Network Layer – Service Model
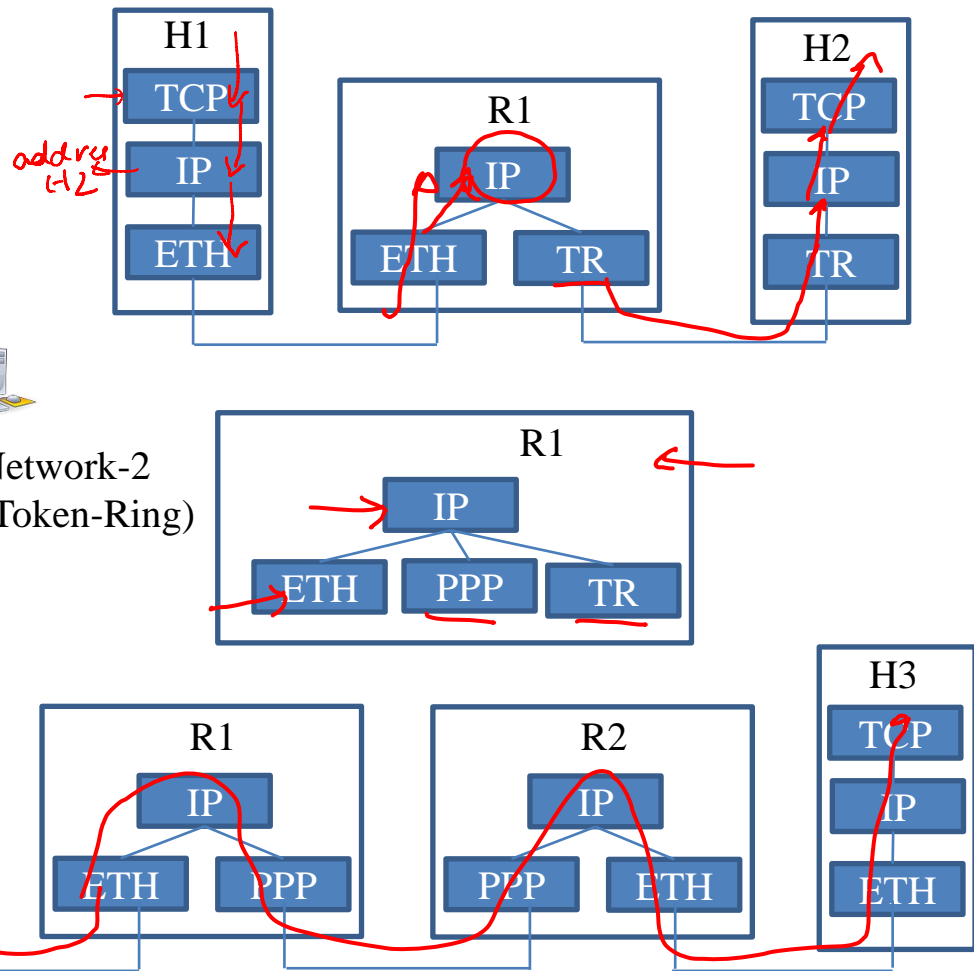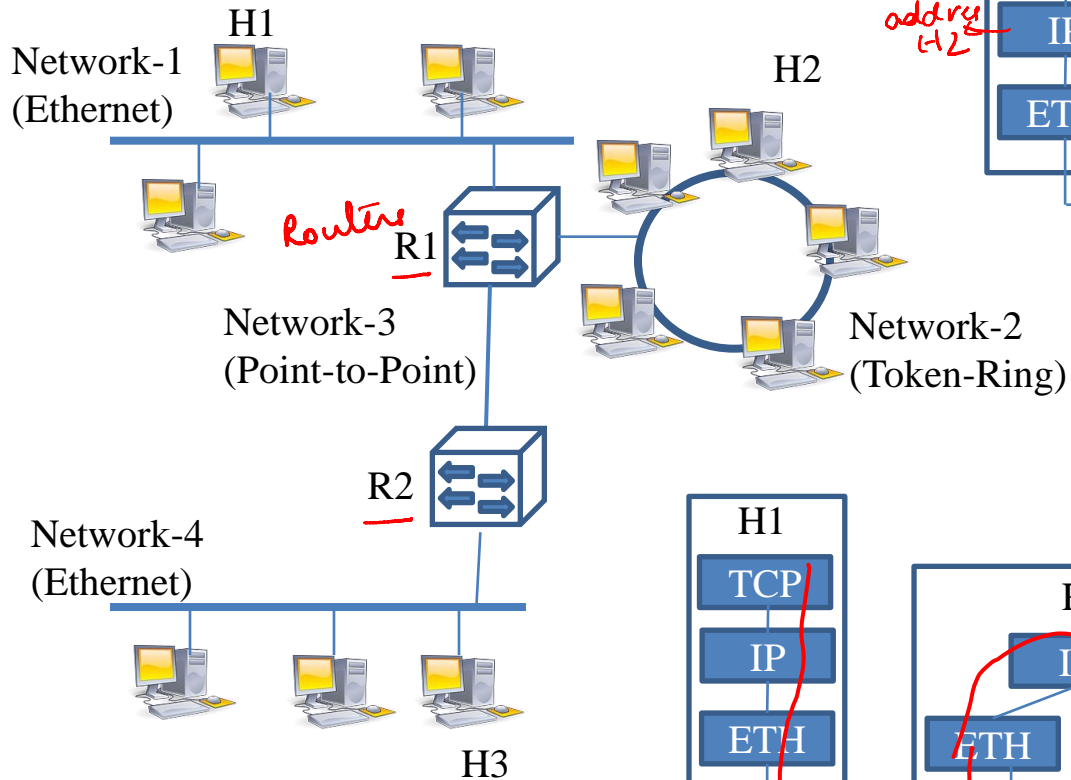
Kameswari Chebrolu

Recap

- Build reasonably sized networks spanning thousands of hosts via Extended LANs

- Drawbacks:

  - Not scalable

  - Can't handle heterogeneity

- Network Layer switching to the rescue

Problem Statement

- Make millions of hosts using different technology communicate

  48 , 16

  – Heterogeneity: Addressing conventions, bandwidth, latency, loss rates, packet sizes

- Solution: Internet Protocol (IP)

  Internet

  – Internet: **Inter**connect **Net**works

  – Invented by Robert Kahn and Vint Cerf

Network-1
(Ethernet)

H1

Network-3
(Point-to-Point)

Router
R1

R2

Network-4
(Ethernet)

H3

H2

Network-2
(Token-Ring)

H1

TCP

addry
(-12

IP

ETH

R1

IP

ETH   TR

H2

TCP

IP

TR

R1

IP

ETH   PPP   TR

H1

TCP

IP

ETH

R1

IP

ETH   PPP

R2

IP

PPP   ETH

H3

TCP

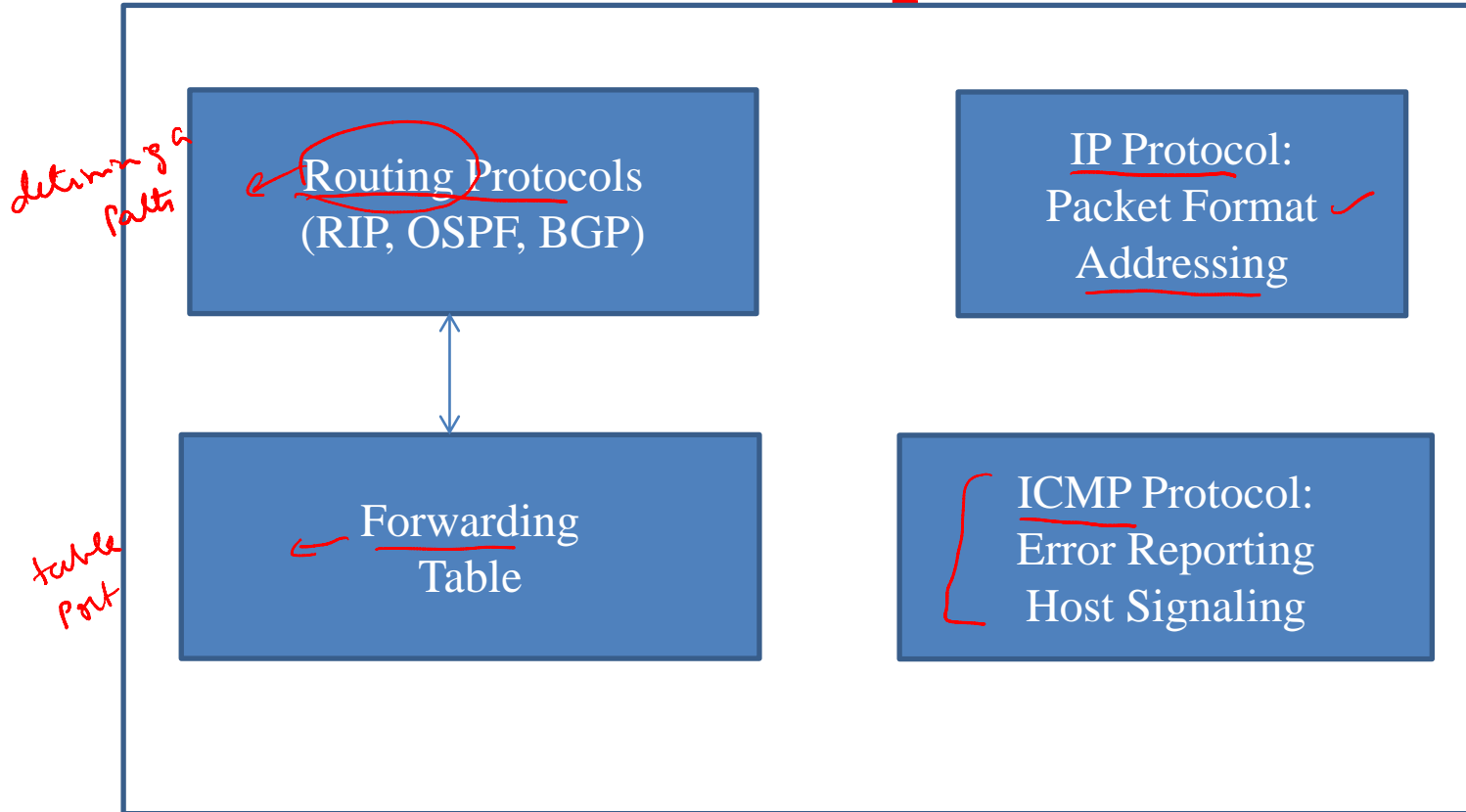IP

ETH

Service Model

- What service can the network layer offer?

  – Deliver given packets to specified destination

- Delivery options (over packet switching)

  – Guaranteed delivery

  – Bounded delay   *x seconds*

  – Guaranteed minimum bandwidth

  – Guaranteed maximum jitter   → *intergap adjacent packets*

  – In-order delivery

  – Duplicate suppression

Datagram Delivery Model

- Datagram: No connection set-up

- Best Effort Service

  – Will make best effort to deliver the packet

    • Packets can get lost, corrupted, reordered, mis-delivered, duplicated, delayed

  – KISS principle in practice (Simplest service)

  – IP protocol's greatest strength
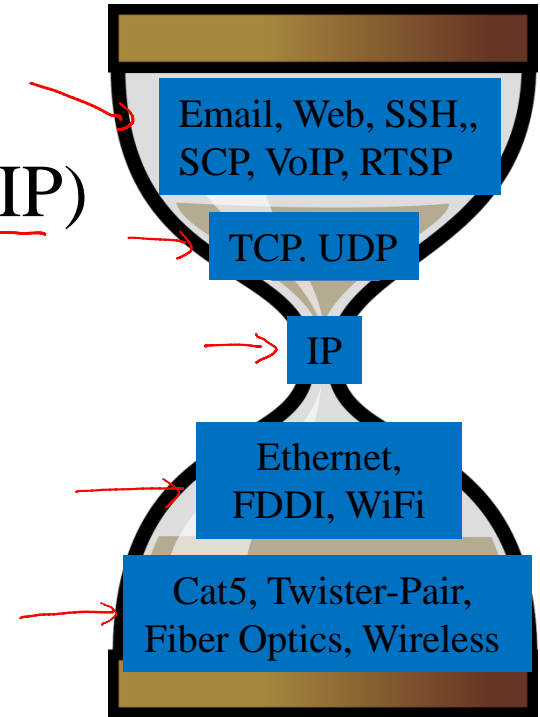
    • Runs over anything

(handwritten annotations: IP; Many different technologies; 20 ms; bounded delay*)*

Service Model Implementation

Routing Protocols
(RIP, OSPF, BGP)

defining a Path

Forwarding
Table

table Port

IP Protocol:
Packet Format
Addressing

ICMP Protocol:
Error Reporting
Host Signaling

Points to Note

- Heterogeneity
  - Move a layer above: Network Layer (IP)
  - Best effort service model

- Scalability
  - Hierarchical addressing
  - Efficient Routing algorithms

- Internet Architecture: Hour Glass

Email, Web, SSH,, SCP, VoIP, RTSP

TCP. UDP

IP

Ethernet, FDDI, WiFi

Cat5, Twister-Pair, Fiber Optics, Wireless

Summary

- Objective: Interconnect heterogeneous networks in a scalable fashion

- Service Model: Best Effort Delivery

- Functionality: IP protocol (packet format, addressing), forwarding, routing

- Ahead: Implementation inside a router