Broadcasting over Internet

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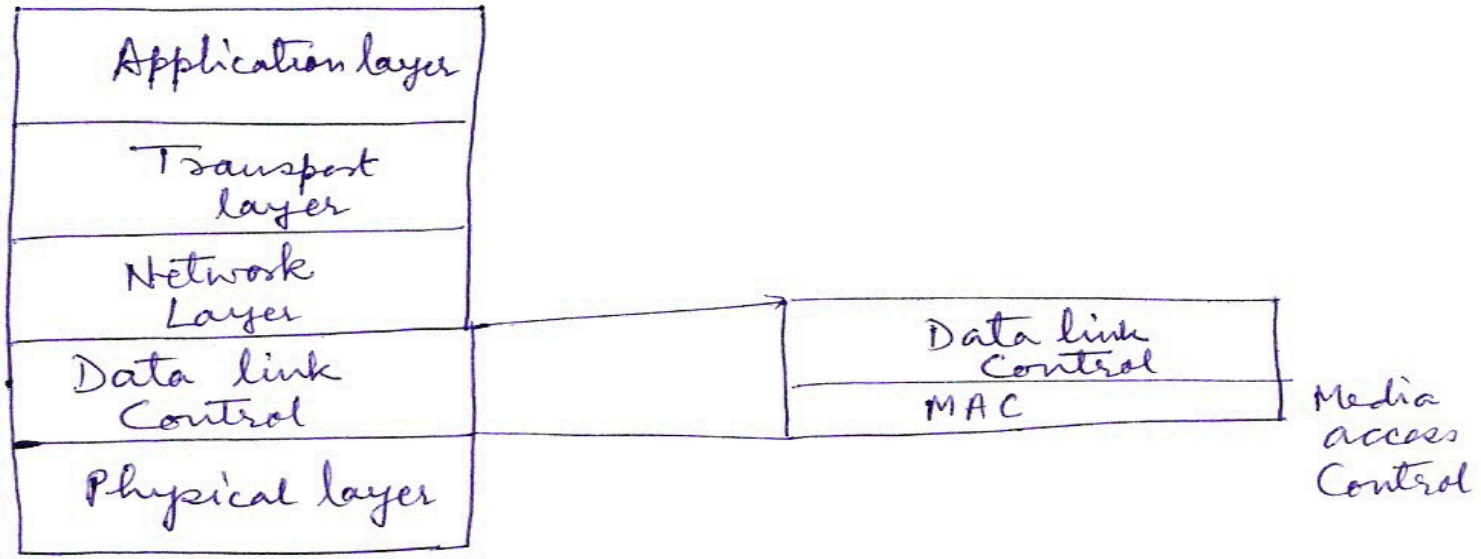
Network structure

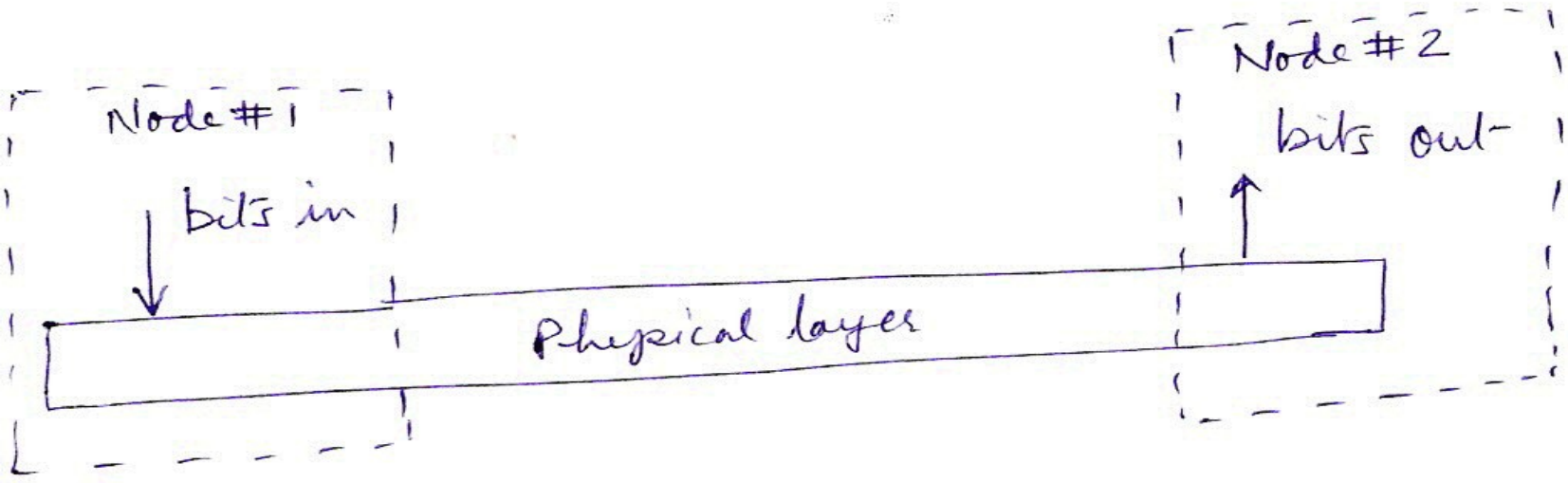
- Layered structure for simplicity and manageability
  - Physical layer
  - Data Link Layer
  - Network Layer
  - Transport Layer
  - Application layer



Layered structure of Internet

Physical layer

- Physical communication medium
  - Radio (wireless), Coaxial cable, Twisted cable – shielded, unshielded, Satellite, Optical fiber
- Transmitter and receiver system



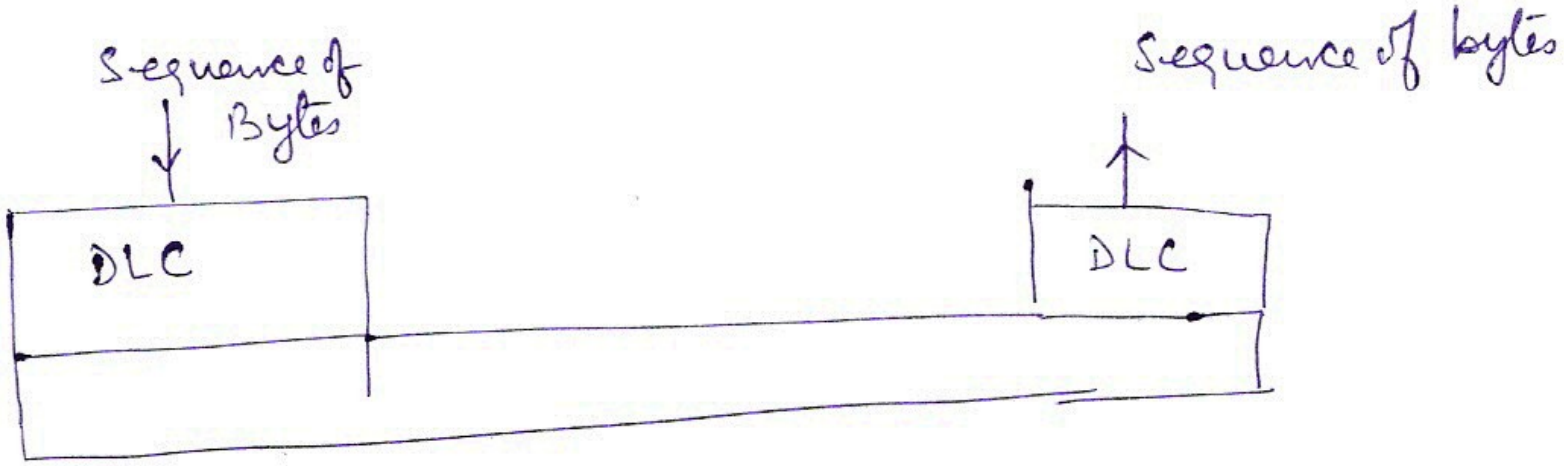
Physical Layer

Physical layer (contd.)

- Channel coding
- Modulation and Demodulation
- Bit clock recovery
- Bits in – bits out

Data link control layer

- Reliable transport over physical connection between two nodes.
- Framing
  - Identification of beginning and end
  - Byte clock recovery
  - Recovery of series of bytes
- Reliable transfer



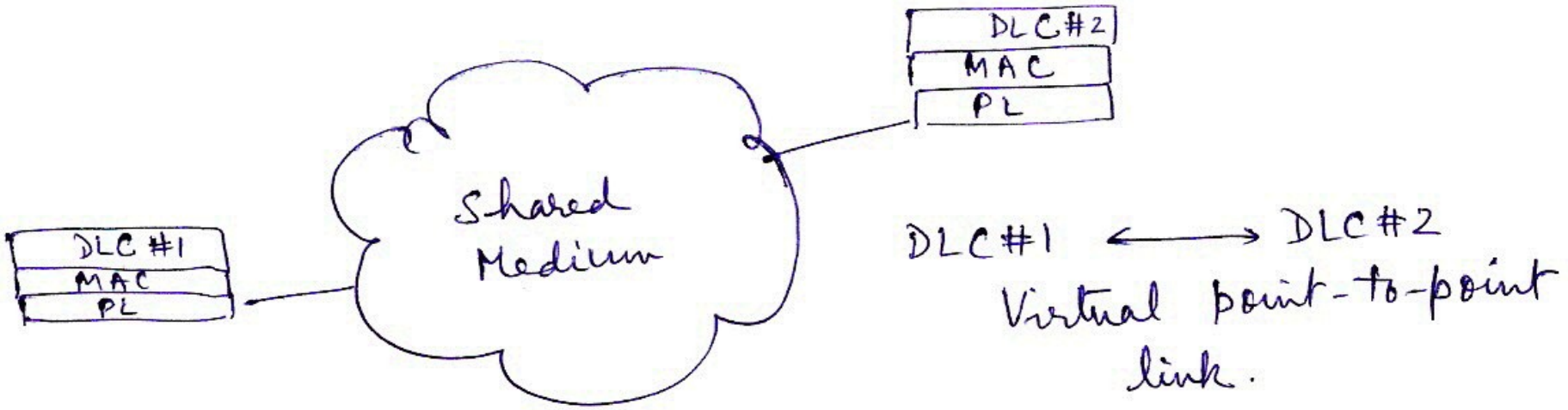
Data link Control

Data link control layer

- Flow control
  - Transmitter and receiver may have different MHz CPUs, different buffer space
- HDLC, IEEE 802.2

MAC layer

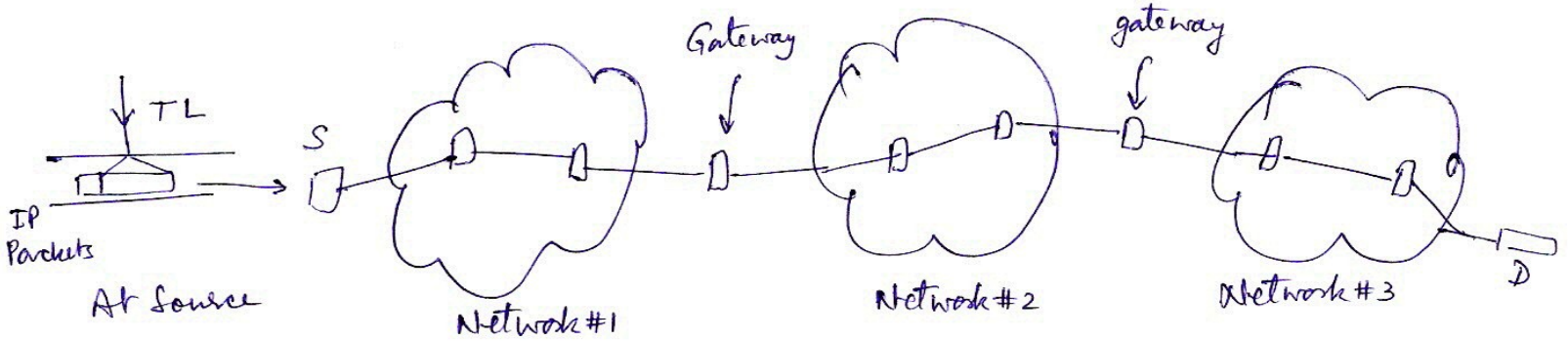
- Sublayer of DLC
- Asynchronous
  - IEEE 802.3, 802.11b
- Synchronous
  - E1, 802.16



Medium Access Control

Internet?

- Information received from transport layer put in packets.
- The packets are routed from source to destination
- Destination handsover the packets to transport layer



At Gateways — only IP should be used.

Internet? (contd.)

- Internet protocol (IP) – language to be used when talking to other networks.
- Within network – network operator can choose any protocol of choice at network layer.
- IP takes care of interoperability issue.

Network layer

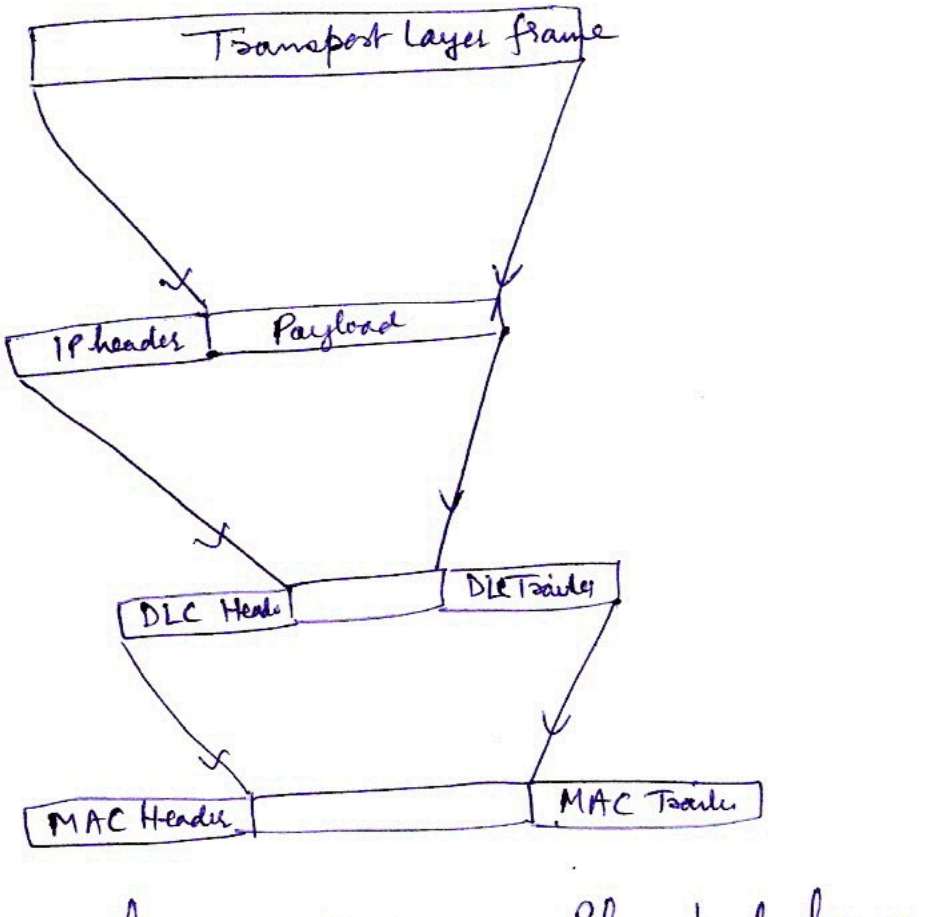
- Network layer is packet switched
- Statistical multiplexing gain
- More efficient use of resources
- IP (internet protocol) – key entity at this layer – for internetworking
- A network under single administration – can have any network layer protocol of its own choice.

Network layer (contd.)

- When talking to any other network – need to comply with IP (internetworking protocol).
  - Address maps
  - Protocol conversion
- Mostly, for inside network use – IP adapted.

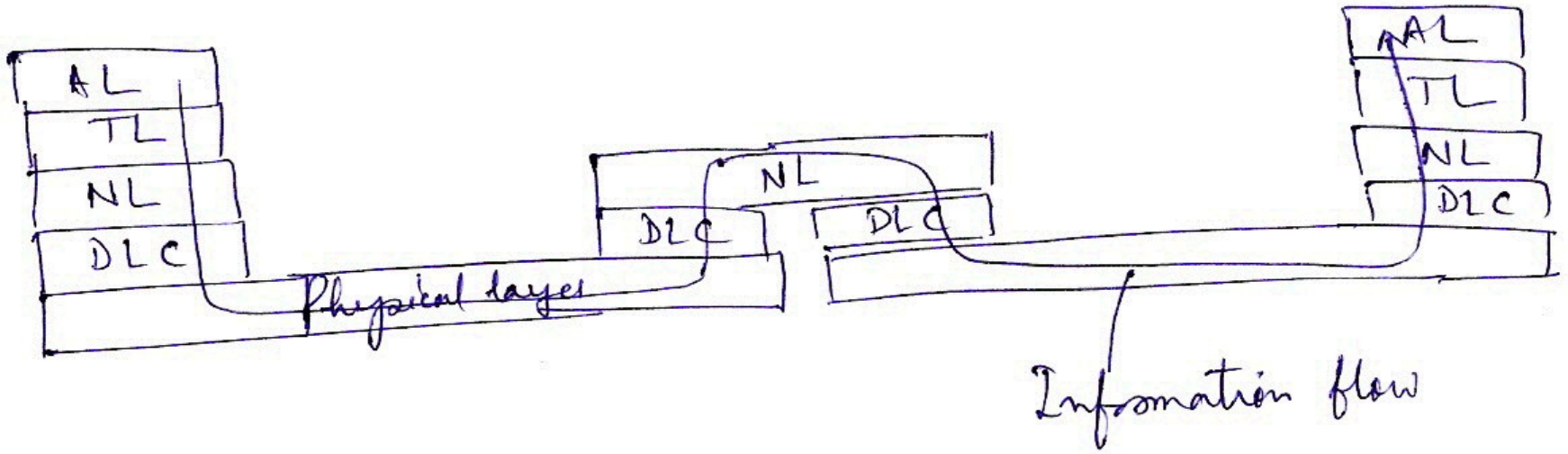
What network layer does?

- Packet received from transport layer, from DLC for various communication interfaces
- Each packet has header, payload.
- Header is analysed



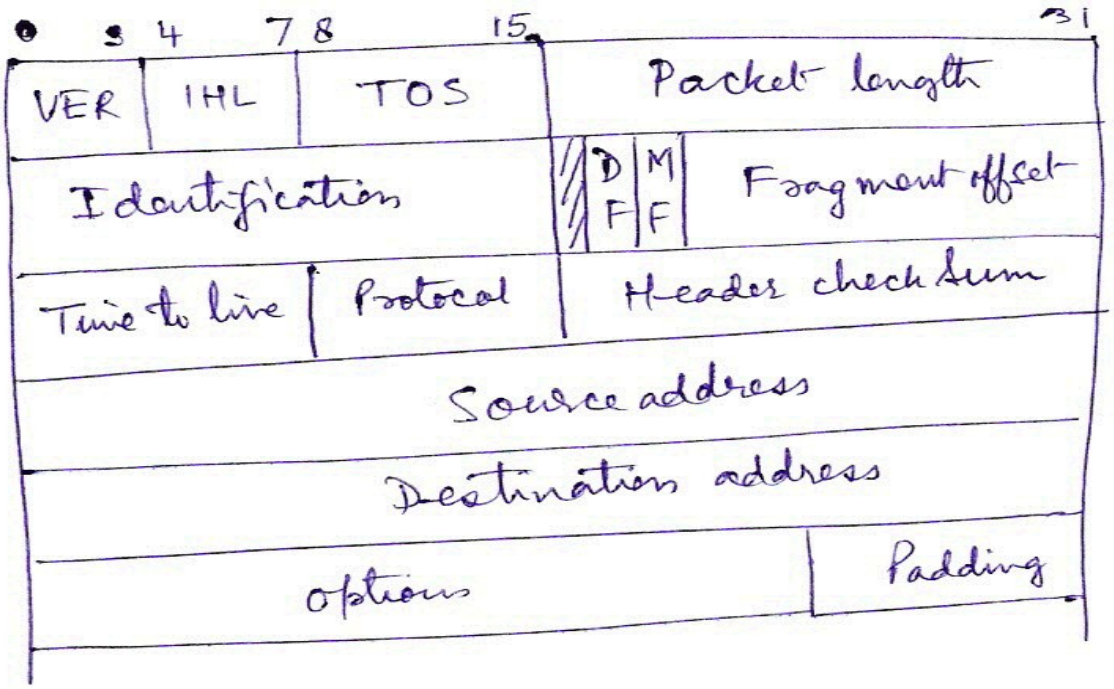
Network layer (contd.)

- Destination address from header
  - Search routing table for possible network address entries to whom packet can be send
  - Determine the entry with most specific match
  - Make the appropriate changes in header as required.
  - Send the packet to DLC corresponding to interface for identified next hop.



Network layer (contd.)

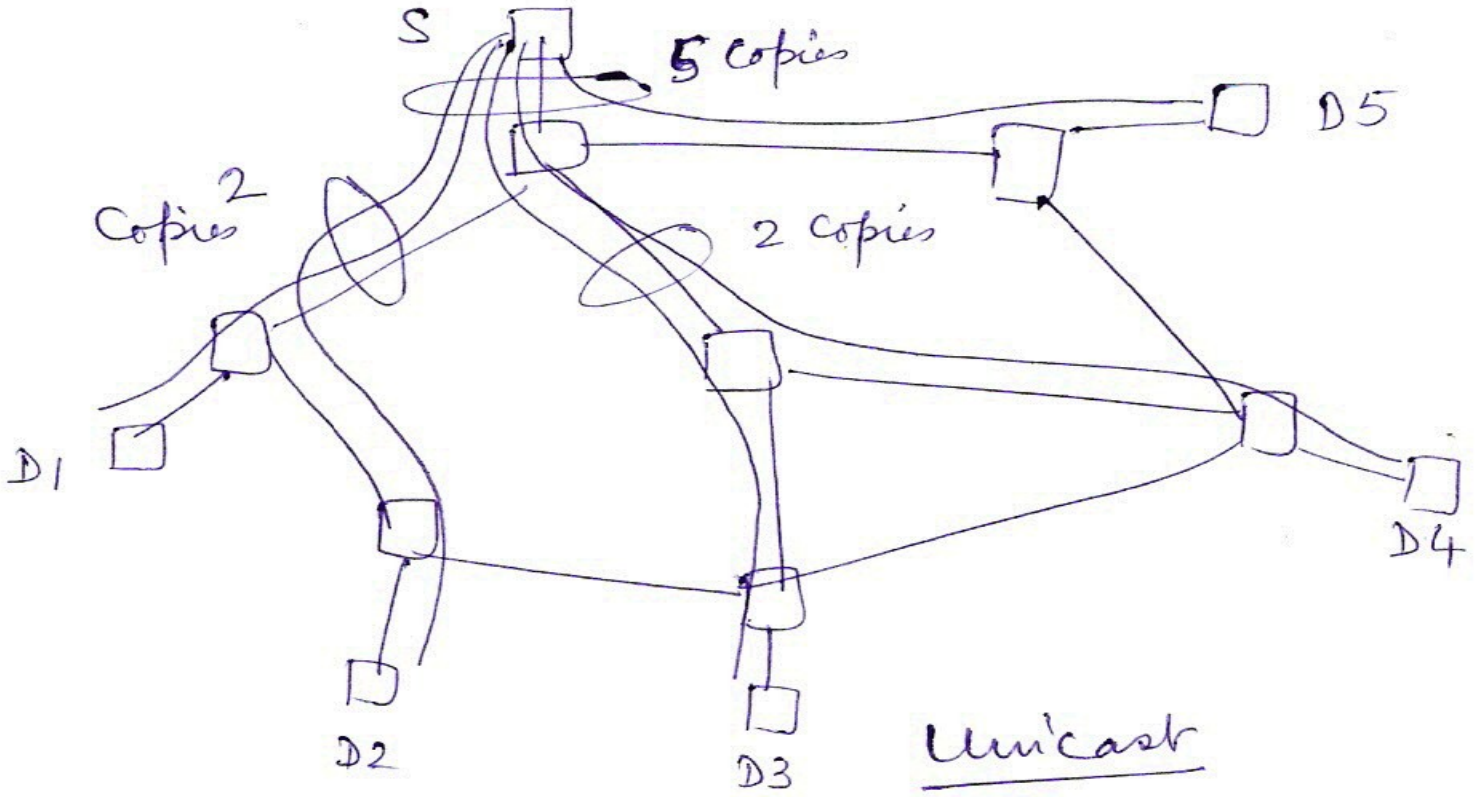
- Destination address – local machine itself
  - Read protocol field in IP header
  - Take payload and put it in buffer for identified protocol
  - Protocol – OSPF, RIP, ICMP, TCP, UDP
  - All the above used for unicast communication.

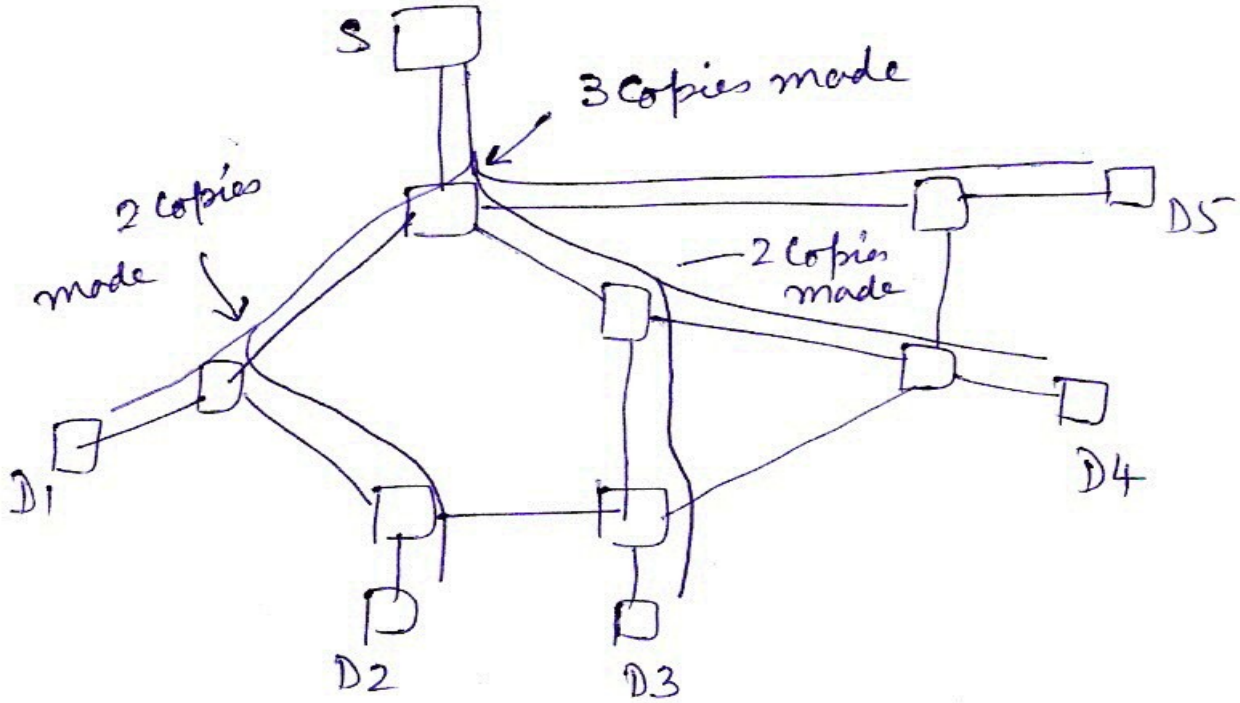

0
3 4
7 8
15
31
VER
IHL
TOS
Packet length
Identification
D F
M F
Fragment offset
Time to live
Protocol
Header checksum
Source address
Destination address
Options
Padding

IP header

Multicast communication

- Single transmitter – many receivers (not everyone on the network)
- 1000 receiver, sending 1000 copies separately – not efficient
- Routers – should make copies of the packet as required while forwarding

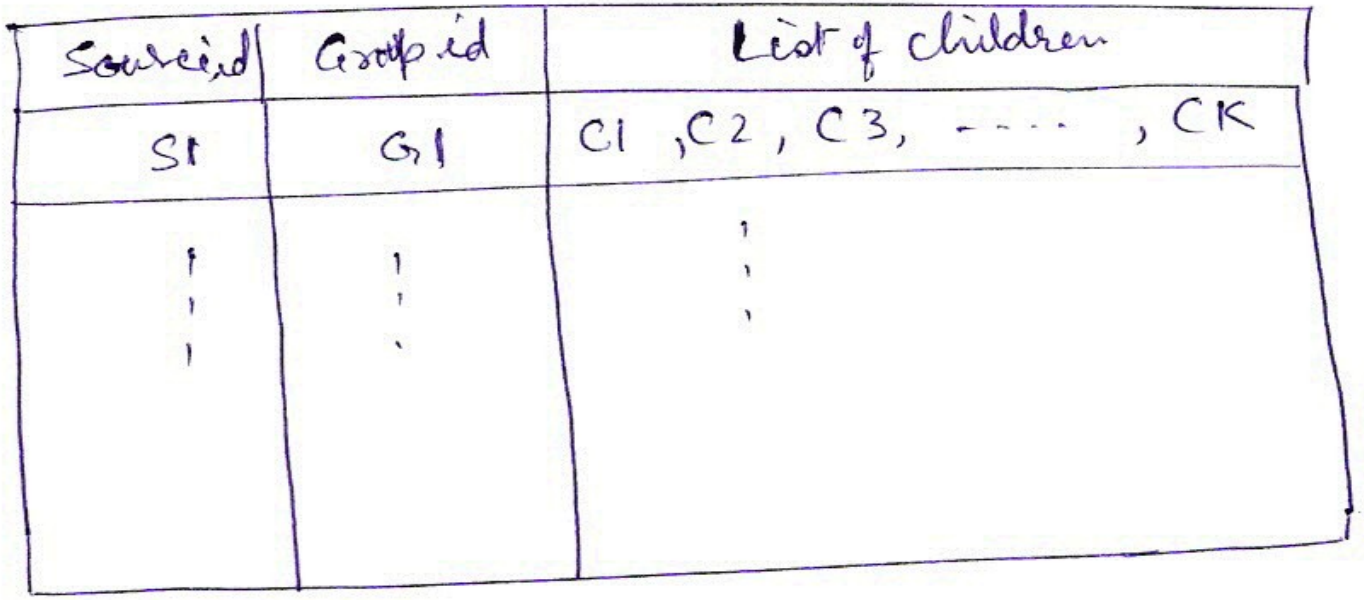




Multicast

Multicast (contd.)

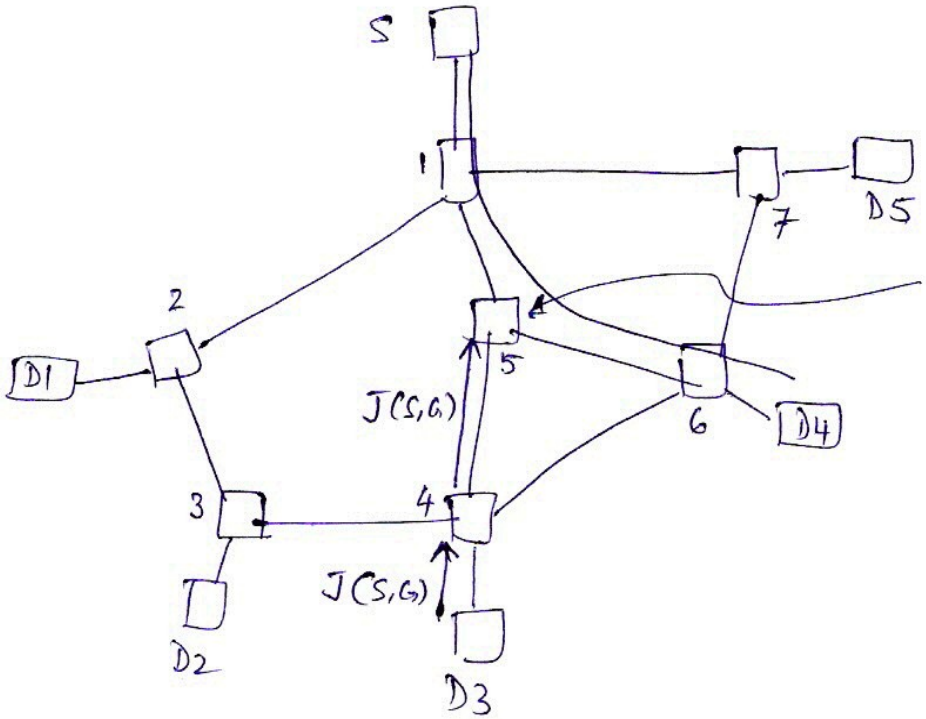
- how the destination address specified?
- We can specify, group address.
- Each router maintains the group membership information
  - Which all neighbors – members of a specific group.



Multicast forwarding table.

Television broadcast over internet

- Not a broadcast but multicast
- User need to know source IP address and Group address (S,G)
- It should ask nearest router – for (S,G) join.
  - Nearest router – designated router on LAN
    - LAN connected through more than one router gateways – one of them acts as designated router



Already has 6 as next child
Adds 4 also as child

- IP router part in DSLAM rack (for ADSL users)
- Gateway router in cable network

- Router creates entry in a table (multicast forwarding table)
  - about source address, group address, and which network sent subscription to group
- Router looks into routing table to find next router in direction of source.

- Sends join(S,G) request to next router.
- Join(S,G) propagates till
  - It reaches a router who had already sent a join(S,G)
  - Or it reaches source S.
- In both cases, the router/source makes an entry about who sent the join request.

- This mechanism leads to formation of (S,G) tree rooted as source S.
- When a multicast packet is received
  - Router checks if it is received from router lying in shortest path to source
  - If no, packet is discarded. There is some incorrect entry in routing table or multicast forwarding table.

- If yes, the router looks into multicast forwarding table
  - Makes those many copies as the number of joins received.
  - Forwards each copy to each of the routers subscribing to (S,G)
- Routers keep on making copies while forwarding
- This is source specific multicast (SSM)

- Basic mechanism for broadcasting over internet
- What problems are there?
  - One have to use UDP (universal datagram protocol)
  - TCP cannot be used – it is for point to point communication.
  - Reliable multicast.
    - For multicast whiteboard, chat system.

- Audio-video
  - does not require reliable transport
  - need timely delivery
- QoS (quality of service) support – needed
- Anybody can join the (S,G) and view the transmission.
  - How to implement pay-channel?

- UDP – no congestion control
  - TCP pushed out – TCP has congestion control mechanism.
  - Multicast congestion control system.
- With large number of transmissions
  - Routers need to keep large number of entries – one each for each (S,G)