



High speed computer networks

Introduction

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Course objective

- ❑ Introducing high speed networks
- ❑ Design issues related to high speed networks, Network Protocols like ATM, Frame Relay and Ethernet networks
- ❑ Provide up-to-date survey of developments in the area
- ❑ Performance analysis, congestion control and provision of QoS to different applications are also discussed.

Course outline

□ Introduction

- Why high speed networks?
- Requirements of high speed networking
- High speed network technologies

□ Frame relay

□ Asynchronous transfer mode (ATM)

□ High speed LANs

- Fast Ethernet
- Gigabit Ethernet
- Fiber channel

□ Congestion and traffic management

- Impact of congestion
- Congestion control mechanisms
- Traffic management

□ High speed network protocols

- TCP
- Protocol for QoS support

□ Media access control

□ Internet routing

- Interior routing protocols
- Exterior routing protocols
- Multicasting

High speed networking

□ High speed networking – delay free data transfer ?

- Reduce delay and increase bandwidth
- Ideal scenario - unlimited bandwidth and no latency

□ Delay

- End-to-end and per hop

□ Bandwidth

- Aggregated and Per flow

High speed networking

□ Causes of delay

- Physical propagation delay – finite propagation speed of EM waves through any medium
- The limited bandwidth availability of the links in the network
- Buffer and queueing delays – network resource sharing
- Processing time at each network component – e.g. routing a packet

High speed networking

t= buffer delay + processing time +

(characteristic frame size/ link transmission rate)

□ Link transmission rate – bandwidth

□ Buffering

- Processing
 - ✓ To process a piece of information, it must first be stored
- Burst traffic and asynchronous transfer
 - ✓ Traffic is generated asynchronously with respect to the operation of the network element
 - ✓ Congestion - to reduce packet loss
- Shared network resource

Driving factors

□ Applications – networking technologies

□ Applications

- Centralized server farms
- Power workgroups
- High speed local backbone

High speed LAN

□ QoS on the internet

- An increase demand for high-speed internet access and bandwidth –consuming application – multimedia
- Real time traffic

QoS on the internet

❑ Real-time application requirements

- A firm minimum throughput
- Delay sensitive
- Reasonable upper bound on delay variation

❑ Difficult to meet in an environment with variable queueing delay and congestion losses

Internetworking: Key technologies

□ TCP and IP

- Internetworking protocol
- IP – for internet routing and delivery
- TCP – for reliable end-to-end transport
- UDP – for applications that do not need reliable delivery
- RTP – for real time application

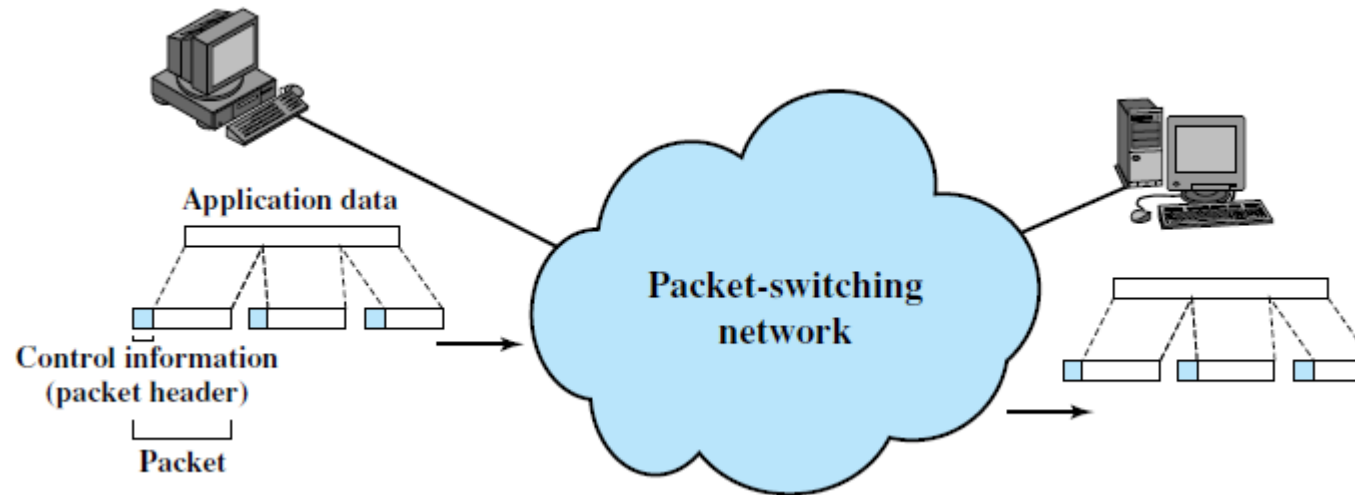
□ Dynamic routing

- Dynamic route discovery
- Route adjustment in the face of congestion and failure

Internetworking: Key technologies

□ Packet switching

- Data are transmitted in short packets (upper bound on packet length)
 - ✓ Portion of data plus control information
- Destination reconstructs the message



□ Ethernet

- Dominate local area networking
- Most internet configuration involve Ethernet networks