have a subnet of 1, 3, 5, 6 or 10 addresses.

Network bits	Host bits	No. of hosts
/31	1	2 hosts
/30	2	4 hosts
/29	3	8 hosts
/28	4	16 hosts
/27	5	32 hosts

* Tukde tere requirement mai depend nahi karta subnet depend karta hai bits par isiliye subnet kabhi bhi 5, 10, 50, 100 addresses ka nahi hanta subnet hamesha '2' ya uske multiple mai banta hai like, 2, 4, 8, 16, 32, 64, 128 & so on.

Jab bhi subnet banta hai wo hamesha maximum requirement ko consider karte hai. Aagar maximum requirement consider kiya hai toh usme minimum requirement fulfill ho jata hai.

Isiliye always consider Maximum requirement instead of minimum.

* Jitne bhi tukde hane hai har tukde ke 1st address network address hota hai aur last address broadcast address hota hai. Jo hamare System ya router ko legega ye wo address hai jise ham configure nahi kar sakte. Ham sirf host address ko configure kar sakte hai. Host

address network address ke niche wale aur broadcast address ke upper wale address hote hai.

Waise he purane din mai operating system par hamare saare tukde mai se Sabse pehla wala tukda "subnet zero" aur akhiri wala tukda yani "last subnet" ye tukde configure karne ke liye ek command likhna padta hai tha

IP subnet - zero

Aaj ye command likhna jaruri nahi hai kyuki hamare Router ye command lekar load k load hota hai alog se ye command likhna ka jarurat nahi hai.

* Classfull Address :- It is an address with default mask of 10.10.10.10 /8 (10.10.10.0 255.0.0.0)

* Class full Address :- It is address with any other mask but not defaut mask
10.10.10.0 /24 (10.10.10.0 255.255.255.0)

B
下
P

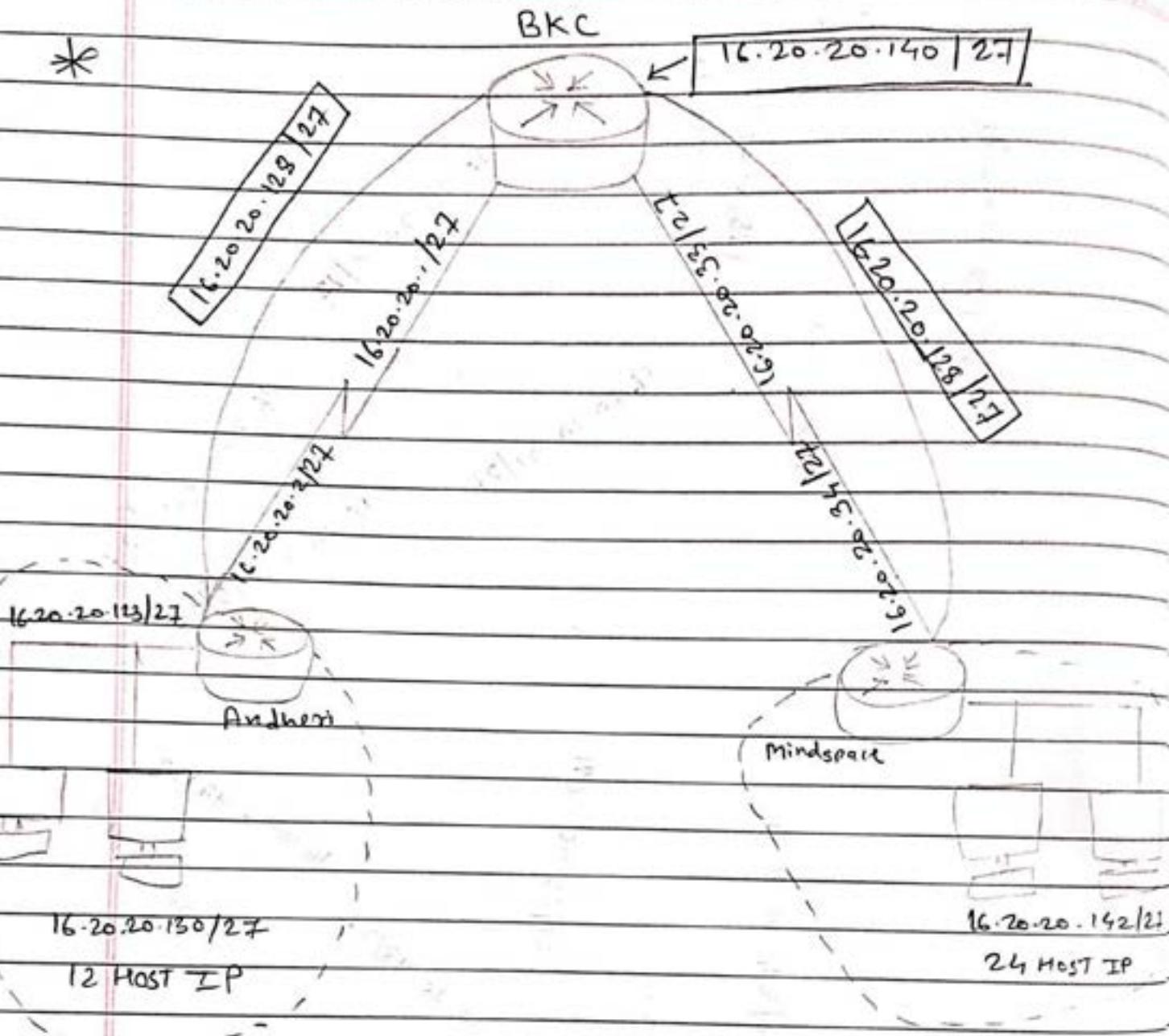
Auditorium
 16.20.20.129 | 27
 16.20.20.150/21
 Drg - 16.20.20.129

Auditorium
 16.20.20.66 | 27
 Mindspace

Library
 16.20.20.2/12X

Computer Lab
 16.20.20.1/12X

Cafeteria
 16.20.20.33/22



Routing table

16.20.20.128 /27 via 16.20.20.2

159 = 5 bits on host side
= 32 host ka subnet

16.20.20.128 /27 via 16.20.20.34

159

Design Rule No 4 :-

A network that is already used at a place in your network cannot be reused at other place in the same network or else it may lead to sub-optimal Forwarding

* Bits to Mask

mask	128	192	224	240	248	252	254	255
Bits	128	64	32	16	8	4	2	1

$$/8 = 255.0.0.0$$

$$/16 = 255.255.0.0$$

$$/24 = 255.255.255.0$$

$$\begin{aligned} /22 &= 255.255. - - && (16+6) \\ &= 255.255.252.0 \end{aligned}$$

$$/10 = 255. - . - - && (8+2)$$

$$255.192.0.0$$

* FLSM (Fixed length subnet mask)
VLSM (Variable length subnet mask)

FLSM network is a network in which subnet have fixed length mask. Jab ham LAN par wahi same mask wala subnet configure karte hai aur MAN aur WAN par bhi wahi same mask wala subnet configure karte hai toh aise network ko ham FLSM network kehte hai. FLSM network ka drawback hai we tend to waste IP addresses. IP address waste kaise honge?

Hamare example mai hamne serial links par 32 address ka tukda configure kiya hai. Ek serial link par 2 addresses ki requirement hai 2 aur add kii jata hai toh max. requirement 4 address ki hoti hai. Waha par ham 32 addresses ka subnet configure karenge toh 4 addresses use honge but 28 address waste honge. Har serial link par agar 28-29 addresses waste karoge toh real world mai itne addresses waste karne ke liye nahi hote hai. This is drawback of FLSM system that we tend to waste IP address. Solution is VLSM network.

part 1 mai hamne conclude kiya we tend to waste IP addresses solution is VLSM network.

VLSM is network is a network which subnet should have variable length mask. Jab ham LAN par ek alog mask wala subnet configure

Karte hai aur MAN or WAN par bhi alag mask wala Subnet configure karte hai. Toh aise network ko ham VLSM network kehte hai. VLSM network ka advantage hai that we tend to save IP addresses.

IP address save kaise honge?

Ek serial link par 2 host ki requirement hai 2 aur add karna padega toh total requirement 4 host ki hogi ab jo bhi requirement hani usko bits mai convert kardo. 4 host liye kitna bit lagega (2×2) 2 bit lagega. Host ki baat ho rahi hai toh 2 bits on host side. 2 bits se kitne host addresses ban sakte hai (2×2) 4 host ka Subnet lagega. Subnetting mai 2 he chiz chahiye tukda kitne addresses ka hogi aur uska mask kya hogi.

mask kaise nikalenge

Total no. of bits = 32

host side = - 2

network side = 30

mask is /30

LAN par ham /27 mask wala tukda jab ham use karenge aur MAN or WAN par /30 mask wala tukda use karenge toh isi ko ham VLSM network kehte hai.

But problem ye hai ham already 127 mask ko 32 addresses ke 8 tukde banai chuke hai ab ye serial link ke liye naya tukda kaha se loay Subnetting yani todna Ek baar Subnetting karne ke baad bhi ham subnet ko tod sakte hai Jab tak divide hoga ham divide kar sakte hai Jaise ham 256 host ko 32 . 32 ke 8 tukde mai divide kiya waise he koi bhi ek 32 ke tukde ko 4-4 mai divide kar sakte hai

$$\text{Total} = 32$$

$$\text{host} = 2$$

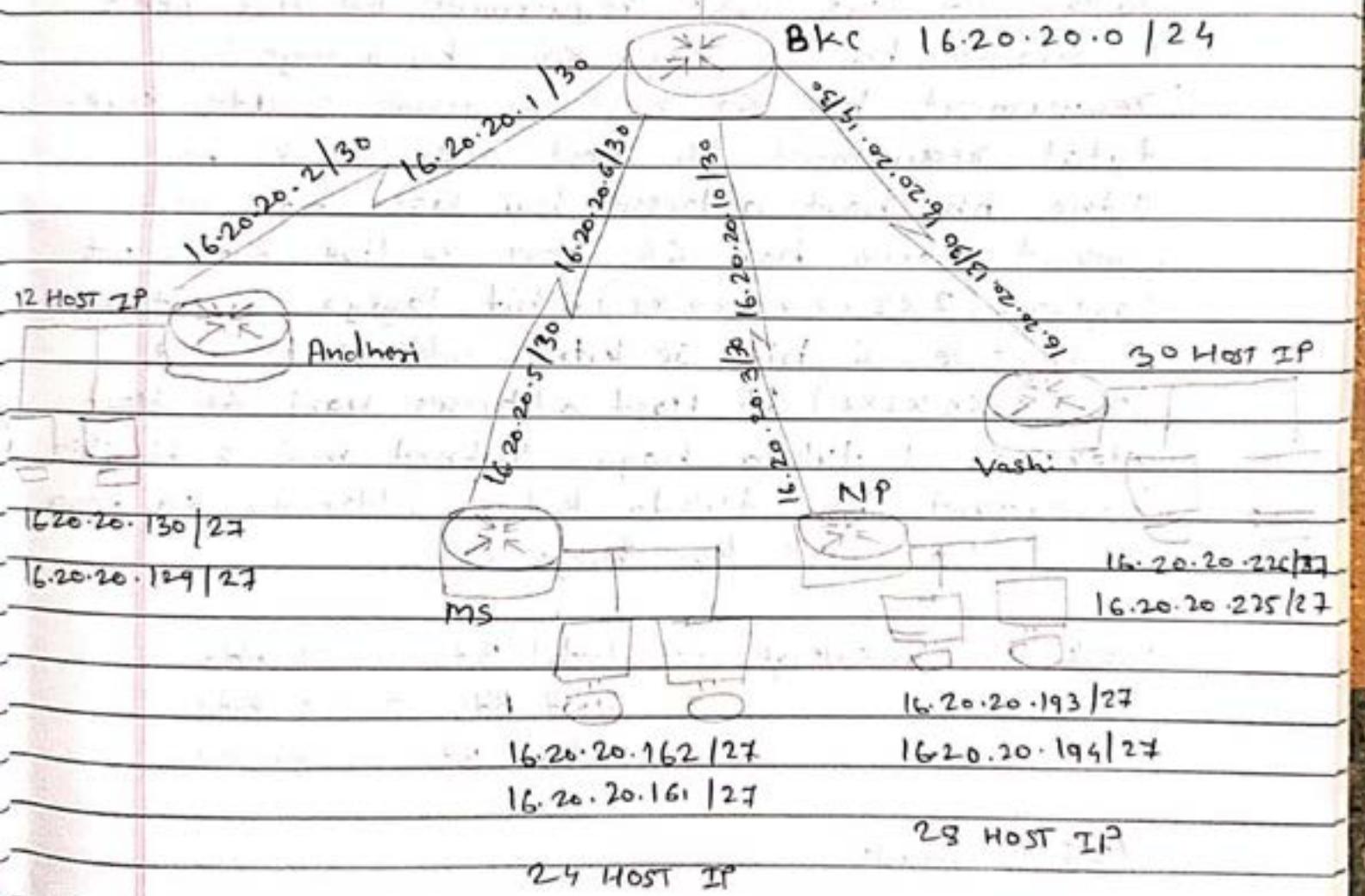
$$\text{network} = 30$$

$$12+2=4$$

1 2 bits on
host side

<u>16.20.20.0 /27</u>	<u>16.20.20.81 /27</u>	<u>16.20.20.0 /30</u>	1 2 bits on host side
<u>16.20.20.32 /27</u>		<u>16.20.20.3 /30</u>	
<u>16.20.20.63 /27</u>		<u>16.20.20.4 /30</u>	1 4 Host
<u>16.20.20.64 /27</u>		<u>16.20.20.7 /30</u>	1 subnet
<u>16.20.20.95 /27</u>		<u>16.20.20.8 /30</u>	
<u>16.20.20.96 /27</u>		<u>16.20.20.11 /30</u>	
<u>16.20.20.127 /27</u>		<u>16.20.20.12 /30</u>	
<u>16.20.20.128 /27</u>		<u>16.20.20.15 /30</u>	
<u>16.20.20.159 /27</u>		<u>16.20.20.16 /30</u>	
<u>16.20.20.160 /27</u>		<u>16.20.20.19 /30</u>	
<u>16.20.20.191 /27</u>		<u>16.20.20.20 /30</u>	
<u>16.20.20.192 /27</u>		<u>16.20.20.23 /30</u>	
<u>16.20.20.223 /27</u>		<u>16.20.20.24 /30</u>	
<u>16.20.20.224 /27</u>		<u>16.20.20.27 /30</u>	
<u>16.20.20.255 /27</u>		<u>16.20.20.29 /30</u>	
		<u>16.20.20.31 /30</u>	

Toh hamne 1st wala subnet liya 16.20.20.0/27 to 16.20.20.31/27 aur is subnet ko 4-4 addresses ke 8 tukde mai divide kar diya. Agar serial link par 4 hai toh in /30 ke 8 tukde mai se 4 tukde use ho raha hai aur 4 tukde save ho raha hai similarly 4 branch mai 32 - 32 ke 4 tukde use krunga aur 1 tukda LAN mai use karunga toh 3 tukde save ho gaye hai.



Andheri mai 12 Host IP use ho rahi hai - 3
Saal mai aur 50 use ho rahi hai aisa maan
lete hai new requirement 62 host ki ho gayi
Andheri mai bache hue addresses se subnet ko
bana sakte hai ? Ha
request hai 62 Host ke tukde ki Jaise
ham 1 subnet ko divide karte hai toh 2
bade 32 ke subnet ko jod sakte hai.
Jodne ke liye iske requirement ke liye pehle
1 subnet banana hoga kaise banayenge ?
requirement hai 62 host ki usme 2 add kiye.
total requirement 64 host addresses ki hai.
Jitne bhi host addresses hai usse bits mai
Convert karna hai . 64 Host ke liye kitna bit
lagega . $(2 \times 2 \times 2 \times 2 \times 2 \times 2)$ 6 bit lagega . 6 bit on
host side . 6 bit se kitne address banenge
 $(2 \times 2 \times 2 \times 2 \times 2 \times 2)$ 64 Host addresses yani 64 Host
addresses 1 tukda hoga . Subnet mai 2 hi chiz
important hai tukda kitne addresses ka hoga
aur uska mask kya hoga ?

Mask kaise nikalenge - Total Bits = 32 bits

Host Bits = 6 bits

Network Bits = 26 bits

126 is mask

Abhi jo bhi tukde bache hai usme se 2 tukde
jodna padega toh tukda 64 ka banega aur
uska mask 126 hoga.

DATE
10 7 24

* IP Examples

1] 16.20.20.0 /24

Requirement : I need 4 network.

1] what is the 1st valid host address.2] what is 2nd host last broadcast address.

→ subnetting from network point of view

4 network ki requirement hai usko bits mai convert kar do. 4 network se kitne bits banenge (2×2)
 2 bit. 2 bits on network side.

mask already /24 hai usme ye 2 bits add kar do $124 + 12 = 126$ mask.

Total no. of bits = 32

Network side = - 26

Host side = 6 bits

6 bit se kitne address bante hai?

$(2 \times 2 \times 2 \times 2 \times 2 \times 2)$ 64 host address.

64 address ka 1 tukda /subnet rahega.

1] 16.20.20.1 /26

16.20.20.0 /26

16.20.20.63 /26

2] 16.20.20.191 /26

16.20.20.191 /26

16.20.20.192 /26

16.20.20.255 /26

2] 16.20.20.0 /24

Requirement :- I need 6 host address per subnet

Q.1. what is 1st valid host address

Q.2. what is 2nd last broadcast address



Subnetting from host point of view.

Maximum no of host mai 2 host address add kardo. New requirement = 6 + 2 host = 8 host. 8 host ka address ko bits mai convert kardo. 8 host address ke liye kitne bits langenge? $(2 \times 2 \times 2)$ 3 bit. 3 bit se kitne host address banenge $(2 \times 2 \times 2)$ 8 host address. so 1 tukda! Subnet 8 addresses ka hoga.

Total no. of bits = 32

Host side = - 3

network side = 29

Mask is /29

Q.1. - 16.20.20.1 /29

16.20.20.0 /29

Q.2. - 16.20.20.247 /29

16.20.20.7 /29

16.20.20.247 /29

16.20.20.248 /29

16.20.20.255 /29

3) $16 \cdot 20 \cdot 20 \cdot 0 / 16$

Requirement :- T. need 1000 host address.

1) What is 1st valid host address

2) what is 2nd last broadcast address

→ Subnetting from host point off view.

Maximum no. of host mai 2 host add Kardo.

New requirement = 1000 host + 2 host = 1002 host address

1002 host address ko bits mai convert kar do.

1002 host address ke liye kitne bits lagenge.

($2 \times 2 \times 2$) 10 bits. 10 bits se
kitne host address banenge?

($2 \times 2 \times 2$) 1024 host address.

So 1024 host addresses ka 1 tukda banega.

Total no. of bits = 32

host side = - 10

$16 \cdot 20 \cdot 20 \cdot 0$

Network side = 22

$16 \cdot 20 \cdot 0 \cdot 255$

Mask is /22

$16 \cdot 20 \cdot 1 \cdot 0$

~~1024~~

$16 \cdot 20 \cdot 1 \cdot 255$

1024

$16 \cdot 20 \cdot 2 \cdot 0$

~~address~~

Q.1. - $16 \cdot 20 \cdot 0 \cdot 1 / 22$

$16 \cdot 20 \cdot 2 \cdot 255$

$16 \cdot 20 \cdot 3 \cdot 0$

Q.2. - $16 \cdot 20 \cdot 251 \cdot 255 / 22$

$16 \cdot 20 \cdot 3 \cdot 255$

$16 \cdot 20 \cdot 0 \cdot 0 / 22$

$16 \cdot 20 \cdot 3 \cdot 255 / 22$

$16 \cdot 20 \cdot 251 \cdot 255 / 22$

$16 \cdot 20 \cdot 252 \cdot 0 / 22$

$16 \cdot 20 \cdot 255 \cdot 255 / 22$

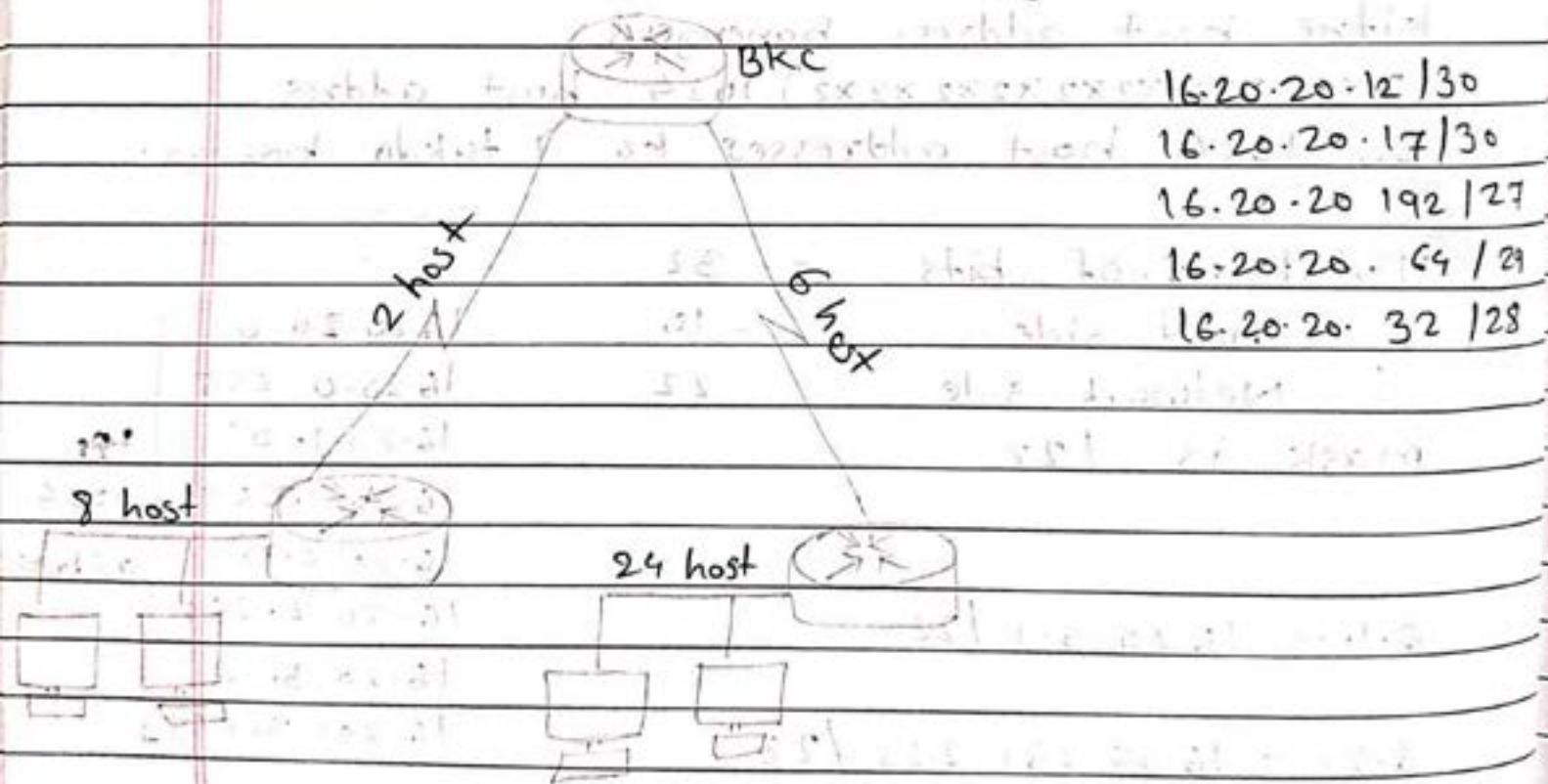
* Drag & Drop type IP questions (Example)

Rule no 1 :- link par network hota hai.
Interface par host hota hai.

Rule No. 2 :- Jitne addresses ka tukda hoga
network address usi ke table mai hoga

Aagar 2 address ka tukda hoga toh network
address 2 ke table mai hoga

Aagar 4 address ka tukda hoga toh network
address 4 ke table mai hoga



1] 2 host

Maximum no. of host mai 2 host addl kaat do
 $2+2 = 4$ host

4 host se kitne bit banenge? $(2 \times 2) 2$ bit
2 bit se kitne host address banenge $(2 \times 2) 4$ host address.

1 tukda 4 host address ka hoga.

refer rule no. 2

Total no. of bits = 32.

host side = - 2

network side = 30

Mask is /30

So 2 host wale link par 16.20.20.12/30 ye address hoga.

2] 6 host

maximum no. of host mai 2 host add karo.
6 + 2 host = 8 host

8 host se kitne bit banenge? ($2 \times 2 \times 2$) 3 bit.

3 bit se kitne host addresses banenge? ($2 \times 2 \times 2$)

8 host address ka tukda / subnet 8 host address ka hoga.

Total no. of bits = 32

host side = - 3

network side = 29

mask is /29

so 6 host wale link par 16.20.20.64/29 ye address hoga.

3] 24 host

maximum no. of host mai 2 host add kar do.
24 + 2 host = 26 host

26 host ke liye kitne bit lagege? ($2 \times 2 \times 2 \times 2 \times 2$) 5 bit.

5 bit se kitne host address banenge?

($2 \times 2 \times 2 \times 2 \times 2$) 32 host address.

1 tukda subnet 32 address ka hoga.

Total no. of bits = 32

Host side = - 5

Network side = 27

mask is 127

So 24 host ke liye wale link par 16.20.20.192/27 ye address hoga.

4) 8 host

Maximum no. of host mai 2 host address kar do.

9 + 2 host = 10 host

10 host ke liye kitna bit Lagega? ($2 \times 2 \times 2 \times 2$) 4 bit

4 bit se kitne host address banenge? ($2 \times 2 \times 2 \times 2$)

16 host address. 1 tukda subnet 16 addresses ka hoga.

Total no. of bits = 32

Host side = - 4

Network side = 28

mask is /28

So 8 Host wale link par 16.20.20.32/28 ye address hoga.

Refer Rule No. 1

16.20.20.13 /30



16.20.20.129 /28

16.20.20.14 /30

16.20.20.12 /30

16.20.20.46 /26

16.20.20.142 /28

16.20.20.70 /29

16.20.20.62 /29

16.20.20.65 /29

16.20.20.13 /30

Mask is /30. Mask batata hai no. of bits on network side from left to right.

Total no. of bits = 32

Network side = - 30

Host side = 2 bit

2-bit se kitne host banenge? $(2 \times 2) = 4$ host addresses.

1 tukda / subnet 4 host ka hogा.

16.20.20.14 /30

Interface par host add lagta hai aur ye

now usi subnet ko belong karta hai

jis subnet ko 13 belong karta hai.

0
3
4
7
8
11
12
15
16
19



16.20.20.129 /28

Mask is /28

Total no. of bits = 32

Network side = - 28

Host side = 4 bits

4 bit se kitne host banenge? $(2 \times 2 \times 2 \times 2)$ 16 host address.

1 tukda / subnet 16 host address ka hoga.

Aisa koi address jo 16 ke table mai ho aur 129 ke kamib hona chahiye.

16.20.20.142 /28

Interface par host address lagta hai. Aur

ye row usko belong karta hai jis subnet ko 129 belong karta hai.

16.20.20.65 /29

Mask is /29

Total no. of bits = 32

Network side = - 29

Host side = 3 bits

3 bit se kitne host banenge? $(2 \times 2 \times 2)$ 8 host 1 tukda / subnet 8 addresses ka hoga..

16.20.20.70 /29

0
7

8

15

16

23

24

Interface par host address lagata
hai.

ye row usiko belong karti hai

jis subnet ka 65 belong karti hai

55

56

63

64 ✓

71

72

79

80

* Whether it is network address, Host address or broadcast address.

1] 16.20.20.99/27

$$\text{Total no. of bit} = 32$$

$$- 27$$

5 bits on host side

5 bit se 32 host address

$$\begin{array}{r} 3 \\ 32 \sqrt{99} \\ - 96 \end{array}$$

3 ← 3rd address of 3rd subnet It is host address.

2] 16.20.20.96/27

$$\text{Total no. of bits} = 32$$

$$- 27$$

5 bits on host side

5 bit se 32 host address

$$\begin{array}{r} 3 \\ 32 \sqrt{96} \\ - 96 \end{array}$$

0

If remainder is 0 then it is network address.

3) ~~16.20.20.95~~/27

$$\begin{array}{r} \text{Total no. of bits} = 32 \\ - 27 \end{array}$$

5 bits on host side

5 bits for 32 host address

$$\begin{array}{r} 2 \\ 32 \sqrt{95} \\ - 64 \\ \hline 31 \end{array}$$

If remainder is 1 less than divisor
then it is broadcast address.

4)

~~16.20.7.0~~/22

$$\begin{array}{r} \text{Total no. of bits} = 24 \\ - 22 \end{array}$$

2 bits on host side

2 bits for 4 host address

$$\begin{array}{r} 1 \\ 4 \sqrt{7} \\ - 4 \\ \hline 3 \end{array}$$

If 2nd last octet is broadcast then
last octet should be 255 or else
it is a host address.

5) 16.20.8.255 /22

$$\begin{array}{r} \text{Total no. of bits} = 2^4 \\ - 2^2 \end{array}$$

2 bits on host side

2 bits for 4 host address

$$4 \overline{) 8} \\ - 8 \\ 0$$

If 2nd last octet is in network
then last octet should be 0 or
else it is host address.

- * For End to End IP Communication every router should have route to reach all networks.
If every router have routes to reach all networks then issue are:
 - a) Huge routing table
 - b) Frequent updates

Huge routing table has 3 issues.

- 1) High memory / processor utilization
- 2) Ease of management is lost
- 3) Packet Forwarding delay.

Frequent updates has 3 issues

- 1) High Bandwidth utilization
- 2) High Processor / memory utilization
- 3) Performance deterioration

10.0.0.0	1/24
10.0.0.1	1/24
10.0.0.2	1/24
10.0.0.3	1/24
10.0.0.4	1/24
10.0.0.5	1/24
10.0.0.6	1/24
10.0.0.7	1/24

R1

10.0.0.0	1/24
10.0.0.1	1/24
10.0.0.2	1/24
10.0.0.3	1/24
10.0.0.4	1/24
10.0.0.5	1/24
10.0.0.6	1/24
10.0.0.7	1/24

R2

DATE	TIME

BKC

R Andrei

B2 Ponvel

10.0.0.3/24

5/24.0.0.0

10.0.0.1/24

10.0.0.0/24

10.0.0.D.4/24

10.0.0.6/24

10.0.0.5/24

5/24.0.0.0

* Rules of summarisation

- 1] only 2 or its powers can be summarised
i.e. $2^1, 2^2, 2^3, 2^4, 2^5$
- 2] only address in sequence can be summarised.
- 3] To summarise 2 address 1st address should be in 2's table

To summarise 4 address 1st address should be in 4's table

Summarisation
Supernetting
Aggregation
Range
CTDR

All 5 things are same

Suppose Supernetting mai hamare Pass 4 network hai.
Toh 4 network ka address separate nahi bhejega.
Saare address ka 1 Summary banakar bheite hai.
Saare address up hue ya down hue toh he
Summary message bhejega. agar koi ek address
up/down hua toh summary mai kuch change
nahi hogा.

To Summary bhejte hai usme kya bheite hai?

Hamare Pass 4 network hai usse bits mai convert
kar do. 4 network se 2 bits banenge. Hamare Pass
jo network hoi address hai uska mask /24 hai.

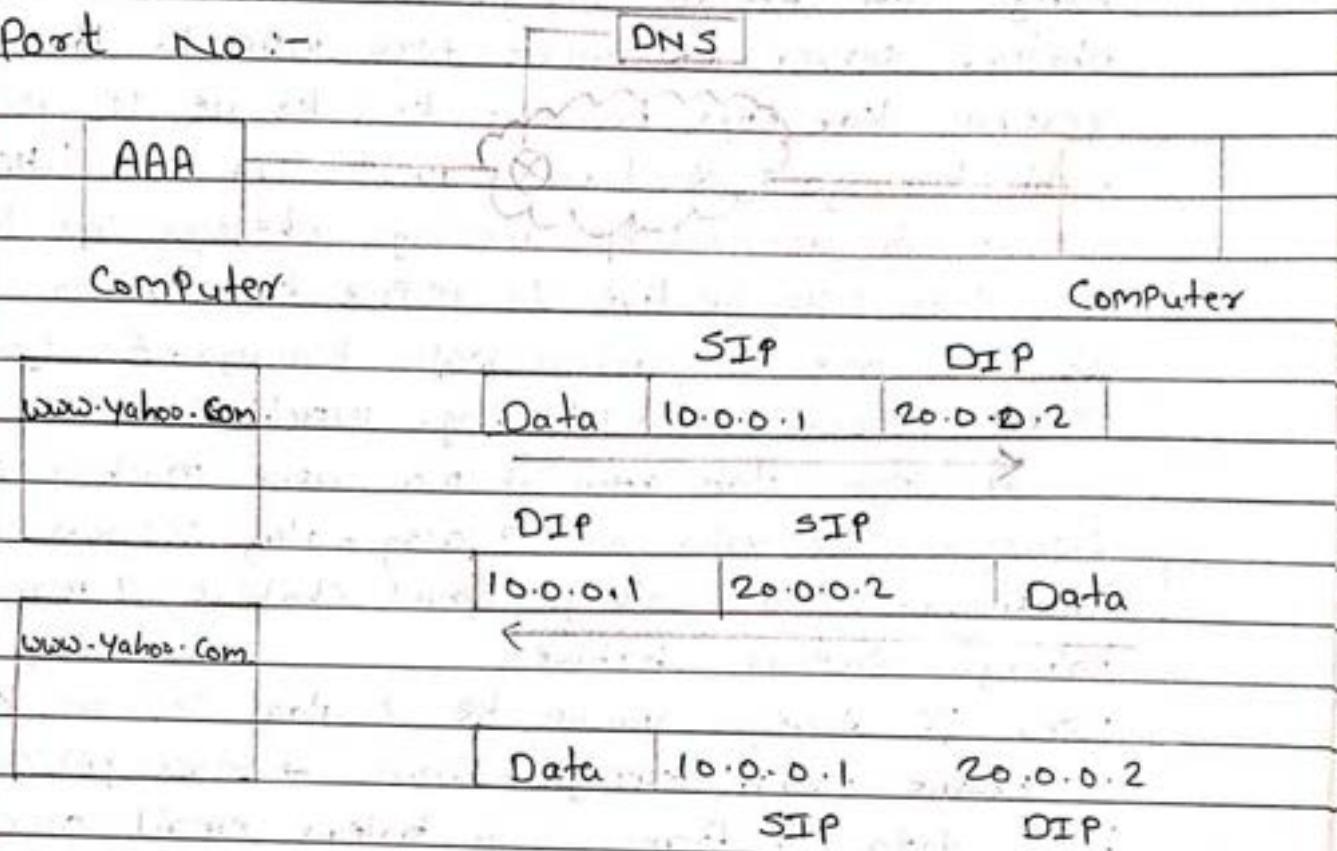
~~super~~ supernetting mai bits ko mask se subtract
kiya jata hai.

$$So \ 124 - 2 = 122$$

Jo 1st address hogा usko new mask ~~together~~ logake
summary mai bheja jata hai.
10.0.0.0/22 - summary

* OSI Layer

* Port No :-



Machine ko agar communication karna hai toh communication karne ke liye 5 chiz ki jarurat hoti hai -

- 1] IP address 2] Subnet mask 3] Default gateway
- 4] Preferred DNS 5] Alternate DNS

Ye 5 chize agar jante hai toh khud se assign kar sakte hai. Agar ye nahi jante toh ham apne machine par jab obtain address automatically per click karenge toh hamara PC DHCP server ke janiye ye 5 chize rat lega.

Sabse pehla mera PC bhejega Discovery message. Usme bolega ye koi jo koi bhi DHCP server hai mero MAC address AAA hai. Mere MAC ko 1 IP de. Jo DHCP Server hogi wo randomly apne pool of IP mai se 1 IP utthayega aur MAC ko offer kar dega. Jo bhi offer

Sabse pehle milega machine usi ko accept karega aur ab jayega our Request message bhejega server ko maine tere MAC ka liye IP reserve kar liya hai curr kisi ko ye IP assign nahi karunga. Ek baar request aya toh DHCp server ab acknowledge message bhejega cur kahega mai tere MAC ke liye IP reserve kar diya hai. ye IP ab kisi cur ko assign nahi karunga. Ek baar DORA Process Complete hogा machine wo 5 chiz samaj lega. toh mai ab mai apne machine par jaunga cur yaha ke 2 alag-alag session kholunga. I mai bolunga email chahiye. I mai bolunga picture chahiye.

Mera PC jayega yahoo ke 2 alag session ke liye 2 Frame tayar karega : Jisme sabse pehla feild data - 1 Frame mai bolega email aur 1 Frame mai bolega picture. Jo source IP ~~lagayega~~ hoga woh khud ka IP lagayega 10.0.0.1. lekin destination IP mai toh naam likha hai toh kya naam likhega? nahi. Jo naam ka IP lene ke liye mera PC sabse pehle apne host table mai entry hai toh utthakar likh dega cur DNS server ke pass aayega. yahoo.com ka IP resolve karega. host table mai likhega cur phir waha se destination IP mai likh dega 20.0.0.2

Ab jaise ye frame wire Par Jayega Electrical signal mai convert ho jayega. yahoo ke layer 1 se layer 2 se layer 3 aayega. yahoo ka layer 3 software layer 3 information kholega cur puchega. kaha jang hai Dono frame bolenge 20.0.0.2 yahoo bolega mai he hu 20.0.0.1 tu mere liye he aya hai. layer 3



Software layer 3 information utha ke side mai rakh dega bache hua information upar ke kis application ko du iski koi jankari nahi hai.

Problem ① :- Pata kaise chale ki yahoo ye data upar ke kis application ko dena chahiye (Telnet, SSH, FTP, HTTP, etc.)

Problem ② :- Har jagah laga-lagakar sumaj gaye ki data aya tha HTTP ke liye.

HTTP Sabse pehla reply frame banayega. Reply frame mai sabse pehla field hoga data. 1 Data mai email dega aur 1 Data mai picture dega. Jab reply ja raha hai toh request mai jo source IP tha reply mai wo destination IP ban jata hai aur destination IP source IP se ban jata hai.

Ab Jaise ye 2 frame wire par Jayega electrical signal mai convert ho Jayega mere PC ke layer 1 se layer 2 se layer 3 aayega. Layer 3 software layer 3 information kholega aur puchega kaha jana hai? Ye bolega 10.0.0.1 PC bolega mai he hu. Tu mere liye aaya hai. PC layer 3 information utha ke side mai rakh dega bache hua Data upar wale session ka hai ya niche wale session ka hai? ye hamne nahi Pata iska matlab TP communication jo hamene padha wo incomplete hai.

Bina Port no. ke TP communication adhura hota hai. Saara ka saara IP communication port no. par depend hai.

DNS

AAA

Computer	SP	DP	SIP	DIP
www.yahoo.com	Data	1024	80	10.0.0.1
		10.0.0.1	20.0.0.2	1024
		20.0.0.2	80	Data
www.yahoo.com	10.0.0.1	20.0.0.2	1025	80 Data
	Data	1025	80	10.0.0.1
	SP	DP	SIP	DIP

Part 1 mai hamne sikha tha Sarara ka Sarara
Communication Port no. ke bina incomplete hota hai
Port No - Every time when PC creates a session
Every session is initiated with a unique Port
no. Anything above 1023 why? because 1 to 1023
are reserve for valid TP application.

Ab mai apne PC Par gaya yaha ke 2 alog-alog session khole. Har session ko mera PC ek Port no ke saath banayega. ye Port no kuch bhi ho sakta hai lekin 1023 ke uppar wala.

Session 1 Par 1024 Port no. aur session 2 Par 1025 Port no dediya.

Toh Jaise he Frame banega 1st Feild hoga Data Session 1 ke Data mai bolega e-mail aur 2 ke Data mai bolega Picture.

Ab niche ke layer 4 ko dega. layer 4 apna header lagayega which is source port (SP) & Destination Port (DP). session 1 mai SP hoga 1024. 2 mai

SP hogi 1025. Destination Port no. use application ko lagayega Jaha home jana hai. HTTP ke Pass jana hai. HTTP ka Port no. hai 80. Niche ke layer 3 ko dega.

Layer 3 apne header lagayega source IP aur Destination IP. Ab jaise ye frame wire par jayega electrical signal mai convert ho jayega.

Yahoo ke layer 1 se layer 2 se layer 3 par aayega. Layer 3 software layer 3 information kholega aur puchega kaha jana hai. Frame bolega 20.0.0.2 mai he hu 20.0.0.2 tu mere liye aaya hai. Layer 3 software layer 3 information uthakar side mai rakh dega.

Bacha hua information uppar ke layer 4 ko dega. Layer 4 software layer 4 information kholega aur puchega kaha jana hai. ye bolega 80. Toh upar ke HTTP ko dega.

Upkar ka HTTP Frame kholega dekhega yaha email chahiye aur Waha Picture chahiye. Jab reply frame banyega toh session 1 mai email dega aur Session 2 mai Picture dega. Jo request mai SP tha wo reply mai DP ban gaya aur jo SIP tha wo reply mai DTP ban gaya.

Ab Jaise ye reply frame wire par jayega electrical signal mai convert ho jayega. mere PC ke layer 1 se layer 2 se layer 3 par aayega. PC ka layer 3 software layer 3 information kholega aur puchega kaha jana hai ye bolega 10.0.0.1 PC bolega tu mere liye aya hai. Layer 4 software layer 3 information uthakar side mai rakh dega. Layer 4 software layer 4 information kholega aur puchega kaha jana hai? ye bolega 1024 aur ye bolega - 1025. Frame



Ko respective jagah pojhchane dega. Iska matlab hai pura ka pura IP communication Port no. par tika hua hai. Bina Port no. ke IP communication incomplete hai.

*

	Ash.JPG	Application	FTP 30.0.0.1
5/5	415	315	2/5 1/5
ECC	Data (1/5)	1024	21
QoS	Data	100.0.1	30.0.0.1
ECS	Data	5E	5E
Fcs	Data	AAA	RRR
1011010			Physical (bits)

Network
(Packet)

LLC

MAC (Frame)

Mujhe apne machine se samne wale ke machine mai file bhejna hai. Toh mai jaunga aur apne machine pe likhunga : FTP. Toh FTP tool activate ho jayega. Tool IP ka hai toh isko TP address samjega. Manlo mujhe FTP karna hai 30.0.0.1. Taise maine FTP 30.0.0.1 likh ke enter mera. IP ko FTP tool active ho Jayega. Phir mai likhunga put Ash.jpg



Taise ye put command likhunga put command ko pehle se Pata hoga ki machine ke harddrive mai Ash.jpg naam ki File kaha store hai . Sidha uttarakar wire par dalega ? Nahi .

Koi ek software 700 mb File ke tukde banayega . Koi ek software uske segment karega . layer 4 he hai wo jiska kaam hai segment karna . layer 4 par bhi (RC) lagta hai aur layer 2 par bhi . layer 4 par ham usse Error Correction Code (ECC) aur layer 2 par ham usse Frame check sequence (FCS) kehte hai . ye layer 4 ka saara kaam layer 4 ka TCP software karta hai . ye Sab karne ke baad wo niche wale layer 3 ko dega .

Jab IP ke Pass Frame aayega . IP apna marking lagayega . Matlab SIP , DIP , Voice - video - data ka mark karke ab jab niche ke layer 2 ko dega .

Jab layer 4 ne header vagera lagake jab niche ke layer 3 ko diya toh layer 3 ke liye pura layer 4 data ban gaya . waise he layer 3 ka saara information layer 2 ke liye Data ban gaya .

Layer 2 Par Pehle LLC ke Pass jayega wo apne header lagayega . SSEP aur DSEP . ab niche ke layer 2 ke MAC ko dega . MAC apna header lagayega aur niche wale wire par dalega . toh hamne sikha hai wire par toh bit chalta hai in the form of electrical signal

* Difference between IPV4 & IPV6

IPV4 address 4 byte, 4 octet, 32 bits ka address hota hai. Jaha mask batata hai no. of bits on network side From left to right.

IPV6 address ye 8 word ka, 8 hexate, 128 bit ka hexadecimal address batata hai. Yaha mask ye ~~batata~~ batata hai. Kitna bits user ne use kiya hai ya configure kiya hai.

IPV6 Mai ye pehle se decide hota hai 64 bits on network side and 64 bits on host side Fixed hai.

* Link Local Address

PF = 1111 1110 10 Link local use addresses
(FE80::/10)

PC | 00 90 27 17 FC OF - MAC Address

00 90 27 | 17 FC OF
FF FE | Header

00 90 27 FF FE 17 FC OF
00000000
00000000 - 2

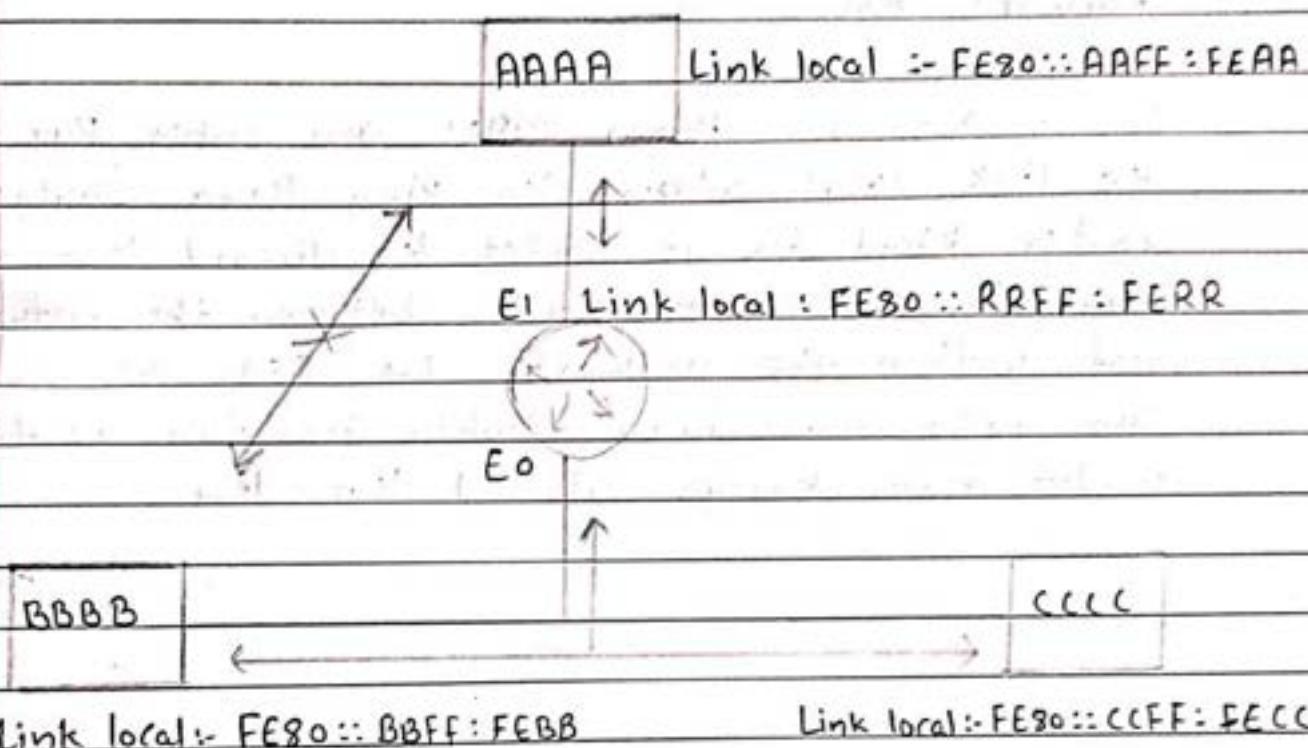
02 90 27 FF FE 17 FC OF

0290:27FF:FE17:FCOF - Host address

FE80::0000:0000:0000:0290:27FF:FE17:FC0F

FE80::290:27FF:FE17:FC0F

* IPv6 Communication



Point No.1 :- Aagar LAN Par 1 PC Ko dusre PC se baat karna hai toh MAC learn karna Padega. MAC learn karne ke liye ham IPv4 mai ARP broadcast karte hain IPv6 mai broadcast nahi hota. broadcast ko replace kiya hai Neighbour Solisitation ne. Yaha Par neighbour Solisitation bheja jayega aur bolega ye bhai koi neighbour hai kya? jo bhi neighbour hai apne ap ko advertise kardo. Advertisement mai MAC address bata dega. phir jaise communication IPv4 mai hota hai waise he communication IPv6 mai bhi hota hai.

Point No. 2 :- Jaise PC apna link local address khud banate hai waise router bhi apna link local address khud banate hai : lekin router PC se baith kar agar kisi ke link local address ko ping kiya jayega toh router packet khud se Forward nahi karega . Wo tujhe puchega - bata packet kahanse forward karna hai .

Point No. 3 :- Aagar MAN aur WAN par kisi ke link local address ko ping kiya jayega toh router khud he ye packet ko discard kar dega kyu ? Kyuki router routes between the network not within the network . Tu FF80 se cya h aur FF80 mai jana chahta hai toh router madat nahi karega : discard kar dega .

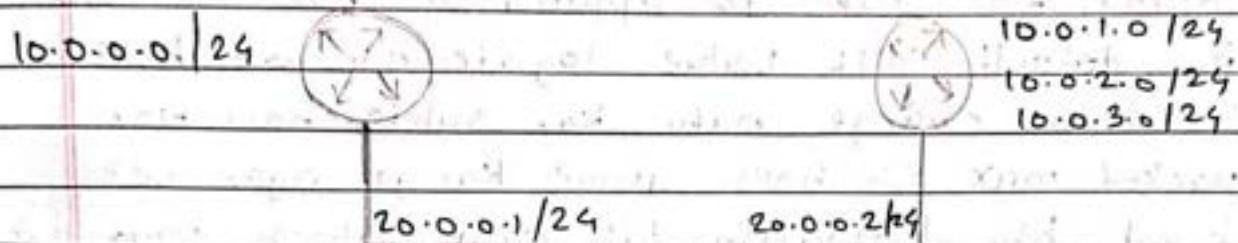
* IPV6 address configure karne ke kitne tarike hai?

1] static

2] DHCP, Version 6

3] Auto Configuration

* TTL (Time to live)



IP route - 0.0.0.0 0.0.0.0 20.0.0.2

IP route - 10.0.0.0 255.255.255.0
20.0.0.1

Router 1 ke Pass 2 network ki jankari hai. Uske alawa usse aur kahi bhi jana hoga toh woh packet 20.0.0.2 ko forward karega. Similarly,

Router 2 ke Pass 4 network ki jankari hai. Uske alawa usse aur kahi bhi jana hoga toh woh packet 20.0.0.1 ko forward karega.

1 Packet 20.0.0.2 ke pass aata hai 10.0.0.1 ke pass Jane ke liye Router kehta hai uske pass 1 static route hai jisse ham 10 network tak ja sakte hai. Toh woh forward kar dega Ab packet 20.0.0.1 ke pass aata hai 10.0.0.1 ke pass Jane ke liye Router kehta hai usse nahi Pata kaha hai kyuki 10 network down hai. Jekin router kehta hai mere alawa koi aur jana hai toh packet 20.0.0.2 ko forward karna hai Toh is Prakar Packet loop mai fas jayega. ye packet infinite time ke liye loop mai phasa na

rahe iske live packet ke saath 1 byte ka TTL (Time to live) bheja jata hai 1 byte matlah 8 bit so 2^8 256 hops 1 IP Packet maximum 256 hops le sakta hai.

Google maximum 2 hops allow karta hai, Real world mai application max 8-10 hops allow karta hai. Toh jo application hote hai apna by default TTL value legate hai 64 hops. Ye ham change nahi kar sakte hai. Har packet max 64 hops jump karega agar uske baad bhi destination tak nahi Pehchaan Paya toh jaha last hop liya hai wahi discarded ho jayega.

* Wild Card mask

1] Net Mask : 20.20.20.0 255.255.255.0
Wild Card Mask : 20.20.20.0 0.0.0.255

Subnet { Start address - 20.20.20.0
 { End address - 20.20.20.255

2] /22

Net Mask :- 30.30.0.0 255.255.252.0
 30.30.0.0 0.0.3.255

Subnet { Start address - 30.30.0.0
 { Last address - 30.30.3.255

Wild Card mask bartata hai no. of host

Net mask - No. of bits on network side from left to right

* VLAN - Virtual LAN

VLAN yani virtual LAN logical LAN . EK bade LAN ko chote chote LAN mai todne ke liye ham VLAN banate hai . VLAN banane ke aneko Fazile hai :-

1] Ease of Management

e.g. 1 banda 1 lakh logo ka network handle karna difficult hai toh bade LAN ko chote LAN kar dunga toh manage karna easy hoga

2] Flexibility milti hai

3] security milega.

e.g. Mano kisi VLAN ke 1 PC mai malware hai toh woh us VLAN ko affect karega ha ki saare 1 lakh PC ko affect karega.

Ye sab to milti hi hai but ye primary purpose nahi hai VLAN ka.

VLAN ka ek he purpose important hai - Broadcast ka control karna.

* Broadcast Control karna Jaruri kyu hai ?

→ Relience hamare Pass ata hai aur kehta hai Pune mai Smart city banane mai madat kare.

Hamare Pass 40000 employee hai . Ham Sabko

1 Flat layer 2 network Par connect karna hai.

Toh ham market gaye 20 Port wale 2000

switch Kharid laye . 40000 Port Par 40000 PC

connect kar diya Par market se jab new

switch jat layenge toh by default har switch

ka har Port VLAN 1 ka member hoga . kyu ?
kyuki VLAN 1 ye default , management , Native
VLAN hai . Agar har switch ka har Port VLAN 1
ka member hoga toh agar VLAN 1 Par broadcast
aya toh woh har switch ke har port par jayega .
Har Port uska multiple copy banayega har switch
ke har port par bhejega . Iski wajah se switch
ka high memory , High CPU , High Processing Power
aur Bandwidth utilization high ho jayega toh
overall network ke performance ki pungi baj
jayegi yani performance degrade hona start ho
jayega . Tsi problem ko overcome karne ke liye
VLAN banate hai .

VLAN banate kaise Hai ?

40000 Port se 20000 Port ko mai VLAN 100 ka
member banunga aur bache hue 20000 VLAN 1 ke
Port ko utthakar VLAN 200 ka member banunga .
Ab jab VLAN 100 ko broadcast dye toh VLAN
100 ke logo ko milega aur VLAN 200 ke logo
ko broadcast aya toh woh VLAN 200 ke logo
ko milega .

sirf 2 VLAN banane se broadcast 50% Control
ho gaya Agar 4 VLAN bante toh broadcast 25%
ban jata . Jitne jyada VLAN utna broadcast
Control hota hai . yahi reason hai VLAN banane
ka kyuki same broadcast ko control karna hai .

EK VLAN ke andar agar broadcast exchange hota hai toh within VLAN switching karo

2 Alag VLAN mai broadcast exchange nahi hota toh uske liye routing karo.

* Intra VLAN switching but Inter VLAN routing

★ Introduction to Network Design

- 1] Network Architecting requires detailed discussions with business managers to understand current and future business requirements.
- 2] It requires design discussion with technical teams to understand their quality and capacity observation.
- 3] It requires listing down principle objectives required from the design, some of these objectives are as listed below.
 - i] Highly Scalable
 - ii] Highly Resilient (Available & Reliable)
 - iii] Fully Redundant
 - iv] NS PoF
 - v] wire - speed
 - vi] Non - Blocking
 - vii] Predictable (Security & QoS)
 - viii] Modular

Campus - wide Network 3-Tier Architecture

Diagram :

* Three Tier Architecture

Abc Corporation ki lottery lag gayi. Abc Corporation ne 1 Acer bala jamin kharida. Jaha par inhone apna campus banane ka socha hai. Campus ke andar 10 building hai. har building mai 1000 employee kam karte hai. har employee ko agar communication karna hai toh Device that can we used for communication is called Edge device. mere edge device ko Samne wale edge device se baat karna hai toh hamko network lagega. To device home network ka access deta hai usse Access device kehte hai. Switch is an access device. 1000 logo ke communication ke liye 20 Port wale 40 switch lagenge. 1 switch par 20 log connected hai toh 20 log apas mai baat kar sakte hai. lekin aise aur 49 switches hai. Toh ham kya korenge switch ko ham Common Aggregation Point ko distribution layer switch se connect kar denge.

distribution layer switch se connect kar denge 1 building ka banda apna building ke sare bande se baat kar sakta hai.

Campus mai 10 building hai ham chahte the har banda 1 dusre se baat karna chahiye. Toh iske liye ham Jayenge aur distribution layer switch ko Common Aggregation point se core layer switch se connect kar denge. with the help of core layer switch har building ka banda dusre building ke bande se baat kar sakta hai. yahi power hai 3 tier architecture ka.

Ham aaj ke time mai 3 tier Architecture isiliye banate hai kyuki aaj companies mai services ko deliver karne ke liye Colphropy ko istamal nahi kiya jata. Aaj services baatne ke liye servers ko istamal kiya jata hai.

Har building ke liye clug-clug server nahi lagayenge. kisi ek building ko identify karenge as your data center block aur server block. High end quality ke server ko waha deploy kiya jayega with the help of core layer. Ab Campus mai kahi par bhi baitha hua banda Service ko utilize kar sakte hai. yahi power hai 3 tier Architecture ka.

Ab jitna important LAN mai Communication hogi utna hi important WAN Aur MAN mai communication hogi. Ab internet Par jana hai toh router lagega. kya har building mai clug-clug router lagayenge? Nahi. kisi -1 building ko identify karenge as your WAN block aur internet edge block. wahi par jayenge. Aur Router ko deploy kar denge. 1 nahi 2 clug-clug ISP se connection le lenge. Ab jis bhi bande ko internet use karna hai wo WAN block mai rakhe hue router ke Pass aayega aur ye jagah ham Campus ka banda internet ka access le sakte hai. yahi reason hai company ke andar 3 3 tier Architecture istamal kiya jata hai.

Objective of 3 Tier Architecture

- 1) Network highly scalable ho :- Aisa Network jo customer ki growth ko compliment kare na ki contradict kare.
- 2) Network Robust, Highly available, fully Redundant & ~~NO LOSSES~~ NSPOT hona chahiye :- iske liye har chiz ka backup jaruri hai.
- 3) Network mai wire speed ho :- start to end 1 gb demand kiya hai toh minimum utna milna chahiye Jyada mila toh chalega but kam hona nahi chahiye
- 4) Networking mai blocking na ho :- Network ya link ke prospective se not blocking jab milega toh ham network mai uplink port use karna start kar denge Aur backplane backplane capacity properly check karke switch purchase karenge toh blocking nahi hoga.
- 5) Network ki service predictable ho :- matlab agar customer ki demand hai ki voice mai delay nahi aana chahiye toh delay na ho.
- 6) Networks modular ho :- Agar kuch new building add kiye ya hata diye toh network ko impact nahi hona chahiye.

* Access layer Feature & Function :

- 1) VLAN use karenge kyuki edge device ko network ka member banana hai.
- 2) Trunk banane ki facility honi chahiye.
- 3) Agar koi banda port se connect hone ki koshish karta hai toh use connect hone dena chahiye ya nahi isiliye port security hona chahiye.
- 4) VLAN Access list - Port par connect hone ke baad VLAN ko member banana hai ya nahi.
- 5) Uplink Port - saare port ka traffic ek baar mai distribution layer switch tak pohchane ke liye uplink ports are high Bandwidth Port they are created for uplinking purpose.
- 6) POE (Power over Ethernet) Enable
- 7) Port density - No. of ports
4500 & 6500 is a modular switch.

* Distribution layer Feature & Function

- 1) Aggregation Point - saare Access layer switch ko aggregate karne ke liye.
- 2) VLAN Aggregation Point
- 3) Trunk Aggregation Point
- 4) Inter VLAN routing
- 5) Layer 3 feature & functionality
- 6) Maximum Traffic manipulation - kaise packet ko kab bhejna hai kaise pehla kaise bad jao
- 7) Filtering & Access list
- 8) Broadcast control - layer 3 switch act as router
- 9) Port density - No. of ports on distribution layer switch

DATE
6 8 29

* Core Layer feature & Function

- 1] Fast switching
- 2] ~~L2~~ L2 Transport
- 3] No Traffic manipulation

Device selection criteria

- 1] Should support features & functions
- 2] Port density

Devices

4500 / 6500 modular switches

* Spine and Leaf 2-Tier Datacenter Architecture

- 1) Leaf and spine switches are connected in full mesh
- 2) Typically, a L3 network is established between spine and leaf so that all links are used simultaneously.
- 3) Path between spine and leaf switches are randomly chosen so that traffic load is evenly distributed between top tier switches
- 4) if a spine layer switch fails only slight degradation is seen throughout datacenter.

- 5] In over subscription scenario a new spine switch can be added with uplinks from all other leaf switches this increases interlayer bandwidth and reduce oversubscription.
- 6] Latency is predictable as traffic between 2 leaves will always cross same no of devices i.e. Source → leaf switch → spine switch → leaf switch → Destination.

* Data center Evolution

- 1] Traditional data centers use three-tier architecture.
- 2] Spanning Tree Protocol is used to build a loop-free topology for the layer 2 part of network. However, it cannot use parallel forwarding paths, and it always blocks redundant paths in a VLAN.
- 3) Cisco introduced virtual-Port-channel (vPC) technology to overcome the limitations of STP protocol
- 4) vPC eliminates the spanning-tree blocked ports, provides active-active uplink from the access switches to the aggregation routers, and makes full use of the available bandwidth.
- 5) vPC technology works well in small DC where most traffic is northbound-southbound (client-server)

* Cloud Computing Overview

- 1) Cloud computing is the delivery of on-demand access to shared pool of computing services over the internet. Cloud computing services are categorized as IaaS, PaaS & SaaS.
 - 2) Many popular internet services function as a cloud. Some are intended for individuals like Gmail, Microsoft One Drive, Dropbox, etc. Other cloud products for business are AWS, Google Cloud, Alibaba, etc.
- ~~3)~~ Clouds are in essence large data centers having following characteristics :
- i] On-Demand self-services
 - ii] Broad network Access
 - iii] Resource Pooling
 - iv] Rapid-Elasticity
 - v] measured service

Following could be reason for an enterprise company to move to cloud:

- i] Lacks In-house expertise
- ii] Where resources are shared by many users or organizational units. Like Large Enterprises, Government or Public organization.

- * iii] When computing resource requirement may increase on an ad-hoc basis and for a short time (Cloud Bursting)
- * Cloud outsourcing may not be good if applications have strict response-time requirements.

Infrastructure as a services (IaaS):

- i) Computing resources (compute, storage, network) are offered as a service rather than a product
- ii) Customer purchase virtual machines (vm). Software (O.S, Applications) are added by customers
- iii) Offers customers a great control to add / remove resource and select speed / power
- iv) E.g. Amazon Elastic computing cloud, Microsoft Azure machines, Google compute Engine, others ~~platforms are a service (PaaS)~~

Platform as a Service (PaaS):

- i) Provides software platform with everything required to build and deliver application
- ii) Users can build, debug, and deploy their own applications and host them on the PaaS provider Infra

iii) E.g. Google APP Engine, Salesforce, Oracle Cloud platform and others.

Software as a service (SaaS)

- i) Ready to use apps and software with all required Infrastructure to run them are offered in SaaS.
- ii) SaaS provider is responsible for managing, installation, maintenance, upgrading and user access.
- iii) E.g. cisco webEx, salesforce, microsoft 365 and others.

* Cloud Service Models :

- 1] Clouds are large datacenters whose computing resources (storage processing, memory, bandwidth) are shared amongst many users.
- 2] Computing resources of a cloud are offered as a service rather than a product.
- 3] Service model defines which services are included in the cloud.

★ Communication Device Architecture

Duniya ke har communicating device ke 2 Port hota hai. ① Control Plane ② Data Plane.

Control Plane yani brain usme routing table, topology table, link state database. Jo bhi logic hoga wo sab Control Plane mai hoga.

Data Plane yani forwarding logic. Jo bhi Packet aaya usse dusre Port par bhejne ka kaam karta hai. Plane yani reservation of resources. Resources ke naam par ek device ke Pass kya kya hota hai? RAM, CPU, storage. Insab ka kuch part Control Plane ke liye reserve hoga kuch part data Plane ke liye reserve hoga.

Reserve kyu karna hai? Agar kabhi control packet aaya toh control packet ko process karne ke liye resources ko burn kiya jayega. Control Packet Jaise routing update, hello message, hello reply. Inki processing control Plane ke resources se hogi.

Agar koi packet mere through pass hoga toh uski processing data Plane mai hogi.

③ Management Plane is a subset of your Control Plane.

Management Plane kisi device ko configure karne ke liye Telnet, SSH karna hoga toh uske liye management Plane ka resources burn hoga.

* Traditional IP Flow

FTP 20.0.0.1 likhne se : FTP tool active ho jayega . Phir mai likhunga Put Ash.jpg . Put ye Command ko Pehle se Pata hota hai device ke harddrive mai Ash.jpg File kaha store hai.

Uthakar direct wire Par dalega ? nahi koi ek software is File ke tukde karega . Koi ek software usko mark karega . Koi ek software uspar CRC code lagayega . koi ek software niche ki technology ko laat marke bolega leja aur deliver karke aa . 1st tukda data kiske saath bahot saare header lagayega . lagenge Source IP 10.0.0.1 , Destination IP 20.0.0.1 , Source MAC AAA , Destination MAC Router ka lagayega RRR . Ab jaise ye frame wire Par jayega electrical signal mai convert ho jayega mere is layer 3 switch & ke port no.1 ke SRAM yani Data Plane mai cake store ho jayega . L2 software aayega L2 information kholega aur puchega kaha se aya hai ye bolega AAA Apne MAC ke Pass jayega entry hai toh refresh karega phir data plane cake puchega kaha jana hai ye bolega RRR . Phir control plane mai jayega dekhega RRR mai he hu . L2 software L2 information Uthakar side mai rakh dega . Ab L3 data plane layer par jayega aur puchega kaha jana hai ye bolega 20.0.0.1 . Toh wapas control plane ke Software routing table ke Pass jayega aur dekhega kya hum 20.0.0.1 ko Pohoch sakte hai ? Toh bolega ha hamare ye Port 2 usike saath connect hai . Ab control plane wala software

jayega Port 1 se Packet utakar Port 2 par rakh dega kyuki hamne Padha hai For end to end IP traceability source IP aur Destination IP change nahi hota. smac & dmac change hota hai. Toh Packet cage bhejne se Pehle jo mera ye layer 3 switch hai wo smac khud ka lagayega RRR aur destination MAC likhne se pehle ARP table ke pass jayega aur 20.0.0.0 network ka MAC puchga malum hai to very good nahi malum toh ARP broadcast korega learn kerke ~~change change~~ phir likh dega BBB phir Frame Forward kar dega. Is Prakar se Packet Flow hota hai. ye technic cai se 20-30 years Pehle use kiya Jata tha. Isi ko ham Process switching kہتا hai. ye ek traditional ~~for~~ Forwarding method hai [64 kb Bandwidth ke time use karte they].

Process switching Forwarding ko bahot slow kar deta hai. isiliye aiske time use nahi kiya jata.

Aiske time mai Packet ka Fast Forwarding hona bahot jaruri hai. Isiliye Cisco ne 1 naya mechanism banaya

1. CEF (Cisco Express Forwarding) CEF kehta hai whatever information required from Control plane download & store in Data plane in the form of Forwarding table (FTB) & Adjacency table (Adjacency CEF Forwarding ko 300x Fast kar diya)

Router aur switches mai MAC aur Routing table jaise kuch nahi hota. Router aur switches mai CAM & TCAM table hota hai.

Jab koi bhi Frame device ke Pass aata hai usme 48 bits ka MAC Address hota hai. ye MAC router ya switch ko bhi Samjana hoga. ye log CPU ki Madat se read karte hai.

Suppose CPU 16 bit ka hai toh 3 CPU cycle lagega. MAC ko read karne ke liye Toh ye 1 MAC hai toh thik hai but jyada MAC honge toh slow ho jayega. Isko fast karne ke liye CAM aur TCAM table use kiya jata hai. Iske andar 48 bit ka MAC nahi hota usse 16 bit mai convert kiya jata hai. 16 mai Fingerprint mai yani # value mai convert kiya jata hai. Toh ab 1 MAC ke liye sirf 1 CPU cycle lagega toh Forwarding Fast ho jayega. This is Power of CAM & TCAM table.



* Data Plane

- It is also called Forwarding Plane.
- It is responsible for high speed Forwarding of data through network device.
- For high speed Packet Forwarding Control Plane creates multiple data structure (Table) in data plane.
- Data plane has table like Content Access memory (CAM) Table, Ternary CAM (TCAM) table, Forwarding information Base (FIB) Table & Adjacency table.
- ACTS are also process in Data Plane (ASIC) to control flow of data packet.
- Data Plane Forwarding is implemented to specialized hardware Application specific Integrated Circuit (ASIC), Field programmable gate arrays (FPGAs) or Specialized Network processors (NPs). Each perform a particular operation in a highly efficient way. Data compression / decompression, computing checksums & MAC based Forwarding is performed in ASIC.

* Control Plane

COPP control plane ko chack hone se bachata hai.

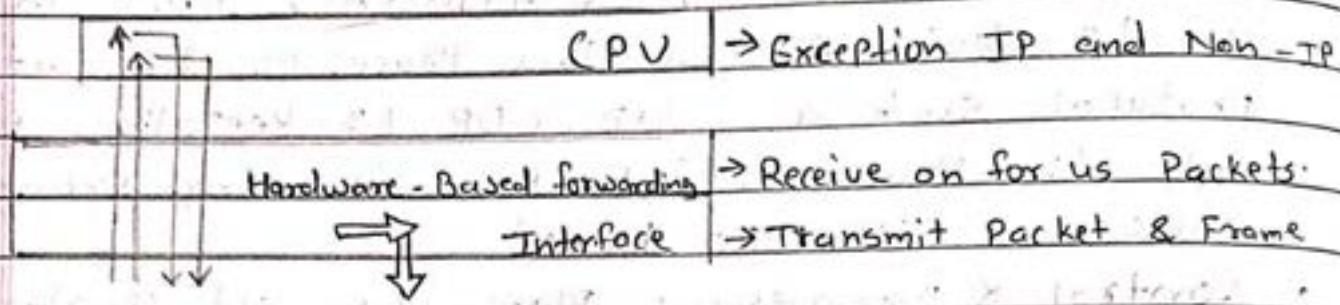
- Control function such as Forwarding decision are taken in Control Plane.
- Control Plane has protocols that exchange control information with neighbour to create best Forwarding Path.

- In L3 devices Control Plane creates RIB which in-turn helps FIB & Adjacency table in data plane
- In L2 device Control Plane processes L2 control protocol such as STP, CDP, L2 keepalives, etc.
- It also processes info from incoming Frame (source MAC to fill MAC table)
- Control & Management planes can get overloaded affecting CPU utilization, Cisco devices have Features like COPP (Control Plane Policing) to prevent choking of Control Plane.
- Control Plane processes the traffic that is destined to the device itself and is directly handled by device Processor, hence traffic forwarded by the Control Plane is said to be process switched.
E.g. 1] Control Packet exchange by routing protocols
2] Packet with TTL value less than or equal to one needs TTL exceed message to be sent will required CPU processing & hence will be process switched.

* Management Plane

- Management Function such as Configuration, Monitoring are achieved.
- It offers ~~interactive~~ interactive configuration session in addition helps manage a device through its Connection to the network.
- It is associated with management traffic of the network or the device itself.
- It uses SSH, HTTP, HTTPS, NTP, FTP, TFTP to manage the device & Network.

* Functional plane : Packet Types



: From the perspective of network device there are 3 general types of packets related to the Functional Planes :

Transit Packet & Frames :- Require IP & MAC based Forwarding & Typically Forwarded with minimum CPU or in Asia in data plane.

Receive , or For us Packet :- Control & management packets destined for the device itself & handed by the device Processor in control Plane & Forwarded to the Application process running on the device.

Exception IP & Non-IP :- IPv4 Packet with unreachable destination , Packet with TTL that expires , IPv4 Packet with option Field , L2 keepalives , ARP Frames , CDP Frames etc. comes in this category & must be handled by the device processor in control plane .

* SDN - Software Define Network

Software define network is a separation of control plane & Data Plane.

SDN mai har device ka control Plane alag kar diya jata hai aur usse common platform par lakin rakh diya jata hai. common platform ko ham controller kehte hai. controller sare device ke ~~base~~ sare brain mai ko Jagah se control karta hai. Cisco ne isko naam diya SD-WAN. SD-WAN ka 1 controller. kitne bhi controller honge unhe manage karne hai ka 1 he engine hoga NMS (Network Management System)

WAN ke router ko vedge \rightarrow Edge \rightarrow WAN-Edge kaha jata hai.

Controller ka old name vSmart tha. NMS ka pura naam ~~vManage~~ \rightarrow Manager tha ~~vManage~~

SDN - LAN

LAN mai chalne wale SDN ko SD-Access kehte hai. LAN mai use hone wala controller ko Dnac kehte hai. (Dna center)

Data center Par chalne wale vision ko ACI aur controller ka Naam hai APIC. LAN aur Data center mai controller he manger hai.

★ SDN logical structure

- In SDN the management & control plane are abstracted into a ~~controller~~ layer.
- External specialized controller provides orchestration of the control & management function.
- Infrastructure layer devices such as switches & routers focus on forwarding data.
- Application layer has SDN application, that sends network requirements towards the controller.