DATA AND COMPUTER COMMUNICATIONS

Lecture 1 Overview - Data Communications, Data Networks, and the Internet

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Based on Lecture slides by William Stallings

OUTLINE

- Data Communications and Networking for Today’s Enterprise
- A Communications Model
- Data Communications
- Networks
- The Internet
DATA COMMUNICATIONS AND NETWORKING FOR TODAY’S ENTERPRISE

Trends

- Three forces that drive the architecture and evolution of data communications and networking

Traffic growth at a high & steady rate

- Development of new services

- Advances in technology
Technology Trends

- Four technology trends are particularly notable:
  - The trend toward faster and cheaper, both in computing and communications, continues
  - Both voice-oriented telecommunications networks and data networks are more “intelligent” than ever
  - The Internet, the Web, and associated applications have emerged as dominant features of both business and personal world
  - There have been a trend toward ever-increasing mobility for decades

Technology Trends (cont’d)
SIGNIFICANT CHANGES IN REQUIREMENTS

- Emergence of high-speed LANs
  - Examples: centralized server farms, power workgroups, and high-speed local backbone
- Corporate WAN needs
  - Driven by the needs of centralized data processing model and distribution of multiple offices.
- Digital electronics

CONVERGENCE

- The merger of previously distinct telephony and information technologies and markets
- Layers:
  - applications
    - these are seen by the end users
  - enterprise services
    - services the information network supplies to support applications
  - infrastructure
    - communication links available to the enterprise
CONVERGENCE LAYERS

Benefits

- Convergence benefits include:
  
  **Efficiency**
  - better use of existing resources, and implementation of centralized capacity planning, asset and policy management

  **Effectiveness**
  - the converged environment provides users with flexibility, rapid standardized service deployment and enhanced remote connectivity and mobility

  **Transformation**
  - enables the enterprise-wide adoption of global standards and associated service levels
A COMMUNICATIONS MODEL

Transmission system utilization
Interfacing
Signal generation
Synchronization
Exchange management
Error detection and correction
Flow control
Addressing
Routing
Recovery
Message formatting
Security
Network management

COMMUNICATIONS TASKS
The basic building block of any communications facility is the transmission line.

The business manager is concerned with a facility providing the required capacity, with acceptable reliability, at minimum cost.
TRANSMISSION MEDIUM

- selection is a basic choice
  - internal use entirely up to business
  - long-distance links made by carrier
- rapid technology advances change mix
  - fiber optic
  - wireless

NETWORKING

- growth of number & power of computers is driving need for interconnection
- also seeing rapid integration of voice, data, image & video technologies
- two broad categories of communications networks:
  - Local Area Network (LAN)
  - Wide Area Network (WAN)
WIDE AREA NETWORKS

- span a large geographical area
- cross public rights of way
- rely in part on common carrier circuits
- alternative technologies used include:
  - leased line
  - circuit switching
  - packet switching: X.25, frame relay
  - Asynchronous Transfer Mode (ATM)
CIRCUIT SWITCHING

- uses a dedicated communications path established for duration of conversation
- comprising a sequence of physical links
- with a dedicated logical channel
- e.g. telephone network

PACKET SWITCHING

- data sent out in sequence of small chunks (packets)
- packets passed from node to node between source and destination
- used for terminal to computer and computer to computer communications
FRAME RELAY

- Motivation
  - packet switching systems have large overheads to compensate for errors
  - modern systems are more reliable, errors can be caught in end system
- Frame Relay
  - provides higher speeds with most error control overhead removed, up to 2Mbps

ASYNCHRONOUS TRANSFER MODE

- evolution of frame relay and circuit switching
  - fixed packet (called cell) length via virtual channels
  - with little overhead for error control
  - bandwidth from 10Mbps to Gbps
  - constant data rate using packet switching technique with multiple virtual circuits
LOCAL AREA NETWORKS (LAN)

- Smaller scope, typically a single building
- LANs are usually owned by the same organization that owns attached devices
- Internal data rates greater than WANs
- Most common configurations are switched LANs and wireless LANs

METROPOLITAN AREA NETWORKS (MAN)

- Covers a geographic area such as a town, city, or suburb
- Middle ground between LAN and WAN
- Supports both data and voice
- Private or public network
THE INTERNET

- Internet evolved from ARPANET
  - first operational packet network
  - applied to tactical radio & satellite nets also
  - had a need for interoperability
  - led to standardized TCP/IP protocols

INTERNET ELEMENTS
INTERNET ARCHITECTURE

EXAMPLE CONFIGURATION
SUMMARY

- Trends challenging data communications:
  - traffic growth
  - development of new services
  - advances in technology

- Transmission mediums
  - fiber optic
  - wireless

- Network categories:
  - WAN
  - LAN

- Internet
  - evolved from the ARPANET
  - TCP/IP foundation