

# Computer Networks

## Exercise Session 05

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# General Schedule

All exercises will follow this general schedule

- Identify potential understanding problems
  - Ask your questions
  - Recap of the lecture
- Address the understanding problems
  - Answer your questions
  - Repeat certain topics
- Walk through the exercises/solutions → Some hints and guidance
  - Work time or presentation of results

# Physical Layer: Technologies

You have seen . . .

- how **Ethernet** has evolved to become the most popular wired LAN technology
- which types of **WLAN** exist and how they differ
- what **Bluetooth**, piconets, scatternets, and **BLE** are

# Data Link Layer: Framing

You have seen . . .

- the main services of the Data Link Layer
- what link layer **frames** are and how they can be **marked**
- the specific design of **IEEE 802.3 (Ethernet)** and **IEEE 802.11 (WLAN)** frames

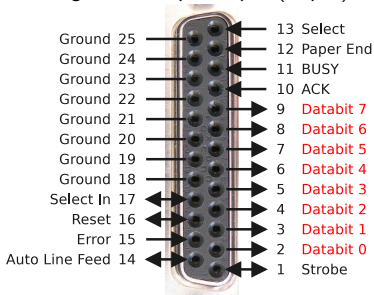
Any other questions left?



# Exercise 1: Guided Transmission Media

- Communication between computers is possible via **parallel** and **serial** data transmission
- With **parallel data transmission**, in addition to the control lines, **multiple** data lines exist
- Example: Parallel port which was the standard interface to connect printers until it was replaced by USB
  - Via this interface, an entire byte of data can be transferred per time unit
- Benefit: Higher throughput
- Drawback: Lots of lines are necessary
  - This is cost-intensive for long distances
- Usage: Local bus systems

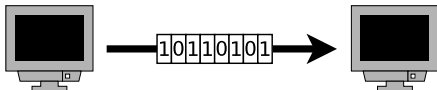
The image shows the parallel port (25 pins)



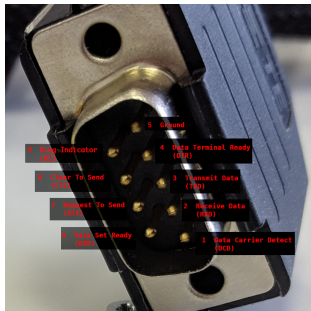
(e.g. ATA, SCSI, ISA, PCI, Front Side Bus, IEEE-1284 "printer port")

# Serial Data Transmission

- When **serial data transmission** is used, the bits are transmitted one after another via the bus
  - Transferring a byte takes 8 times longer compared to parallel data transmission (when using 8 data lines)
- Benefit: Can be used for long range distances, because only few wires are required
- Drawback: Less throughput
- Usage: Local bus systems and **computer networks**



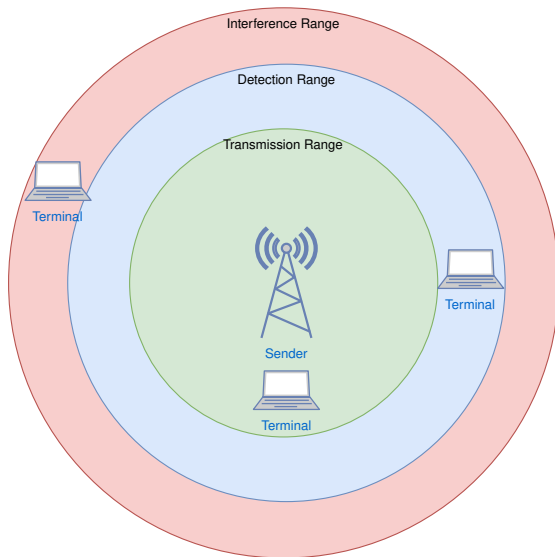
The image shows the serial port RS-232 (DB-9 = 9 pins)



Some serial network technologies

Ethernet, USB, CAN, FireWire, Fibre Channel (for SAN), InfiniBand

# Exercise 2: Unguided Transmission Media





## Exercise 2: Unguided Transmission Media

### ■ Wireless propagation phenomenons:

**Absorption** Different material absorb the energy of the radio wave

Material	Absorption
Human body	3 – 5 dB
Plain-Glass Window	3 – 8 dB
Wooden door	4 – 7 dB
Steel door	20 – 30 dB
Concrete Wall	20 – 30 dB

**Reflection** Waves being reflected from surfaces  
→ **multi-path fading**

**Diffraction** Radio waves are bent and spread when they encounter obstructing objects

**Scattering** Rough surfaces, dust, humidity, rain etc. cause scattered reflections

## Exercise 3: Technologies

- An **Ethernet repeater** or hub will **amplify** the received signal
- It has one port per connection
- A **WLAN repeater** (or extender or booster) often has only **one antenna**
- Hence, the throughput is reduced by 50 %
- In order to extend the range of WLAN typically multiple access points are used

# Exercise 5: Bridges and Switches



- Repeater, Switch, Router?
- On which layer?

# Link Layer Protocols

- HDLC (High-Level Data Link Control)
  - Standardized by ISO
  - Emerged from *Synchronous Data Link Control (SDLC)*
- SLIP (Serial Line Internet Protocol)
  - Specified by the IETF
  - Developed to transport IP over serial lines
- PPP
  - Successor of SLIP
  - Commonly used by ISPs (as Point-to-Point Protocol over Ethernet (PPPoE) and Point-to-Point Protocol over ATM (PPPoA))
- ATM
  - Standardized by ITU and ANSI
  - Uses small, fixed-sized cells for to eliminate jitter for voice communication