Computer Networks (CS30006)

Spring Semester (2021-2022)

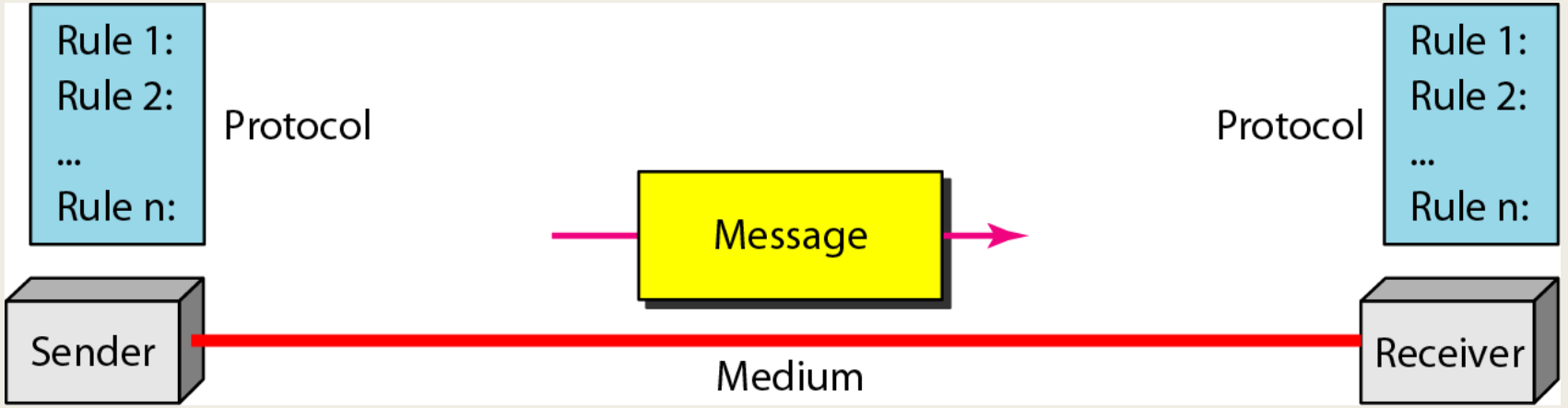
Lecture 1: Introduction

Prof. Sudip Misra

Department of Computer Science and Engineering
Indian Institute of Technology Kharagpur
Email: smisra@sit.iitkgp.ernet.in
Website: http://cse.iitkgp.ac.in/~smisra/
Research Lab: cse.iitkgp.ac.in/~smisra/swan/

Data Communication

- Exchange of data between two devices via some form of transmission medium.
- Fundamental characteristics: Delivery, Accuracy, Timeliness, Jitter.

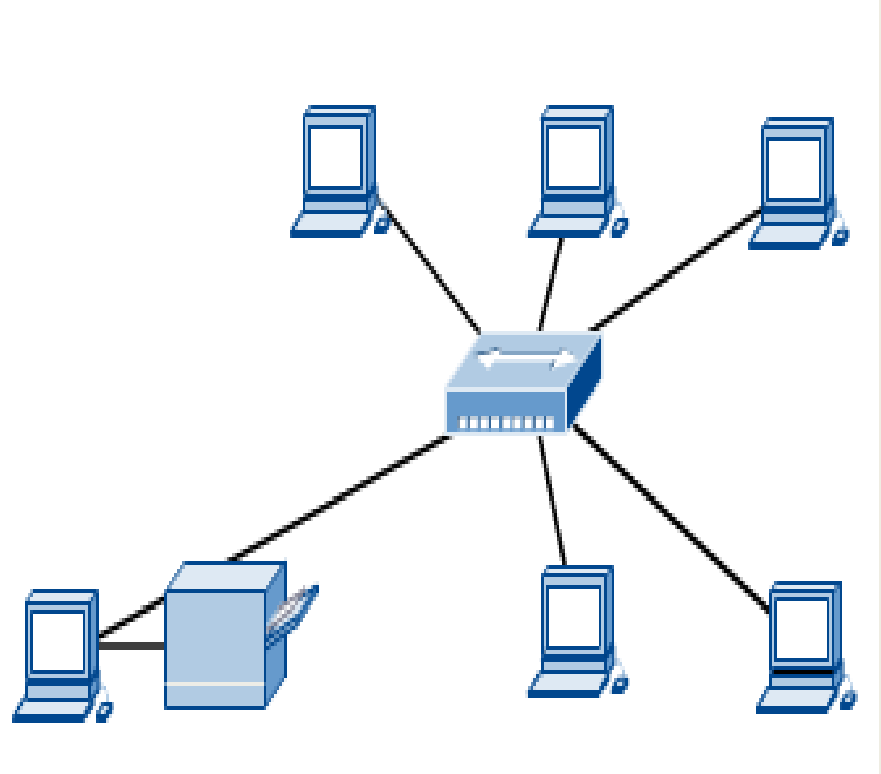


Source: B. A. Forouzan, " Data Communications and Networking ," *McGraw-Hill Forouzan Networking Series*,5E.

Networks

- A network is a set of devices (often referred to as nodes) connected by communication links.

- **Network Criteria**
  - Performance
  - Reliability
  - Security



Source: B. A. Forouzan, “ Data Communications and Networking ,” *McGraw-Hill Forouzan Networking Series*,5E.

Physical Structure of Network

- Depends upon:
  - The type of connection
  - The physical topology

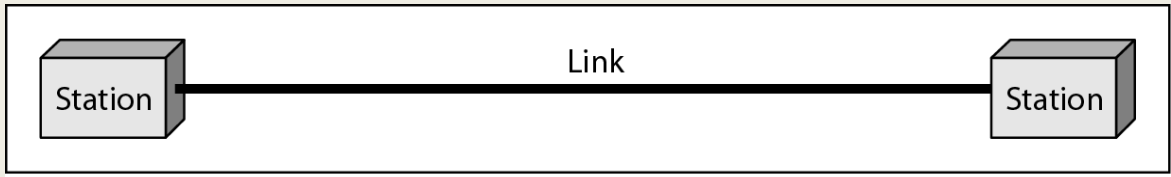
- Type of Connection
  - Point to Point - single transmitter and receiver
  - Multipoint - multiple recipients of single transmission

- Physical Topology
  - Connection of devices
  - Type of transmission - unicast, multicast, broadcast

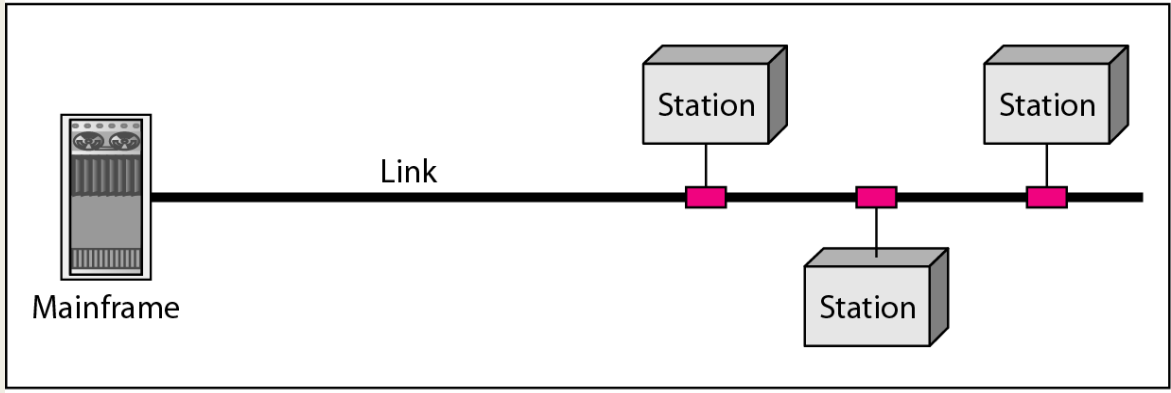
Type of connection

- **Point-to-Point**
  - A point-to-point connection provides a dedicated link between two devices.
  - The entire capacity of the link is reserved for transmission between those two devices.

- **Multipoint**
  - A multipoint (also called multidrop) connection is one in which more than two specific devices share a single link.
  - The capacity of the channel is shared, either spatially or temporally.



a. Point-to-point

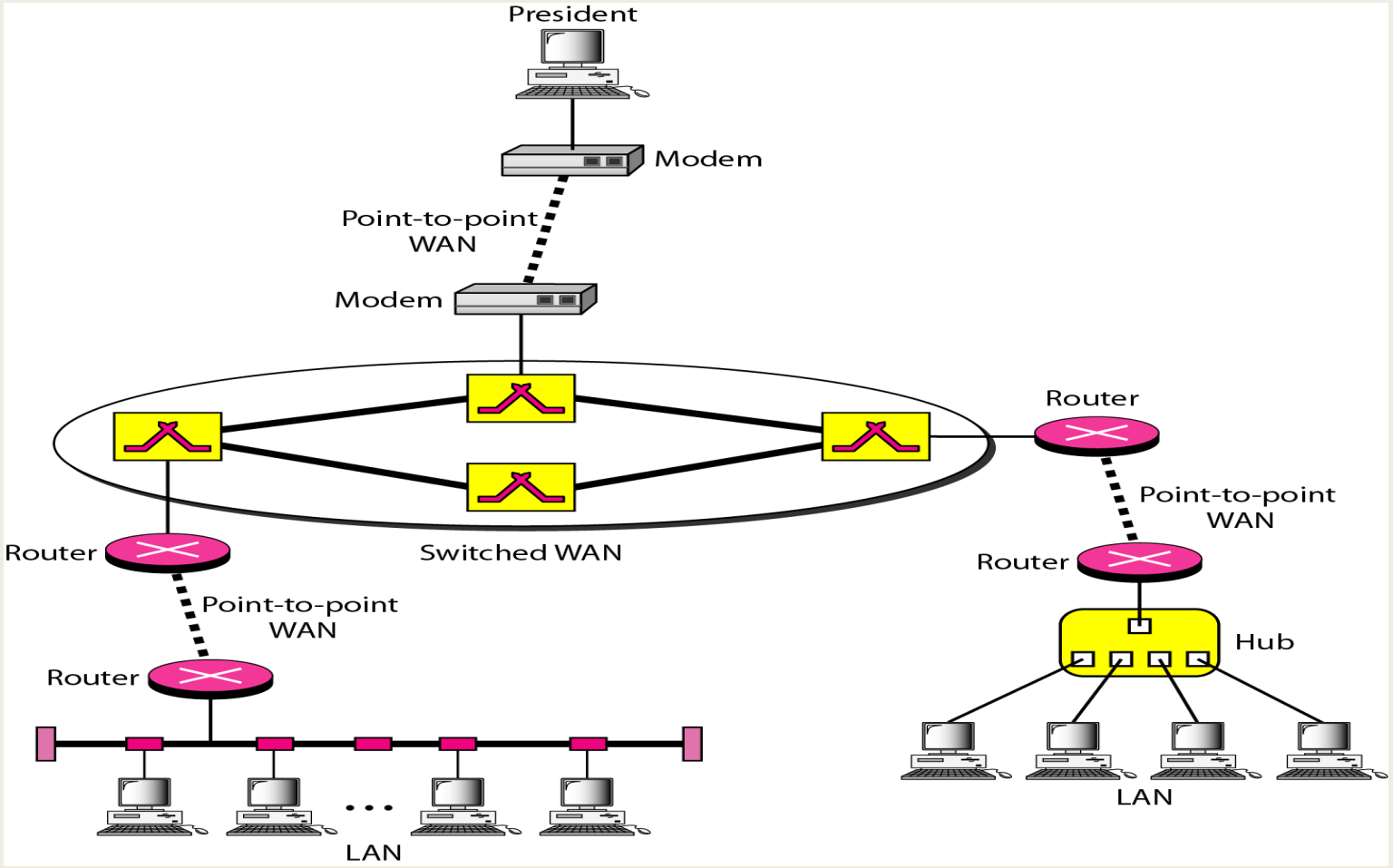


b. Multipoint

Source: B. A. Forouzan, " Data Communications and Networking ," *McGraw-Hill Forouzan Networking Series*,5E.

A Heterogeneous Network

The computers use common communication protocols over digital interconnections to communicate with each other.



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Categories of Network

Local Area Networks (LANs)

- Short distances
- Designed to provide local interconnectivity

Wide Area Networks (WANs)

- Long distances
- Provide connectivity over large areas

Metropolitan Area Networks (MANs)

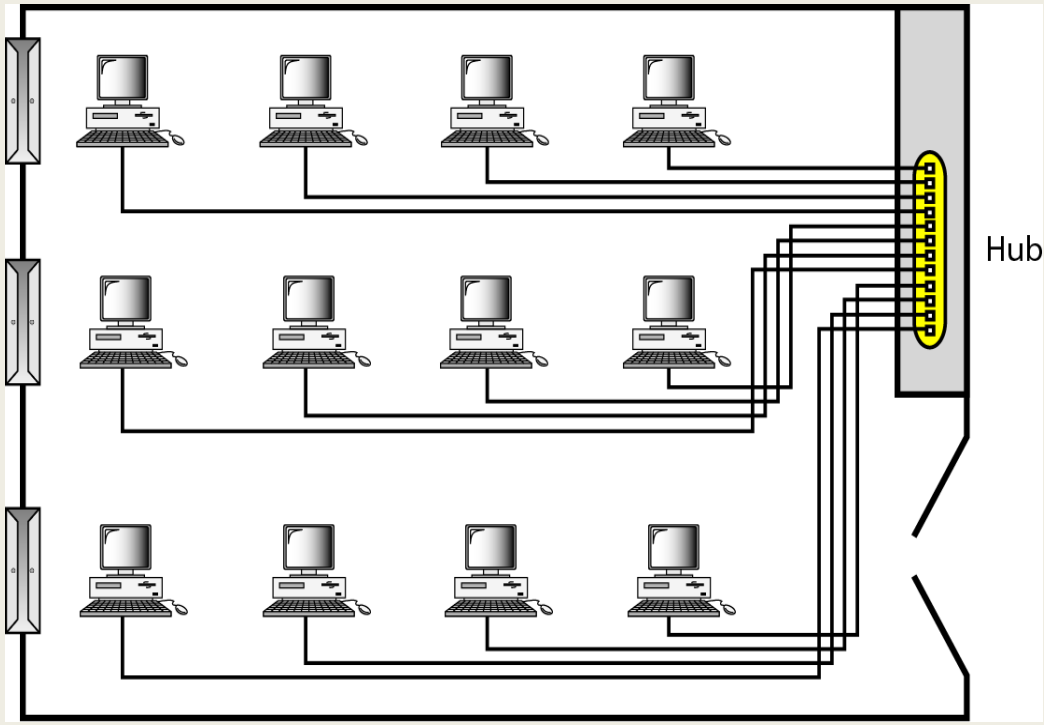
- Provide connectivity over areas such as a city, a campus

LAN

A local area network (LAN) is usually privately owned and links the devices in a single office, building, or campus.

LAN can be as simple as two PCs and a printer in someone's home office; or it can extend throughout a company and include audio and video peripherals.

Currently, LAN size is limited to a few kilometers.



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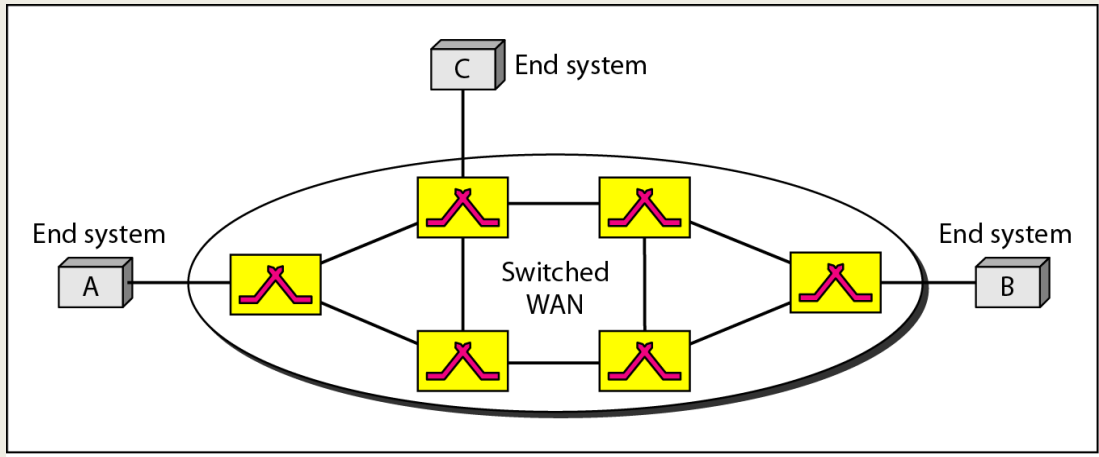
MAN

- A metropolitan area network (MAN) is a network with a size between a LAN and a WAN.
- It normally covers the area inside a town or a city.
- It is designed for customers who need a high-speed connectivity, normally to the Internet, and have endpoints spread over a city or part of city.

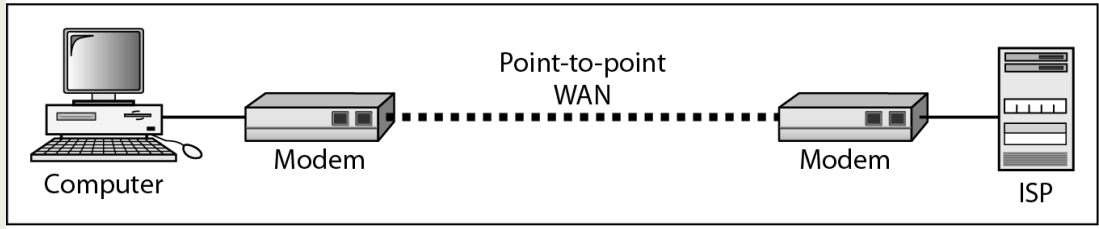
Example of a MAN is the part of the telephone company network that can provide a high-speed DSL line to the customer.

WAN

- A wide area network (WAN) provides long-distance transmission of data, image, audio, and video information.
- The switched WAN connects the end systems, which usually comprise a router (internetworking connecting device) that connects to another LAN or WAN.
- The point-to-point WAN is normally a line leased from a telephone or cable TV provider that connects a home computer or a small LAN to an Internet service provider (ISP).



a. Switched WAN



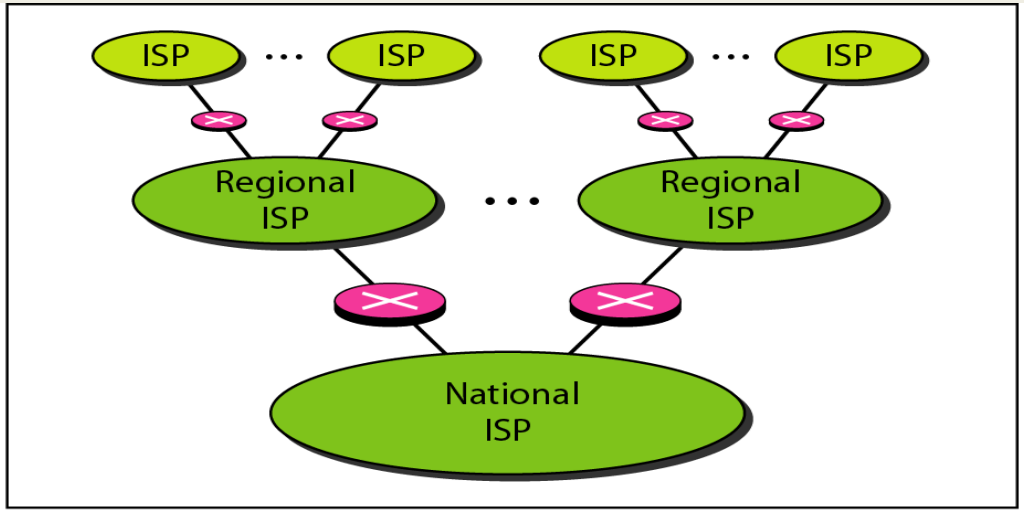
b. Point-to-point WAN

Source: B. A. Forouzan, " Data Communications and Networking ," *McGraw-Hill Forouzan Networking Series*,5E.

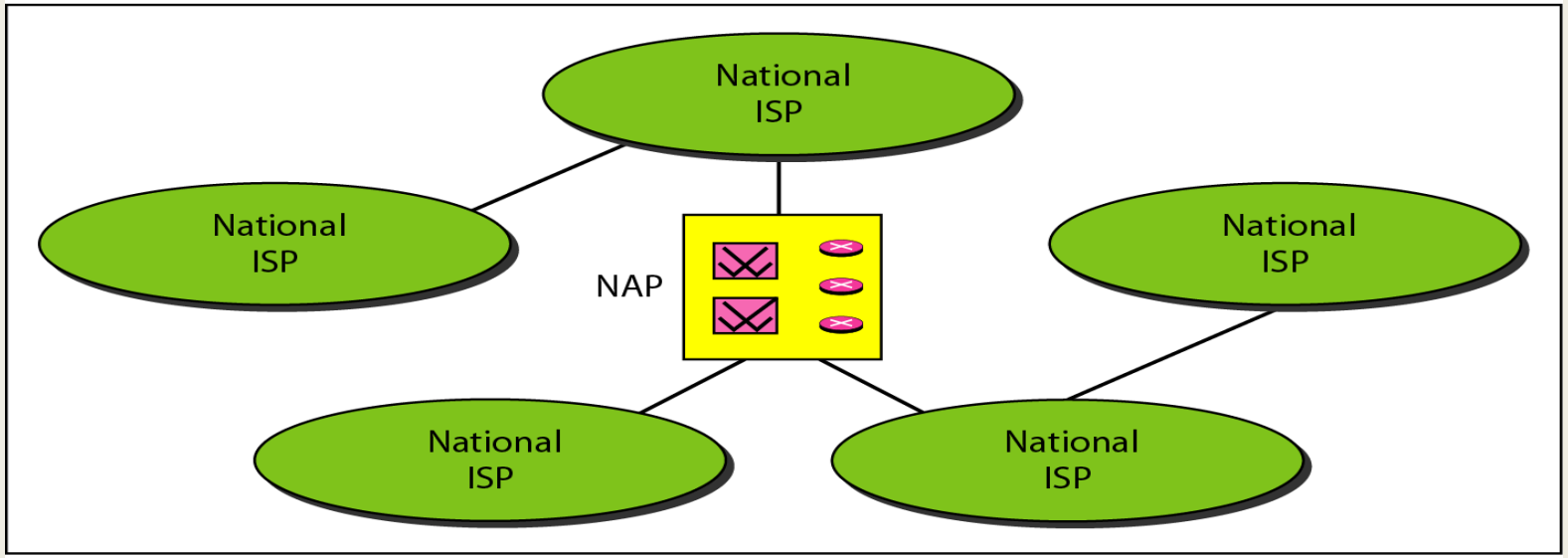
Internet

- Internet is worldwide network of computer networks.
- **How does it work?**
  - Most computers are not connected directly to the internet.
  - They are connected to smaller networks.
  - Which are connected through gateways to the internet backbone.

Hierarchical Organization of Internet



a. Structure of a national ISP

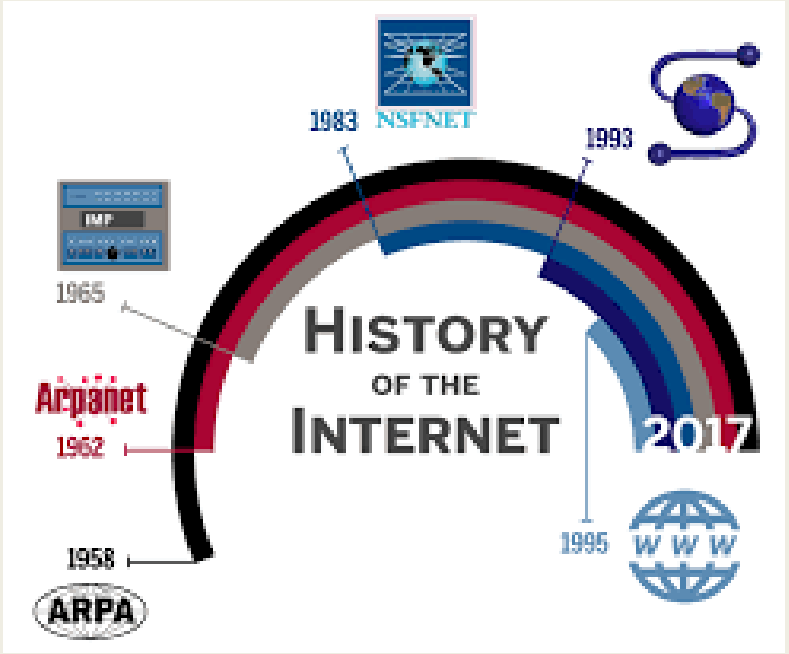


b. Interconnection of national ISPs

Source: B. A. Forouzan, " Data Communications and Networking ," *McGraw-Hill Forouzan Networking Series*,5E.

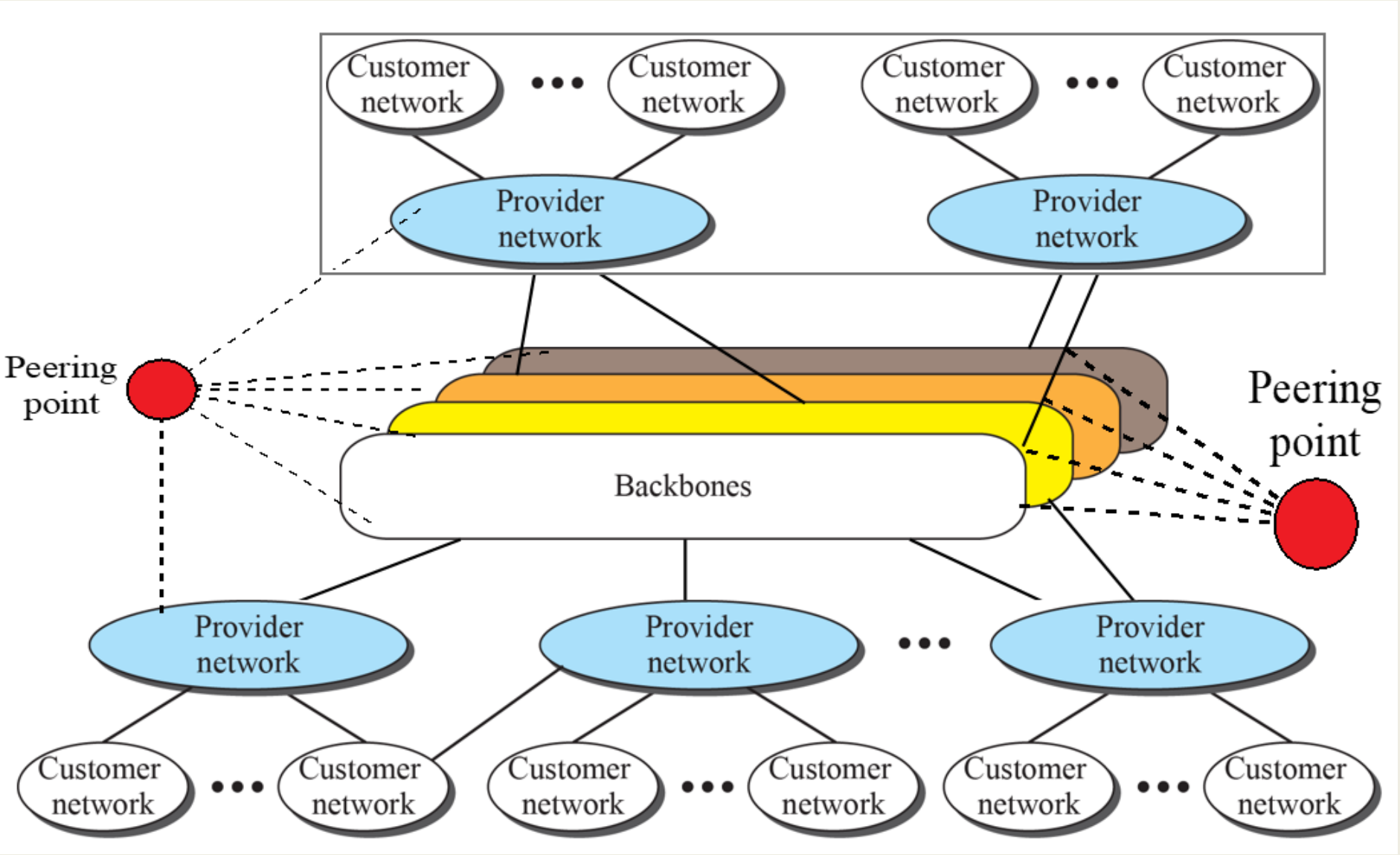
History of Internet

- The Internet has its origin in the ARPANET network sponsored by the U.S. Department of Defense starting in the 1960s.
- The ARPANET was a datagram store-and-forward network that the Department of Defense liked for its ability to reroute packets around failures.
- ARPANET was a great success but membership was limited to certain academic and research organizations who had contracts with the Defense Department.
- In response to this, other networks were created to provide information sharing.
- A new communications protocol was established called Transfer Control Protocol/Internetwork Protocol (TCP/IP).
- This allowed different kinds of computers on different networks to "talk" to each other.
- ARPANET and the Defense Data Network officially changed to the TCP/IP standard on January 1, 1983



Source: [Online], Available: https://sciencenode.org/feature/a-brief-history-of-the-internet-.php

The Internet Today



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Protocols

- A protocol is synonymous with rule.
- It consists of a set of rules that govern data communications.
- It determines what is communicated, how it is communicated and when it is communicated.
- The key elements of a protocol are syntax, semantics and timing.

Elements of a Protocol

Syntax

- Structure or format of the data.
- Indicates how to read the bits - field delineation.

Semantics

- Interprets the meaning of the bits.
- Knows which fields define what action.

Timing

- When data should be sent and what.
- Speed at which data should be sent or speed at which it is being received.

Need

- Setting up procedures for sending and receiving messages, acknowledgement of receipt, congestion avoidance, and error correction.
- Ensuring correct addressing of source and destination and steering messages towards their target.
- Ensuring integrity and security of communication.
- Regulating coding and media access (language and customs issues)

Organization of the Course

Basics of data communication

- Brief overview of of analog and digital transmission
- Transmission media

Suppose you have only two machines connected directly by a link. How can you make them communicate reliably?

- Synchronization, encoding, flow control, error detection and control

Suppose you have more than two machines, but still connected directly by a single link. How can you make them communicate reliably?

- How can more than two machines be even connected with a single link?
- How do they share the link without conflict?
- Medium access control
- How does each machine know if the data on the link is for it or not?
- Addressing

Cont…

Building networks with any number of machines, which may not be connected with direct links

- How to organize the hardware and software
- Protocol architecture, layering, OSI and TCP/IP layers and their functions
- Local Area Networks (LANs) - Ethernet
- Wide Area Networks (WANs)
- How to find and maintain a path between two machines
- Packet and circuit switching, Routing algorithms
- TCP and IP for end-to-end communication

Configuration and naming protocols – DHCP, DNS

Application Layer Protocols

Other advanced topics depending on time

Goals

At the end of this course:

- You should be able to explain how some of the everyday things you use works underneath
- How does your mail reach its recipients, a web page opens, file transfer over the net happens, your google search reaches google
- Should be able to explain the protocols in play, the packet formats, the path and transformation of the packets on its way
- Should have an idea about the design of these protocols
- Should be able to identify the physical infrastructure that makes it possible and their interconnection

Thank You!!!