Module 4
(Lecture – 1)

(Network Layer: Router architecture; Internet Protocol (IP) - Forwarding and Addressing in the Internet; Routing algorithms - Link-state routing, Distance vector routing, Hierarchical routing; Routing in the Internet - RIP, OSPF, BGP; Broadcast & multicast routing; ICMP; Next Generation IP - IPv6)

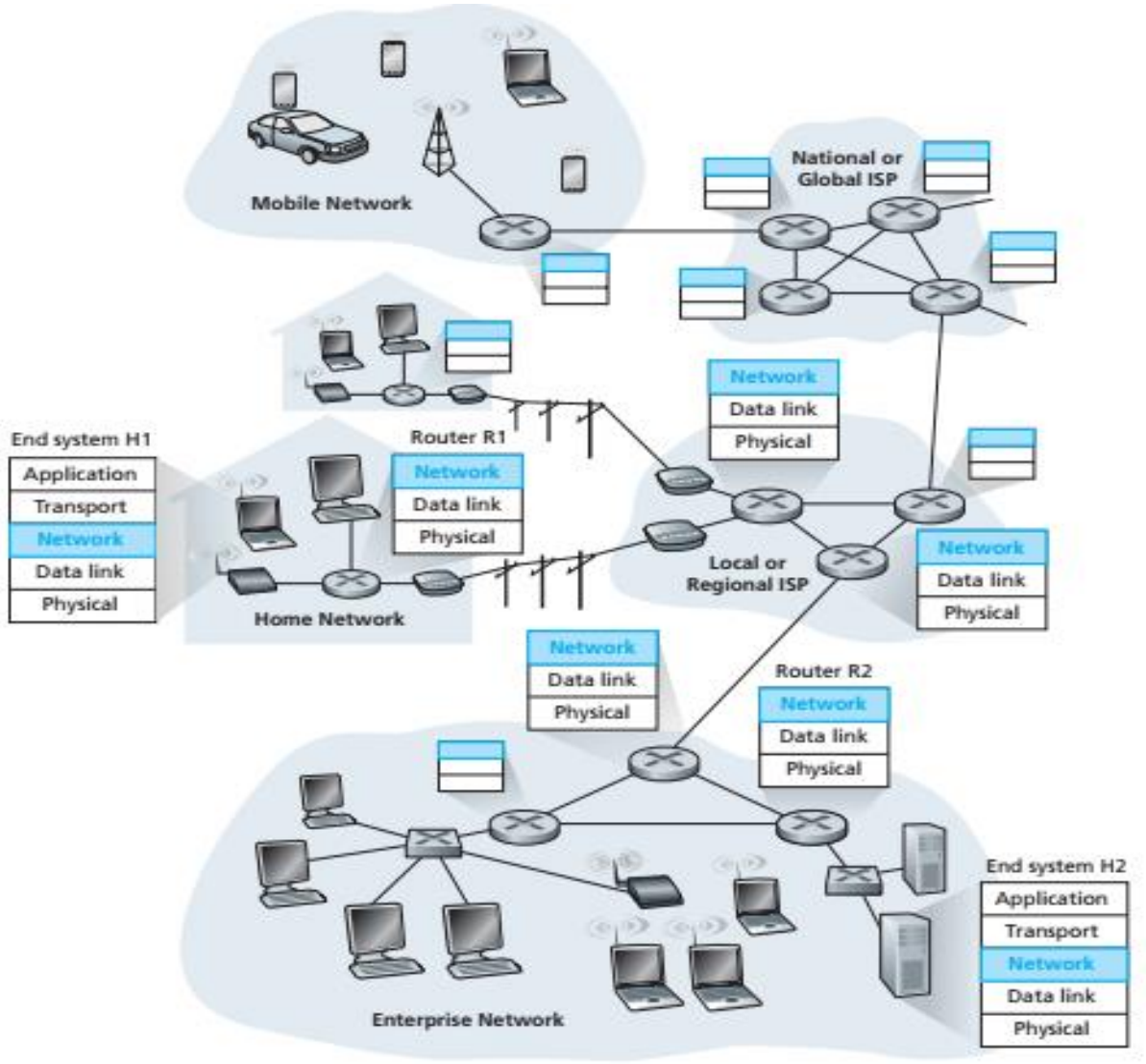
Dr. Nirnay Ghosh

Assistant Professor

Department of Computer Science & Technology

IIEST, Shibpur

Network Layer

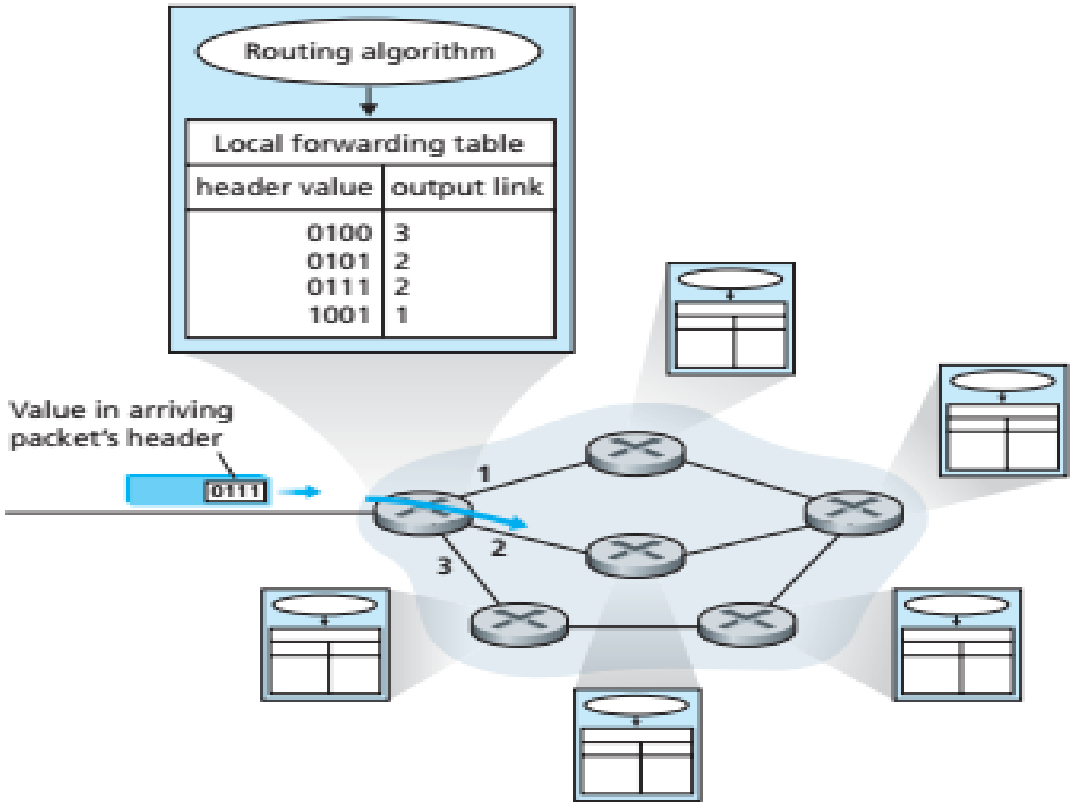


The Network Layer

- Forwarding: when a packet arrives at a router's input link, the router must move the packet to the appropriate output link
- Routing: determine the route or path taken by packets as they flow from a sender to a receiver
  - The algorithms that calculate these paths are referred to as routing algorithms.

Forwarding Table

- Examines the value (usually destination address) of a field in the arriving packet's header
- Uses this header value to index into the router's forwarding table:
  - Outgoing link interface to which the packet is to be forwarded
- Routing algorithm – determines the value to be inserted into the forwarding table
  - Centralized or decentralized
  - Sends routing protocol messages to each router – used to configure its forwarding table



Forwarding Table of Router

- Packet switches
  - Link-layer switches
  - Routers

Network Service Models

- Important network layer services:
  - Guaranteed delivery
  - Guaranteed delivery with bounded delay
  - In-order packet delivery
  - Guaranteed minimal bandwidth
  - Guaranteed constant jitter
  - Security services

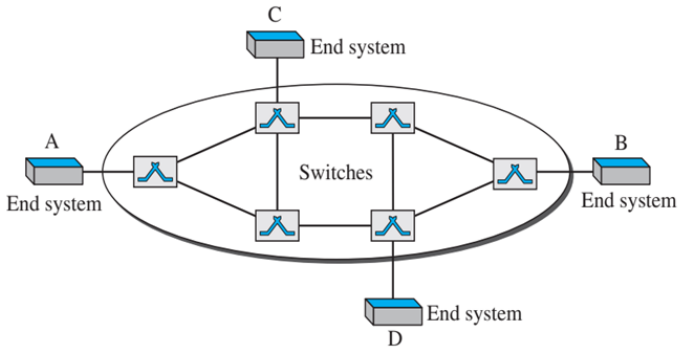
Network Architecture	Service Model	Bandwidth Guarantee	No-Loss Guarantee	Ordering	Timing	Congestion Indication
Internet	Best Effort	None	None	Any order possible	Not maintained	None
ATM	CBR	Guaranteed constant rate	Yes	In order	Maintained	Congestion will not occur
ATM	ABR	Guaranteed minimum	None	In order	Not maintained	Congestion indication provided

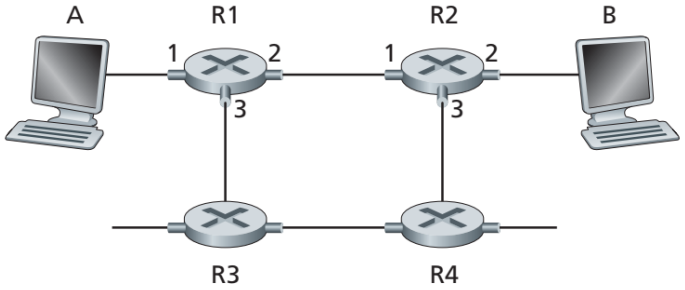
Various Network Service Models

- Internet's network layer – provides best-effort service - minimalist network-layer service model
- ATM – Asynchronous Transfer Mode – provides multiple network service models
  - Constant bit rate (CBR) ATM
  - Available bit rate (ABR) ATM

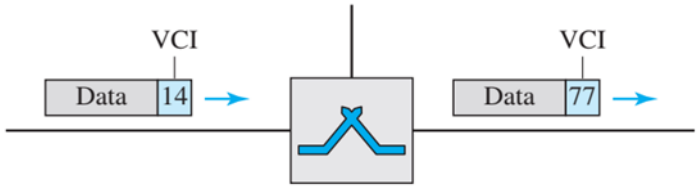
Virtual Circuit Network

- Some network architectures (ATM, frame relay etc.) use connection service at network layer
- Virtual circuits (VC) – network layer connections : (1) a path, (2) VC numbers, and (3) forwarding table entries in each router along the path
- Each intervening router replace the VC number of each traversing packet with a new VC number
- The new VC number is obtained from the forwarding table.
- If a new VC is established across a router, an entry is added to the forwarding table
- If a VC terminates, the appropriate entries in each table along its path are removed.

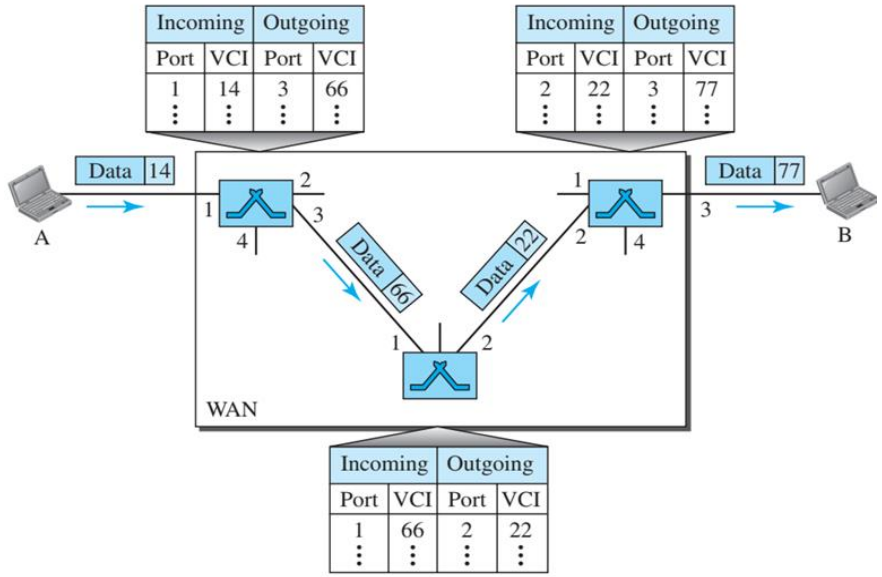




Simple Virtual Circuit Networks



Virtual Circuit Number



Data Transfer Phase