Data Communications and Networks - An Introduction -

ETSF05
Internet Protocols
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(Jens Andersson)

Today's lecture

- Introduction
- Network topologies §1.1-2
- Network models §2.1-5
- Frames and data link control §11.1-5
- Local area networks and Ethernet §13.1-3

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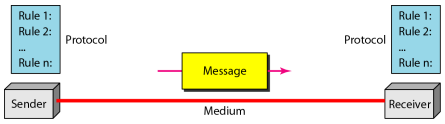
Introduction

- Data
- Communication
- Network



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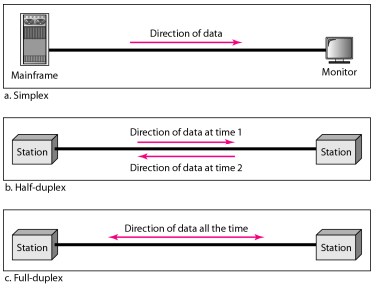
Data flow



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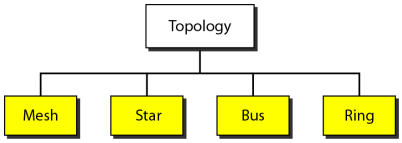
Network topologies

- Layout of links and nodes



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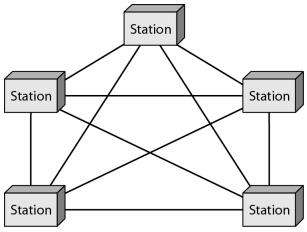
Mesh network

- Full vs. partial
- Redundant links



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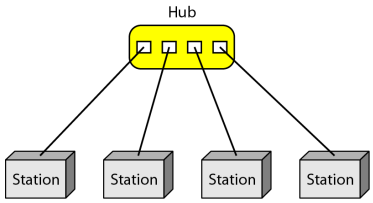
Star network

*



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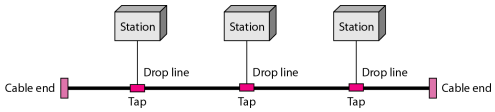
Bus network

- Simple
- Vulnerable to collisions



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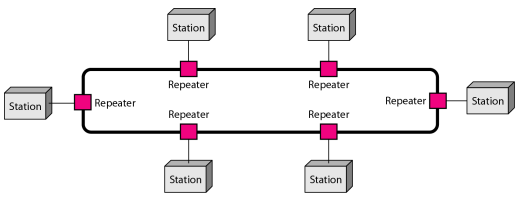
Ring network

- Circular
- Susceptible to node failures



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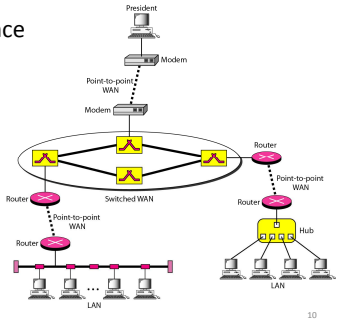
Network engineering

- High performance
  - Reliability
  - Throughput
  - Speed
  - Security



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Network models

- Why?
  - Too complicated
  - Divide and conquer
- Layered architecture
  - Hierarchy
  - Specialisation
  - Simplification

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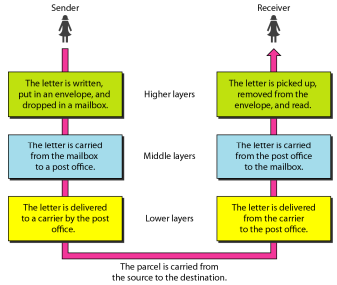
Layer concept



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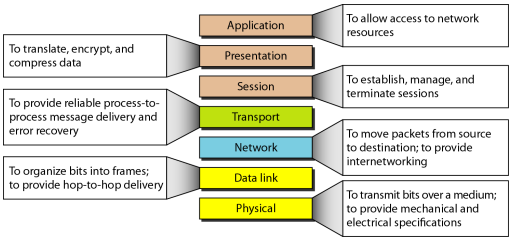
OSI model

- Developed by ISO, 1970~



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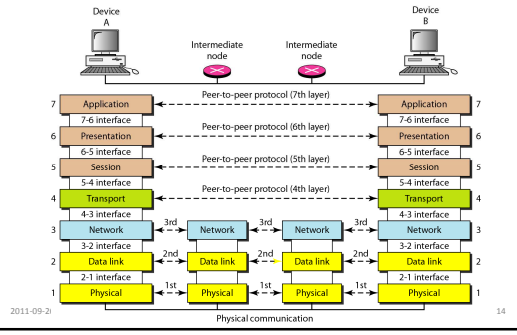
OSI model in action



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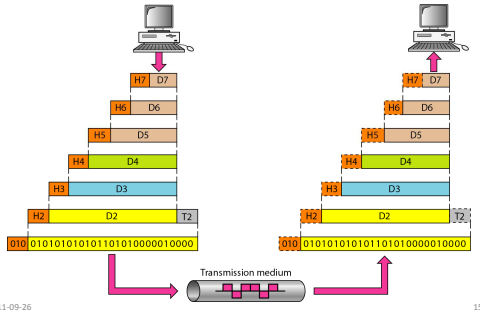
Encapsulation



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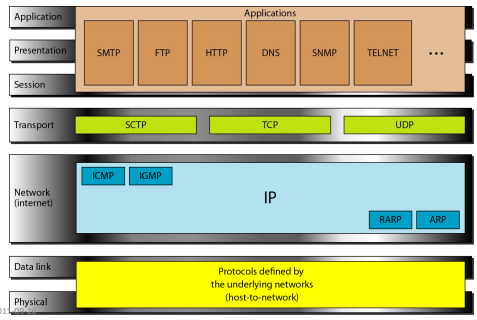
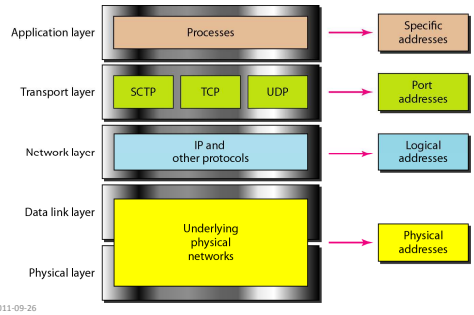
TCP/IP model

- Developed by DARPA, 1970~
- Some OSI layers merged
- Internet protocol suite

TCP/IP layers

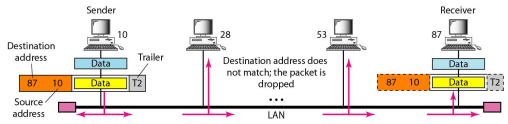


Addressing in TCP/IP

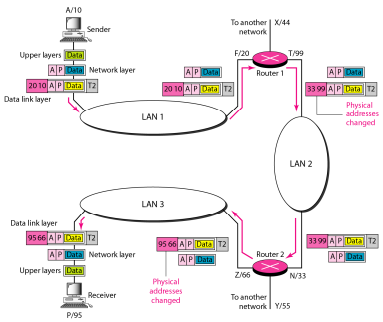


Physical addresses

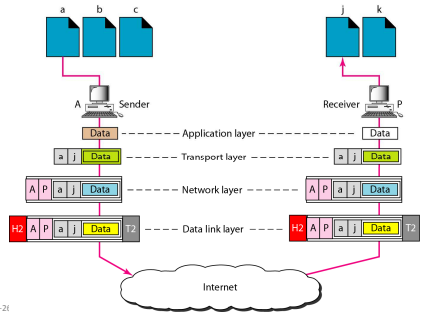
- Hardware-coded



Physical and logical addresses



Logical and port addresses



See you in 15' :)

- After the break
  - From bits to frames
  - Data flow
  - Local area networks

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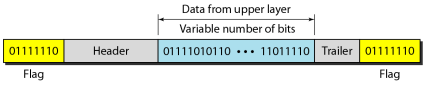
Frames

- Need to limit unit of data
  - Multi-user system
  - Addressing
  - Error correction



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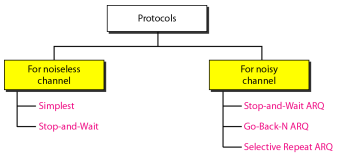
Data link control protocols

- Framing
- Flow control
  - Send data
  - Wait for ACK
- Error control
  - Detect error
  - Retransmit



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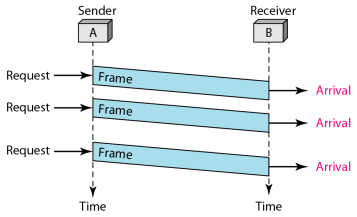
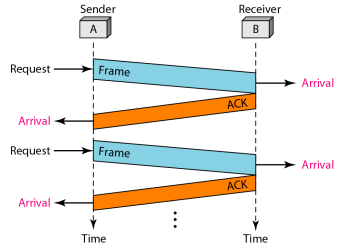
Simplest protocol



- Problem: Data arrival rate?
- Solution: Wait for ACK!

Stop-and-wait protocol

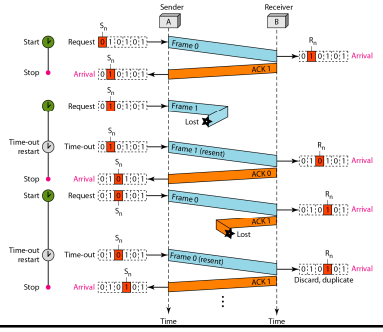


- Problem: Still no error correction?

Stop-and-wait ARQ

- Send and wait
  - Keep time
  - Wait for ACK
  - Retransmit
- Automatic repeat request
  - Frames (SEQ++)
  - Acknowledgements (SEQ+1)
  - Mismatch = problem!

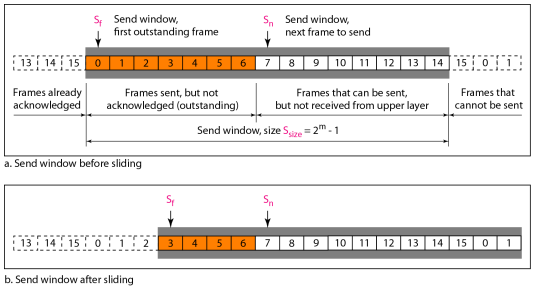
Stop-and-wait ARQ flow diagram



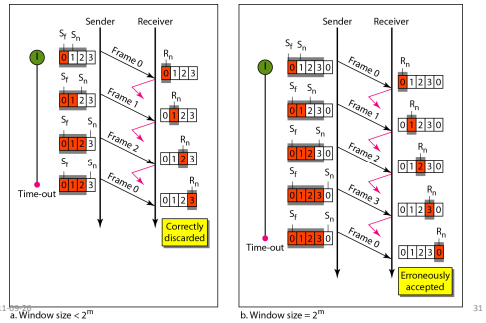
Stop-and-wait ARQ

- Problem with stop-and-wait
  - Too much waiting
- Solution
  - Keep the pipe full
  - But not too full
- Sliding window
  - Size matters

Sliding window

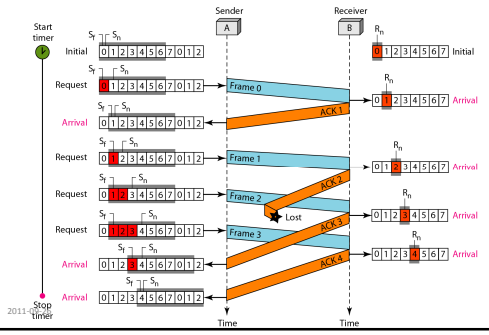


Go-back-N ARQ window size



a. Window size < 2^m b. Window size = 2^m

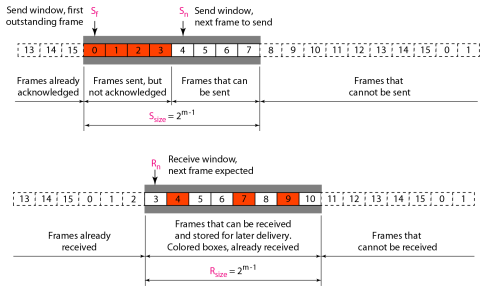
Go-back-N ARQ flow diagram



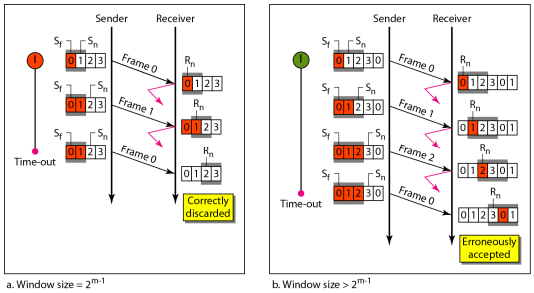
Selective repeat ARQ

- Why?
  - Too many retransmissions
- Higher receiver complexity
- Higher efficiency

Windows again



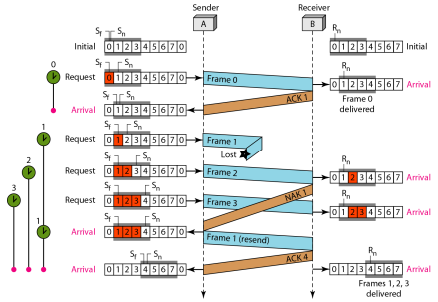
Selective repeat ARQ window size



a. Window size = 2^{m-1}

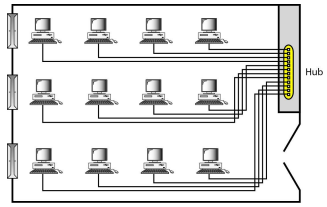
b. Window size > 2^{m-1}

Selective repeat ARQ flow diagram



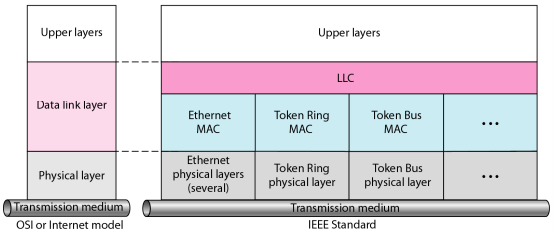
Local area networks

- Designed for limited areas
  - Offices
  - Campuses
  - Homes



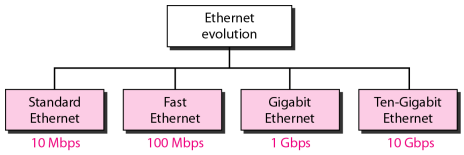
IEEE's LAN standards

LLC: Logical link control
MAC: Media access control

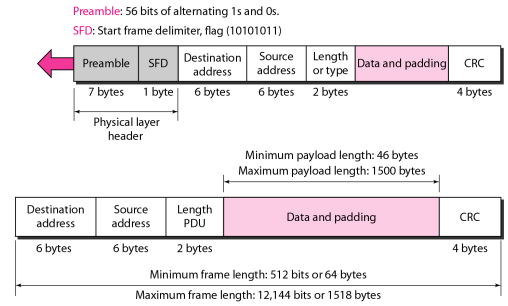


Ethernet

- Created 1976 by Xerox
- Evolved through new versions



Standard Ethernet



IEEE 802.3 MAC address

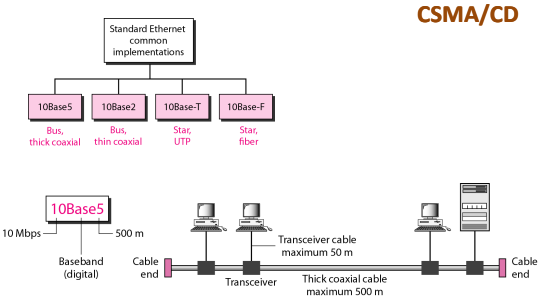
- ipconfig /all

06 : 01 : 02 : 01 : 2C : 4B

6 bytes = 12 hex digits = 48 bits

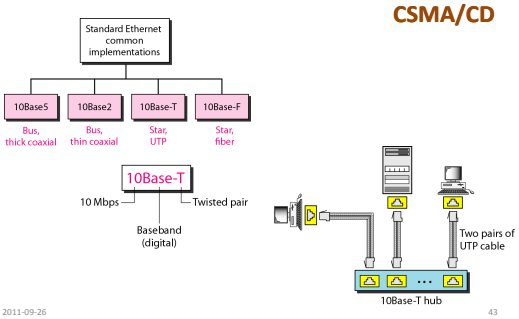
Standard Ethernet implementations

CSMA/CD



Standard Ethernet implementations

CSMA/CD



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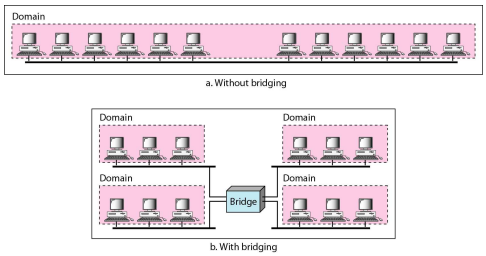
Evolution of Ethernet

CSMA/CD

- Sharing bandwidth



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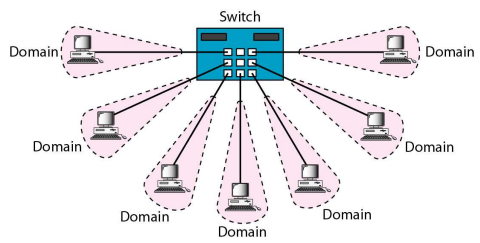
Switched Ethernet

CSMA/CD



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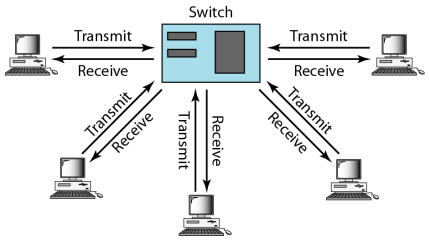
Full-duplex switched Ethernet

~~CSMA/CD~~



Even more evolution

- Fast Ethernet
  - 100 Mbps
- Gigabit Ethernet
  - 1 000 Mbps
- More and better wires
- More advanced encoding

Coming up next week

- Point-to-point protocol (PPP) §11.7
- Routing §22.3
- IPv4/IPv6 addresses §19.1-2
- Internetworking §20.1
- Address mapping §21.1