Ch-3. Networking and Internetworking

The networks used in distributed systems are built from a variety of transmission media, including wire, cable, fibre and wireless channels; hardware devices, including routers, switches, bridges, hubs, repeaters and network interfaces; and software components, including protocol stacks, communication handlers and drivers. The resulting functionality and performance available to distributed system and application programs is affected by all of these. We shall refer to the collection of hardware and software components that provide the communication facilities for a distributed system as a communication subsystem. The computers and other devices that use the network for communication purposes are referred to as hosts. The term node is used to refer to any computer or switching device attached to a network.

Networking issues for distributed systems:-

1) performance
2) Scalability
3) Reliability
4) security
5) Mobility
6) Quality of service
7) Multicasting

Q. If block C contains 32 IP addresses which of the following is first address of the block?

(a) 10.0.0.5
(b) 10.0.0.16
(c) 10.0.0.9
(d) 10.0.0.15
(e) 10.0.0.32
(f) 10.0.0.160
(g) None of the

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Types of network :-

1) Personal area networks (PANs)
2) Local area networks (LANs)
3) Wide area networks (WANs)
4) Metropolitan area networks (MANs)
5) Wireless Local area networks (WLANs)
6) Wireless wide area networks (WWANs)
7) Wireless Metropolitan area network (WMANs)
8) Internetworks

N/w performance mapping table

	Example	Range	Bandwidth (mbps)	Latency (ms)
wired :				
LAN	Ethernet	1-2 kms	10-10,000	1-10
WAN	IP routing	worldwide	0.010-600	100-500
MAN	ATM	2-50 kms	1-600	10
Internetwork	Internet	worldwide	0.5-600	100-500
wireless :				
WPAN	Bluetooth (IEEE 802.15.1)	10-30m	0.5-2	5-20
WLAN	Wifi (IEEE 802.11)	0.15-1.5km	11-108	5-20
WMAN	WiMAX (IEEE 802.16)	5-50 km	1.5-20	5-20
WWAN	3G phone	cell: 1→5 km	348-14.4	150-500

Q. If block having 64 IP address then ~~address~~ which one of the following will be

~~(a)~~ 20.0.0.64 ~~(d)~~ 20.0.0.128
(b) 20.0.0.17 (e) 20.0.0.32
(c) 20.0.0.47

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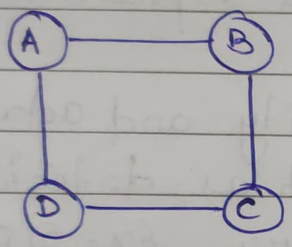
Network principles

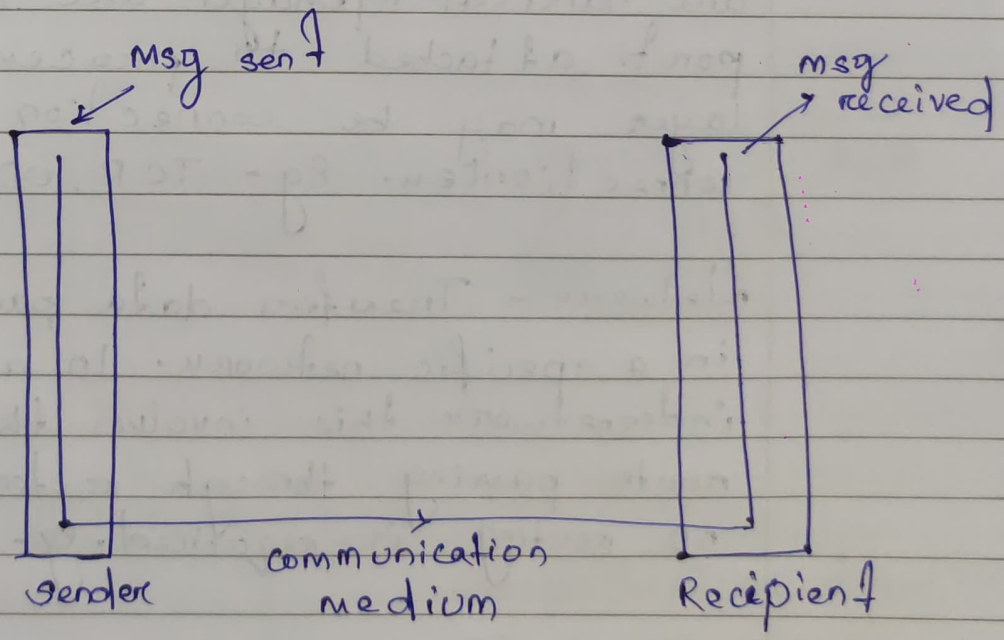
- packet transmission
  - Data streaming
  - switching schemes
    - Broadcast
    - circuit switching
    - packet switching
- Protocols
  - protocol layers
- Routing
  - Routing algo
    - LSR
    - DVR
- congestion control and Internet-working



	A	B	C	D
A		1		1
B	1		1	
C		1		1
D	1		1	

Layers in OSI model (Open system interconnection)

Layers
- Application
- presentation
- Session
- Transport
- Network
- Data link
- Physical



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Application – Protocols at this level are designed to meet the communication requirements of specific applications, often defining the interface to a service. Ex - HTTP, FTP, SMTP, CORBA IIOP

Presentation - Protocols at this level transmit data in a network representation that is independent of the representation used in individual computers, which may differ. Encryption is also performed in this layer, if required.
Ex- TLS security, CORBA data representation

Session - At this level reliability and adaptation measures are performed, such as detection of failures and automatic recovery. Ex - SIP.

Transport - This is the lowest level at which messages are handled. Messages are addressed to communication ports attached to processes. Protocols in this layer may be connection oriented or connectionless. Eg - TCP, UDP.

Network - Transfers data packets between computers in a specific network. In a WAN or an internetwork this involves the generation of a route passing through routers. In a single LAN no routing is required. Eg - IP, ATM virtual circuits.

~~Application~~

Data link - Responsible for transmission of packets between nodes that are directly connected by a physical link. In a WAN transmission is between pairs of routers or between routers and hosts. In a LAN it is between any pair of hosts.
Eg- Ethernet MAC, ATM cell transfer, PPP

Physical - The circuits and hardware that drive the network. It transmits sequences of binary data by analogue signalling, using amplitude or frequency modulation of electrical signals, light signals or other electromagnetic signals.
Eg- Ethernet base band signalling, ISDN

~~Transport~~

IP address

class A	8 NID	24 HID	$2^{24}-2$
class B	16	16	
class C	24	8	
Class D			
class E			

0-127
128-191
~~192~~ 192-223
224-239
~~240~~ 240-255

TCP/IP layers

Layers	Message
Application	messages (UDP) or stream (TCP)
Transport	UDP or TCP packets
Internet	IP datagrams
Network interface	network specific frames.
underlying network	

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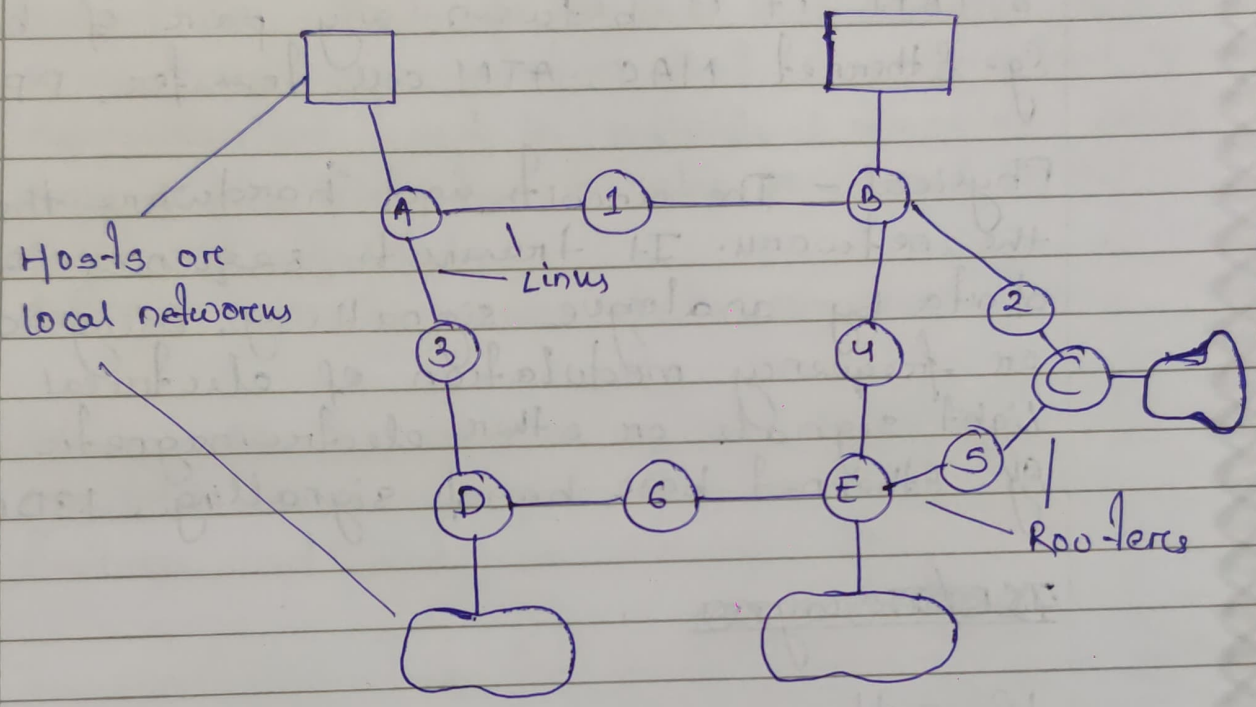
Routing algo :-

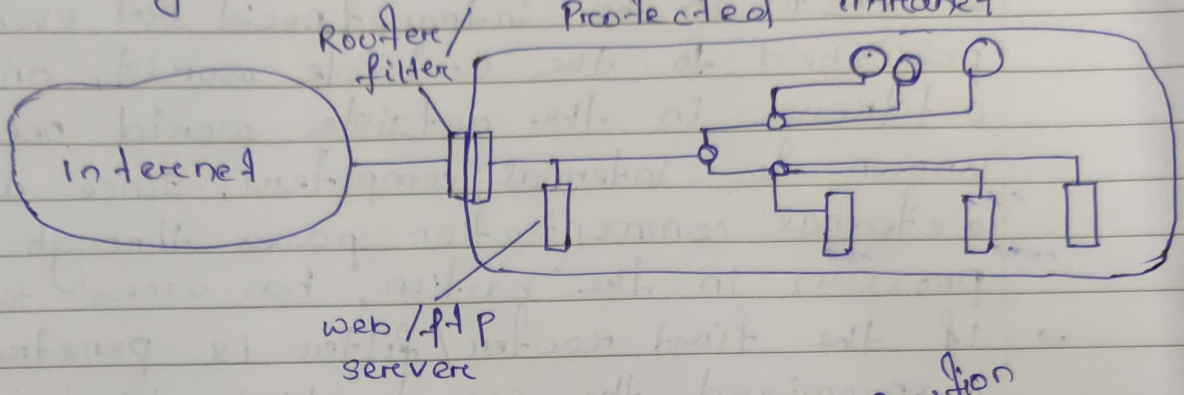
for packet transfer
- DVR
- LSR



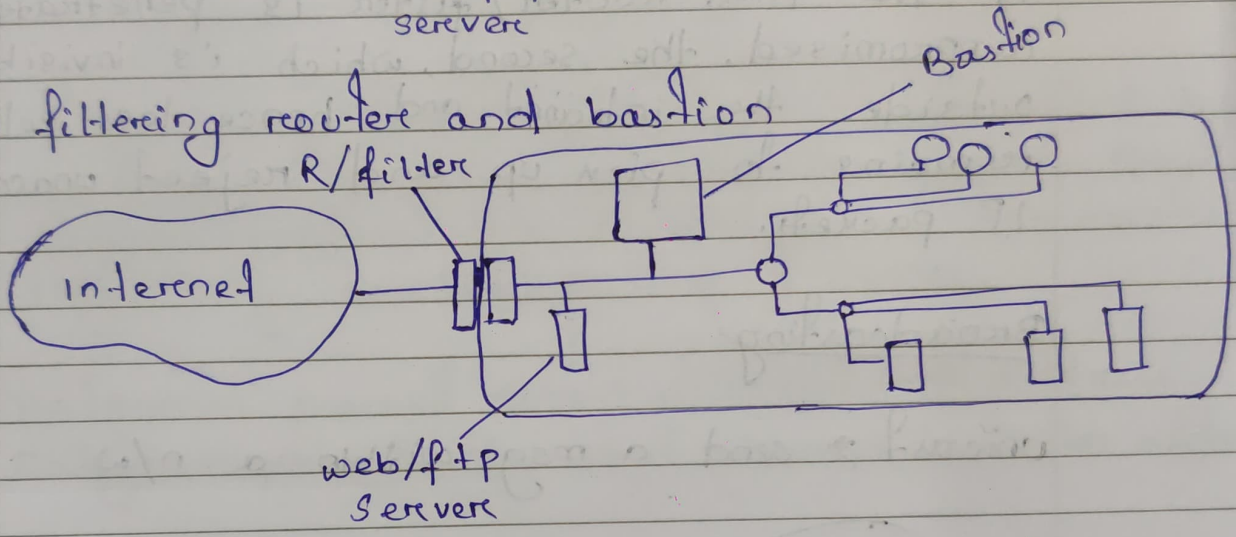
IPV6 header

version (4 bits)	Traffic class (8 bits)	flow label (20 bits)	
payload length (16 bits)		Next header (8 bits)	Hop limit (8 bits)
Source address (128 bits)			
Destination address (128 bits)			

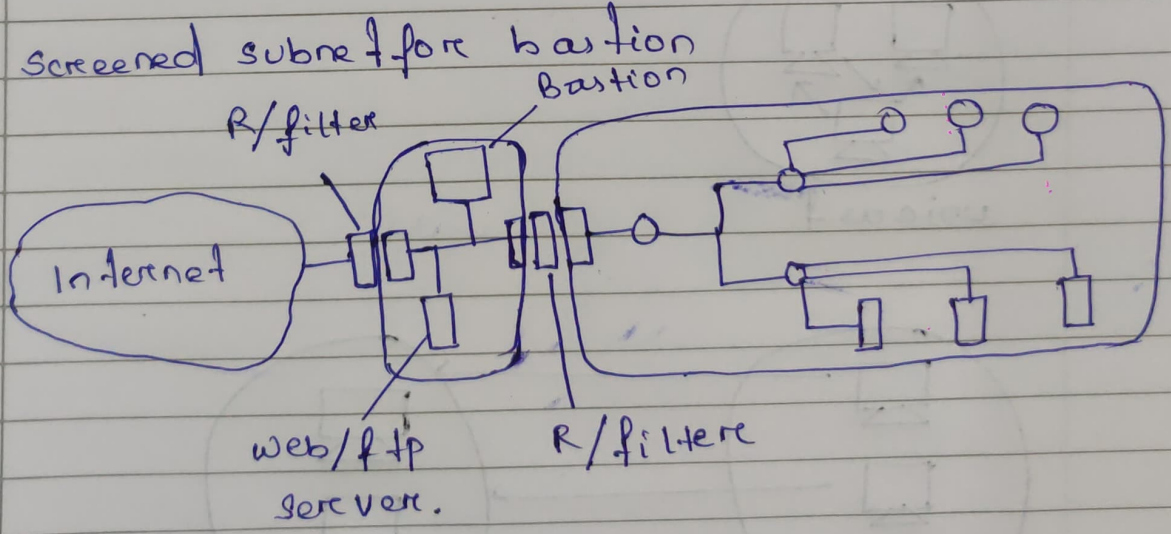
(a) filtering routers



(b) filtering routers and bastion



(c) Screened subnet for bastion

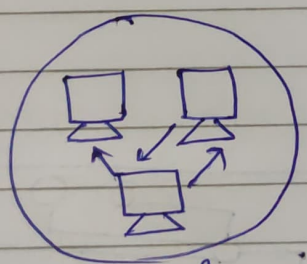


→ If the bastion policy is strict, the IP addresses of hosts in the intranet need not even be published to the outside world, and the addresses in the outside world need not be known to internal computers, since all external communication passes through proxy processes in the bastion, has access to both.

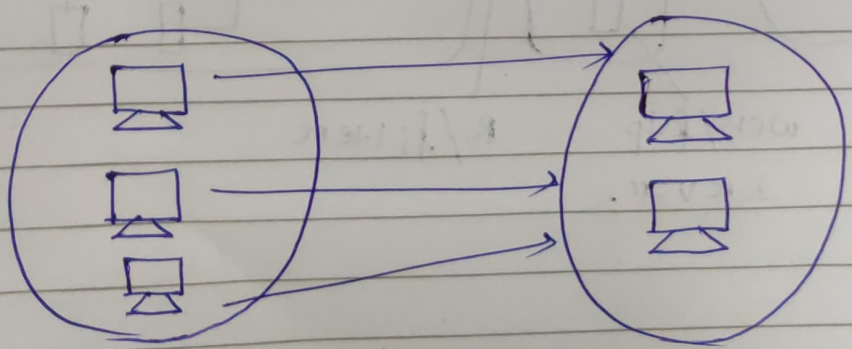
→ If the first router/filter is penetrated or compromised, the second, which is invisible from outside the intranet and hence less vulnerable, remains to pick up and reject unacceptable IP packets.

Broadcasting

unicast → send a msg within a n/w



unicast



Multicast

when one n/w sends the info onto another n/w.

Q. 197.32.0.25

unicast → 197.32.0.0
broadcast → 197.32.0.255

Packet delivery

I) Datagram packet delivery

→ In this, a sequence of packets transmitted by a single host to a single destination may follow different routes and when this occurs they may arrive out of sequence.

Datagram packet size = full network address
Datagram packet size = Host address + Destination address.