Lectures 8 – Networks

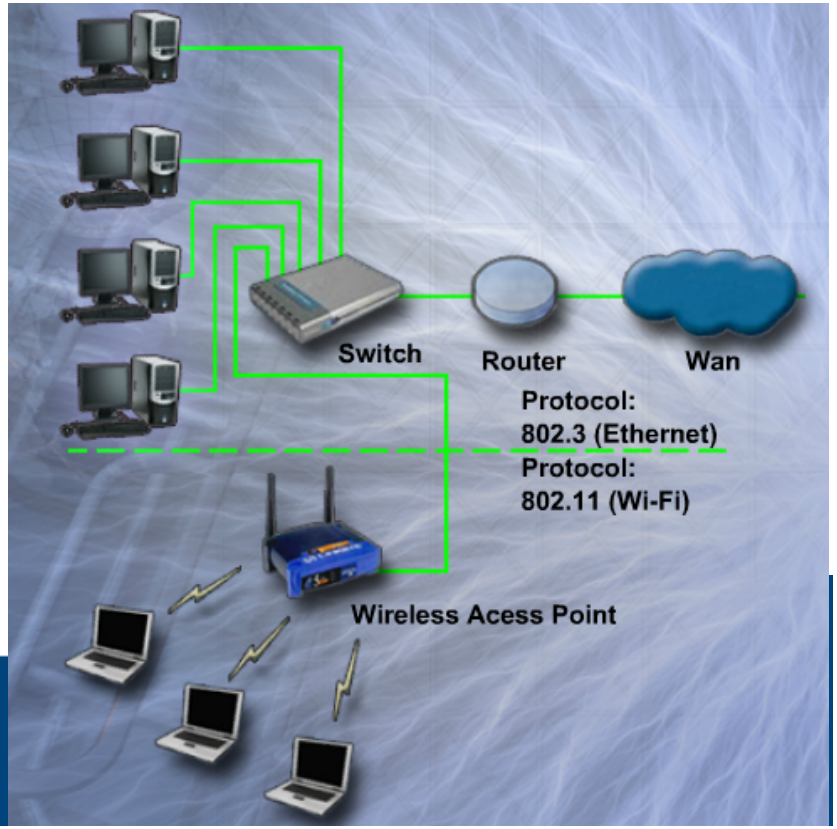
Computer Systems Administration
TE2003

Lecture overview

- At the end of lecture 8 students can identify, describe and discuss:
  - Ethernet standards
  - OSI and TCP/IP data models
  - Configure a NIC
  - Other technologies used to establish connectivity
  - Networking preventive maintenance
  - Network troubleshooting

Ethernet standards

- **Ethernet** is the dominant standard for today's networks
  - Cabled Ethernet standards
  - Wireless Ethernet standards



Ethernet standards

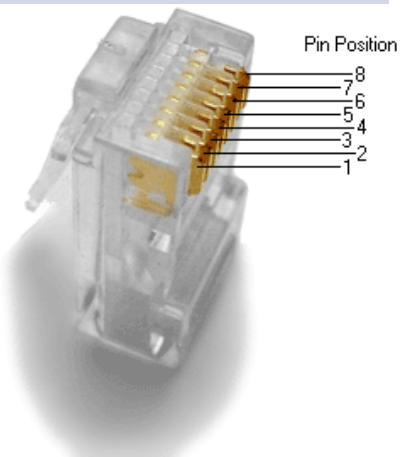
Cabled Ethernet standards (IEEE 802.3)

- CSMA/CD
- Susceptible to EMI

Expensive

	10BaseT	100Base-TX	1000Base-T
Media	EIA/TIA CAT 3,4,5 UTP, 2 pair	EIA/TIA CAT 5, 5e UTP, 2 pair	EIA/TIA CAT 5, 5e UTP, 4 pair
Max. Segment Length	100m		
Topology	Star		
Connector	ISO 8877 (RJ-45)		

- Fiber-optic
  - 10Base-FL, 100Base-FX, ...



Ethernet standards

Wireless Ethernet standards (IEEE 802.11)

- IEEE 802.11(a, b, g, n)
  - Frequency, speed, range, ...

Comparison of 802.11 Standards

Standard	802.11a	802.11b	802.11g	802.11n
Max. throughput	54 Mbps	11 Mbps	54 Mbps	100+ Mbps
Max. range	150 feet	300 feet	300 feet	300+ feet
Frequency	5 GHz	2.4 GHz	2.4 GHz	2.4 and 5 GHz
Security	SSID, MAC filtering, industry-standard WEP, WPA	SSID, MAC filtering, industry-standard WEP, WPA	SSID, MAC filtering, industry-standard WEP, WPA	SSID, MAC filtering, industry-standard WEP, WPA
Compatibility	802.11a	802.11b	802.11b, 802.11g	802.11b, 802.11g, 802.11n, (802.11a in some cases)
Spread-spectrum method	DSSS	DSSS	DSSS	OFDM
Communication mode	Ad hoc or infrastructure	Ad hoc or infrastructure	Ad hoc or infrastructure	Ad hoc or infrastructure

OSI and TCP/IP data models

- Computers exchange information in a network
- To communicate, computers agree on common protocol
- The TCP/IP model and the OSI model are both reference models for explaining Internet communications and developing communication protocols
- These models separate the functions of protocols into manageable layers
- Each layer performs a specific function in the process of communicating over a network

OSI and TCP/IP data models

TCP/IP model or **Internet Protocol Suite**

- Reference for the development of the protocols used on the Internet
- Open standard
- HW independent
- Required for communication over the Internet
- 4 layers

TCP/IP Model	Description
Application	Where high-level protocols such as SMTP and FTP operate
Transport	Specifies which application requested or is receiving data through specific ports
Internet	Where IP addressing and routing take place
Network Access	Where MAC addressing and physical components of network exist

OSI and TCP/IP data models

TCP/IP Application Layer Protocols

- Provide network services to user applications such as web browsers and e-mail programs
  - HTTP
  - TELNET
  - FTP
  - SMTP
    - Routes emails through internetworks
  - HTML
  - DNS (Domain Name System)
    - Host name and IP address resolution

OSI and TCP/IP data models

TCP/IP Transport Layer Protocols

- Provide end-to-end management of the data
- Divides the data into manageable segments for easier transport across the network
  - **TCP (Transmission Control Protocol)** — Most common
    - Connection-oriented protocol
    - Offers error correction: "guaranteed delivery"
    - Flow control

    e-mail, web browser, file transfer,...
  - **UDP (User Datagram Protocol)**
    - Connectionless Transport layer protocol (no acknowledgments)
      - Faster than TCP
    - No flow control or error correction

    Audio and video stream

Packet structure: TCP vs. UDP

Bit offset	0–3	4–7	8–15	16–31
0	Source address			
32	Destination address			
64	Zeros		Protocol	TCP length
96	Source port			Destination port
128	Sequence number			
160	Acknowledgement number			
192	Data offset	Reserved	Flags	Window
224	Checksum			Urgent pointer
256	Options (optional)			
256/288+	Data			

Optional

offset (bits)	0 – 15	16 – 31
0	Source Port Number	Destination Port Number
32	Length	Checksum
64	Data	

65,507 bytes
(65,535 − 8 byte UDP header − 20 byte IP header)

OSI and TCP/IP data models

OSI Model

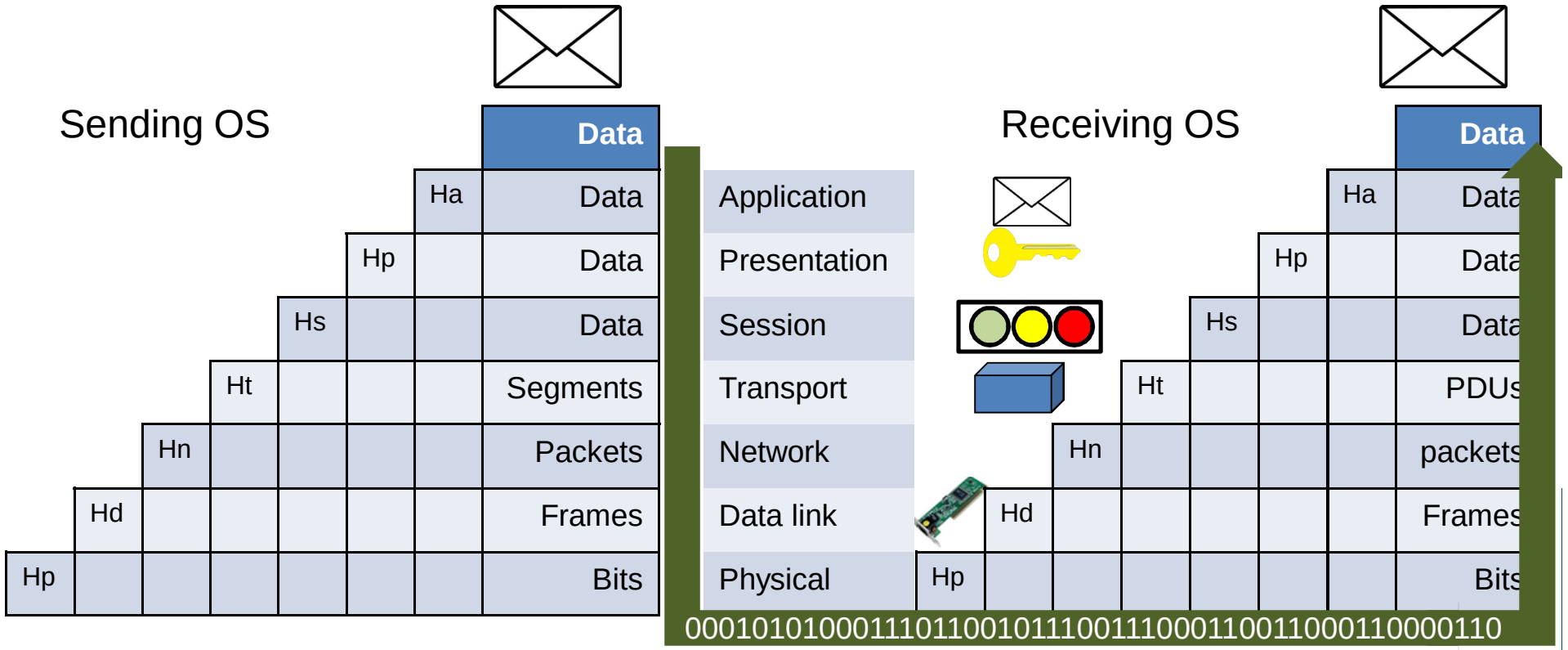
- Conceptual framework for understanding network communication and comparing various types of protocols
- Implemented in HW or SW, or combination of both
- Each layer is responsible for part of the processing to prepare data for transmission on the network

Layer	Name	Description
7	Application	Interacts with users
6	Presentation	Describes how to present data
5	Session	Manage connections between the local and remote machines
4	Transport	Reliable transport and flow control across the network
3	Network	Logical addressing (IP) and routing
2	Data link	Physical addressing (MAC) and media access control
1	Physical	Specification of NICs, cables, switches, hubs, … (1s and 0s)

OSI and TCP/IP data models

OSI Models

- Data travels down the OSI model layers of the sending computer, and up the OSI model layers of the receiving computer



OSI and TCP/IP data models

OSI model vs. TCP/IP model

- "TCP/IP is the most widely used protocol suite in networks today"
- "TCP/IP is the protocol of choice for the Internet and is also used on private networks"
- "OSI model is essentially an abstraction that is used to understand network communications"

OSI	TCP/IP
Application	Application
Presentation	
Session	
Transport	Transport
Network	Internet
Data link	Network Access
Physical	

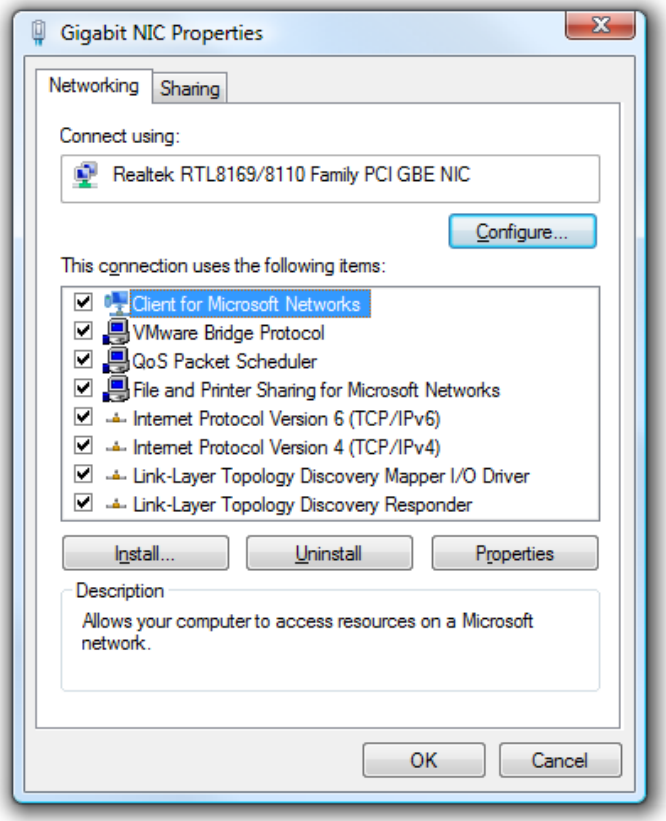
How to configure a NIC

- Install a NIC like any other expansion card
  - Disconnect the power
  - Insert card
  - Turn on computer
  - Install drivers if necessary
- If the NIC does not install automatically, then use the Add Hardware Wizard in Control Panel
- Link LEDs
  - Connectivity
  - Activity

How to configure a NIC

- You need a network client for each type of server NOS
  - Client for Microsoft Networks is automatically installed when you install a NIC in Windows

- IPCONFIG
- PING



Other technologies used to establish connectivity

- Telephone Lines
  - Analog Telephone
  - Integrated Services Digital Network (ISDN)
  - Digital Subscriber Line (DSL)
  - Asymmetric Digital Subscriber Line (ADSL)
- Power Line Communications
- Cellular
- TV Cable
- VoIP
- VPN

Other technologies used to establish connectivity

Telephone Technologies

- Digital Subscriber Line (DSL)
  - “Always-on”
  - Shares the telephone wire with analog signals to provide high-speed digital data communication
  - DSL has distance limitations
  - Voice information and the data carried by DSL must be separated at the customer site
- Asymmetric Digital Subscriber Line (ADSL)
  - Most commonly used DSL technology
  - Different bandwidth capabilities in each direction

Other technologies used to establish connectivity

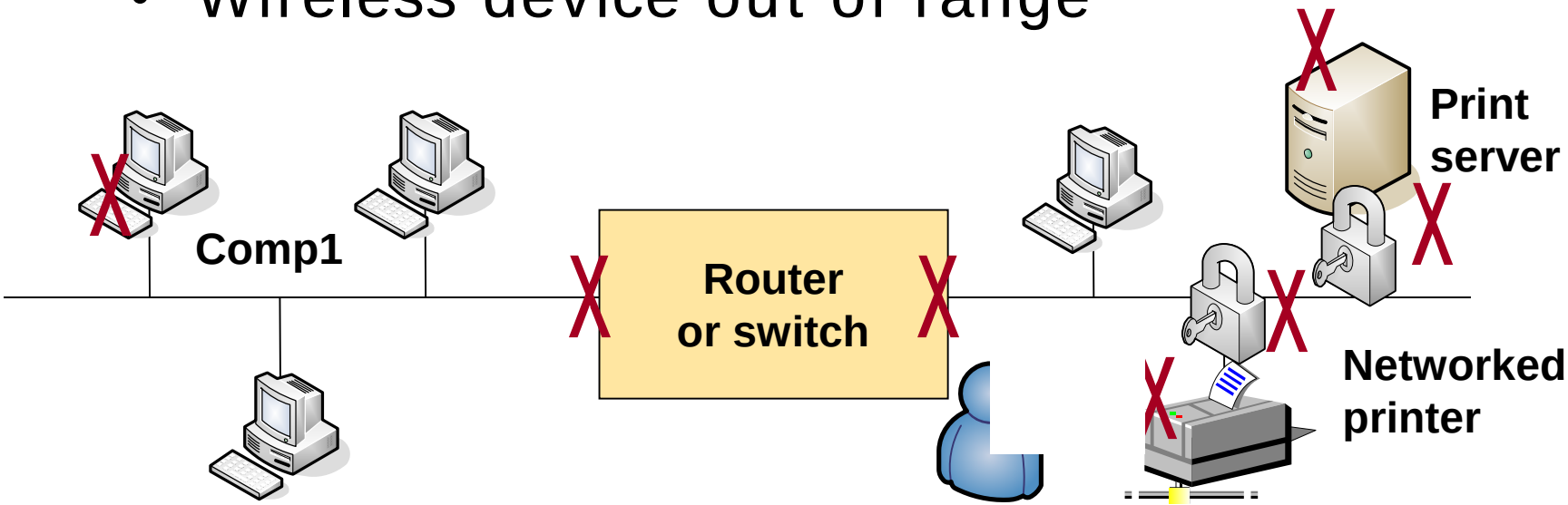
Power Line Communication

- Uses power distribution wires (local electric grid) to send and receive data
- An electric company can superimpose an analog signal over the standard 50 or 60 Hz AC that travels in power lines
- The analog signal can carry voice and data signals
- X10, HomePlug AV

Networks - Troubleshooting

If a user can't print from Comp1, it could be due to many possible network problems

- Cable unplugged
- Router or switch powered off
- Wireless device out of range



Networks - Troubleshooting

- Process
  - Identify the problem
  - Identify the cause
  - Identify solutions
  - Rank causes and solutions
  - Apply solutions
  - Test solutions
  - Document the procedure

- Check the book for some problem examples and possible solutions