CS 716: Introduction to communication networks

- 12th class; 7th Sept 2011

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Clicker-1: Wireless v/s wired

- Which of the following differences between Wireless and Wired affect a CSMA-based protocol?

1. Wireless range/RTT is more than Wired.
2. Wireless losses/errors are more than Wired.
3. Wireless bandwidth is less than Wired.
4. Wireless lacks full connectivity.

Clicker-2: RTS/CTS

- What should be the contents of an RTS packet?

  1. Destination address.
  2. Source address and Destination address.
  3. Destination address and Packet size (duration).
  4. Source address, Destination address and Packet size.

- What should be the contents of a CTS packet?

Clicker-3: RTS-CTS

- Which of the following statements are True?

1. RTS-CTS is always required.
2. RTS-CTS is required only when there are too many stations.
3. RTS-CTS is required only for large packets.
4. RTS-CTS can be given as an option to the user.

Recap of previous class

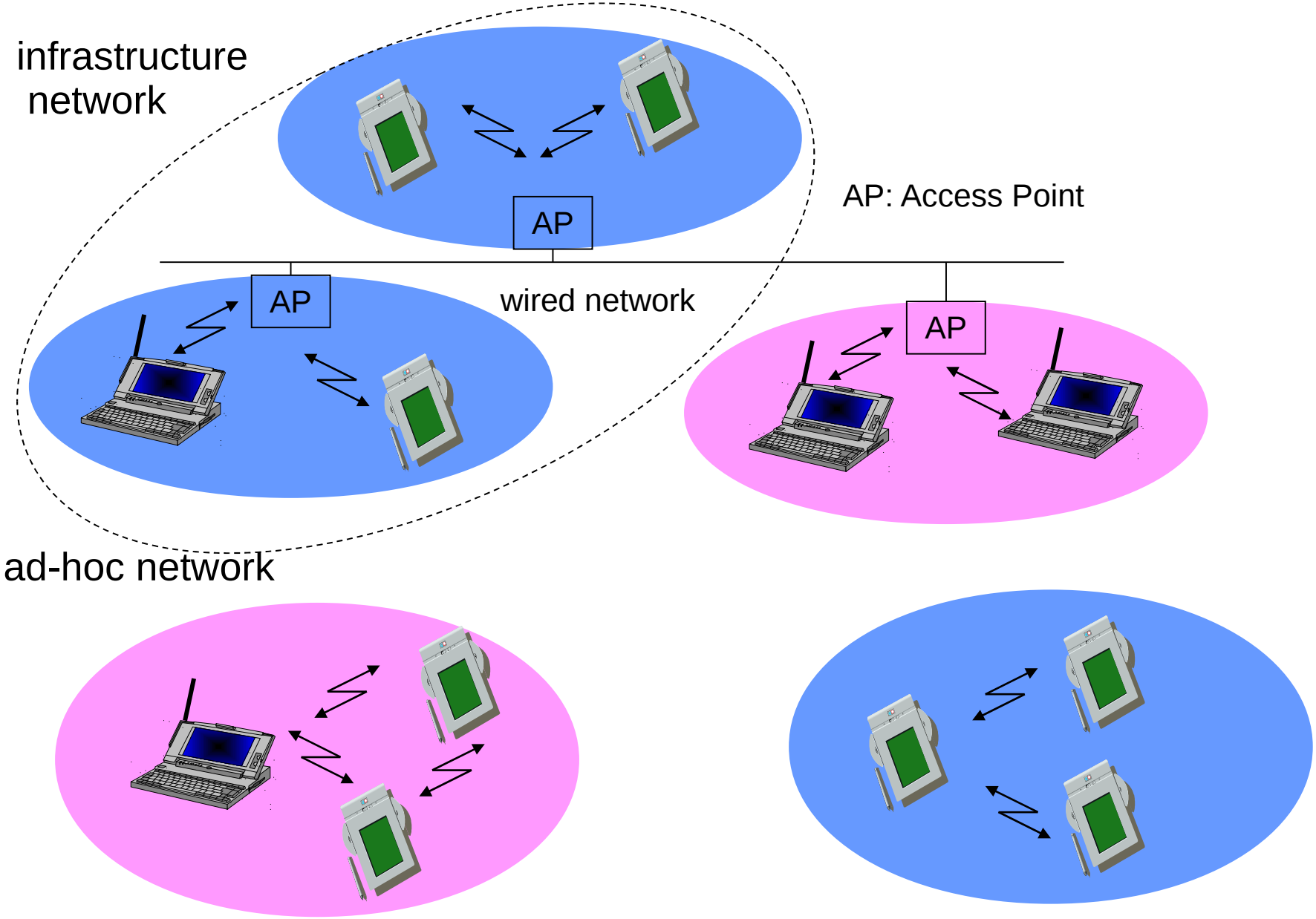
Topics covered: CSMA/CA, Backoff

- Difference between wired and wireless:
  - Wireless PHY boundaries are not fixed.
  - Wireless PHY may be time varying and asymmetric.
- Hidden terminal problem
  - CS (carrier sense) fails at sender.
  - CD (collision detection) fails at sender.
- CSMA/CA (Collision Avoidance)
  - RTS-CTS-Data-Ack mechanism.
  - Binary exponential backoff mechanism.

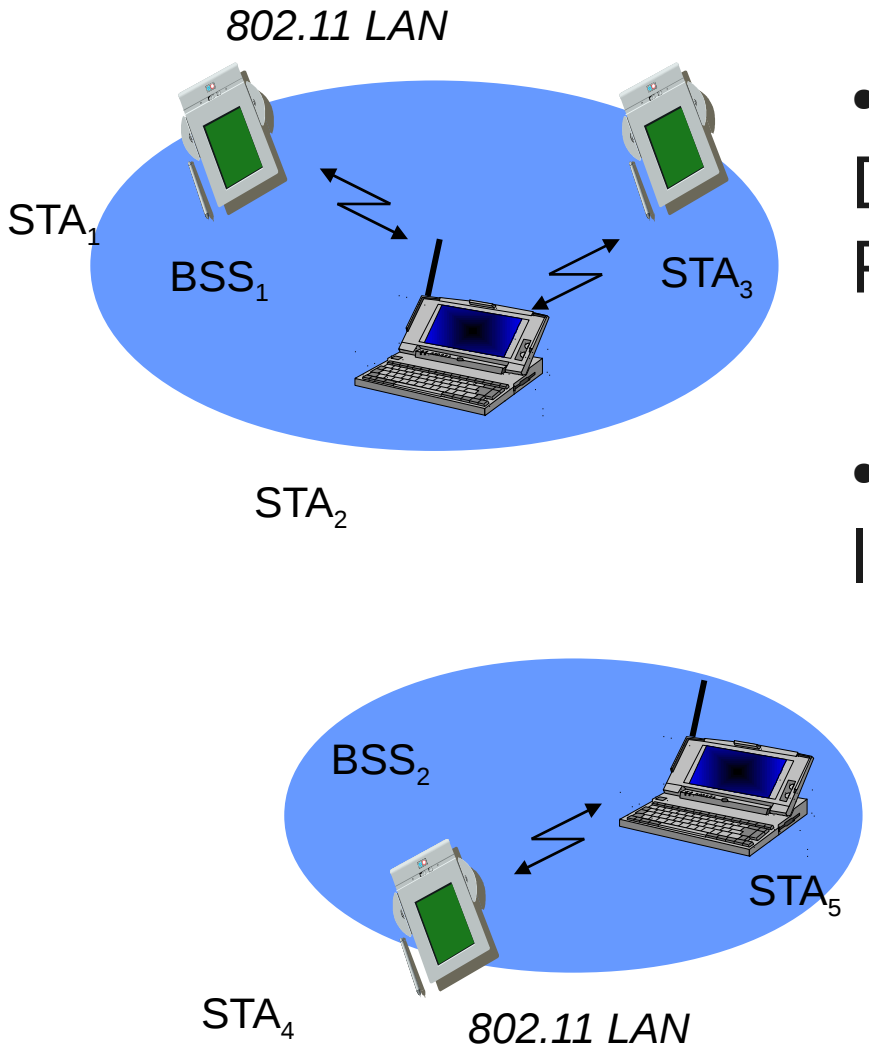
IEEE 802.11 (popular as WiFi)

- Standards covers the MAC sublayer and PHY layers
- Three different physical layers in the 2.4 GHz band
  - FHSS (Frequency Hopping Spread Spectrum)
  - DSSS (Direct Sequence Spread Spectrum)
  - IR (Infra Red)
- OFDM (Orthogonal Frequency Division Multiplexing) based PHY layer in the 5 GHz band

Infrastructure and Adhoc Networks



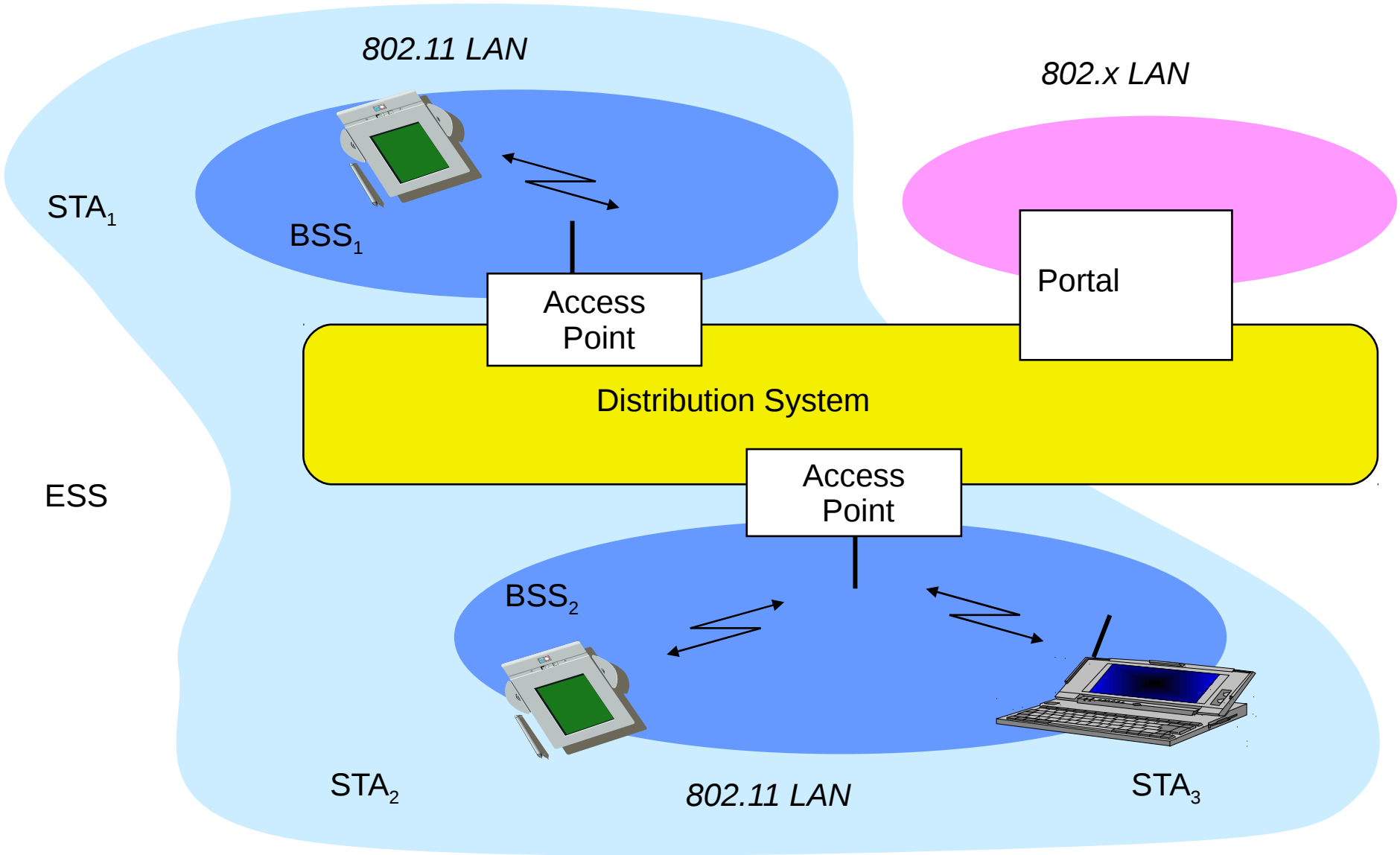
802.11 - ad-hoc network (DCF)



- This mode is known as DCF – Distributed Co-ordination Function.

- Direct communication within a limited range
  - Station (STA): terminal with access mechanisms to the wireless medium
  - Basic Service Set (BSS): group of stations using the same radio frequency

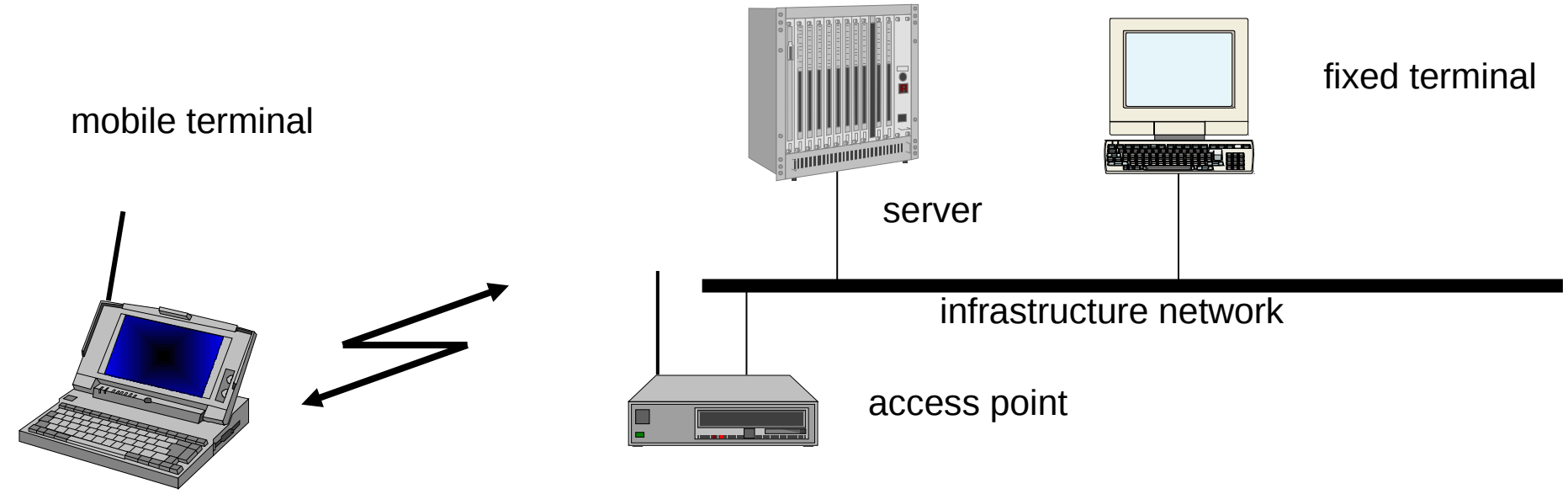
802.11 - infrastructure (PCF) Point Co-ordination Function

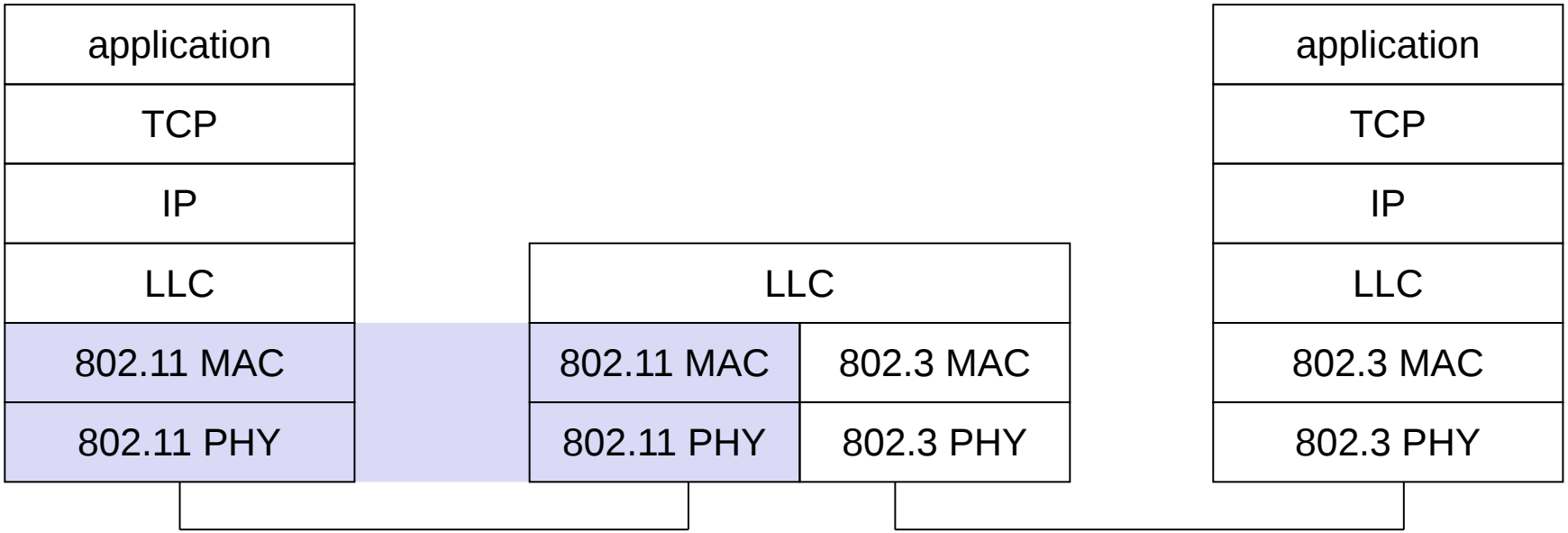


PCF components

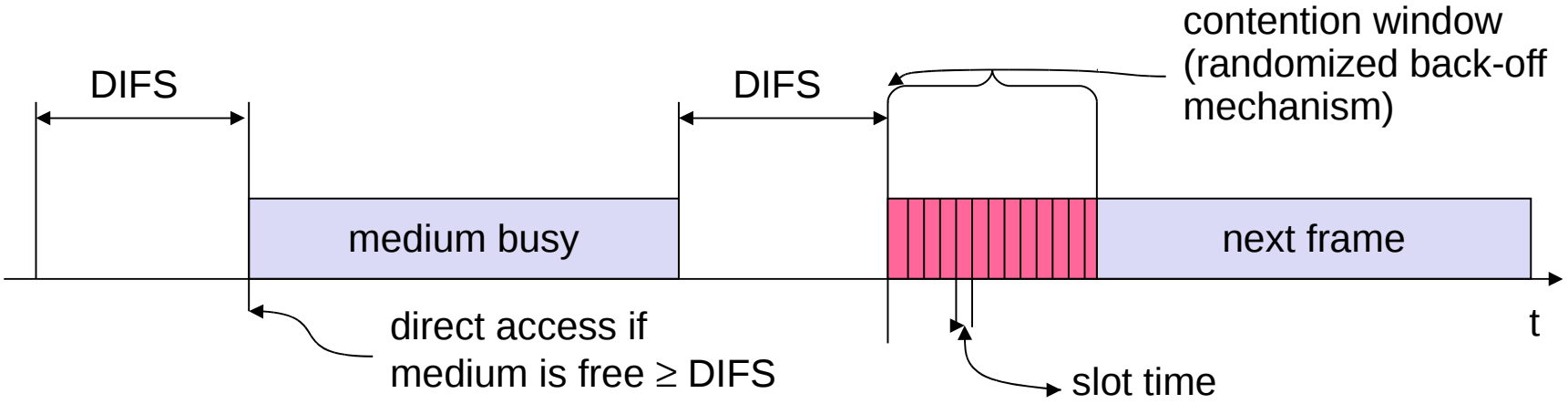
- Station (STA): terminal with access mechanisms to the wireless medium and radio contact to the access point
- Basic Service Set (BSS): group of stations using the same radio frequency
- Access Point: station integrated into the wireless LAN and the distribution system
- Portal: bridge to other (wired) networks
- Distribution System: interconnection network to form one logical network (EES: Extended Service Set) based on several BSS

802.11- in the TCP/IP stack





802.11 - CSMA/CA



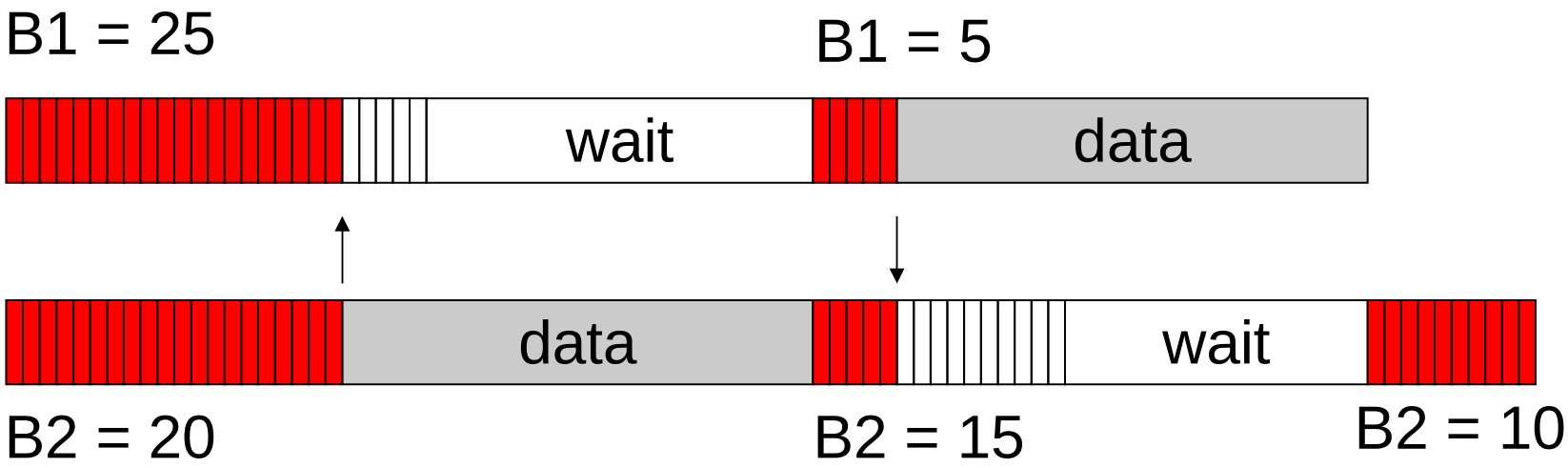
- station ready to send starts sensing the medium (Carrier Sense based on CCA, Clear Channel Assessment)
- if the medium is free for the duration of an Inter-Frame Space (IFS), the station can start sending (IFS depends on service type)

802.11 – CSMA/CA

- if the medium is busy, the station has to wait for a free IFS, then the station must additionally wait a random back-off time, after the medium becomes free again. (collision avoidance, multiple of slot-time)
- if another station transmits during the back-off time of the station, the back-off timer is paused. (fairness)
- When back-off counter reaches 0, transmit.

DCF Example

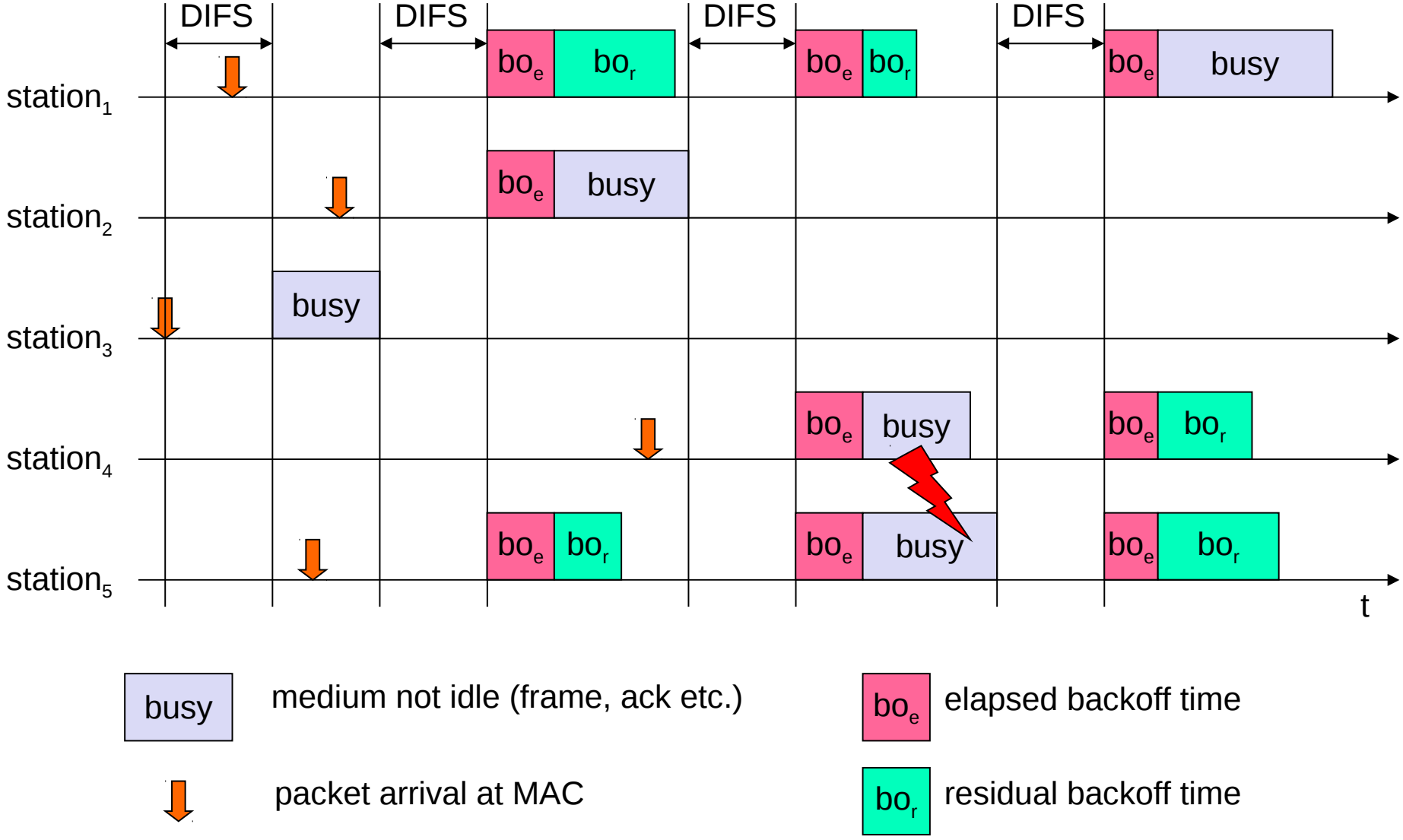
- When transmitting a packet, choose a backoff interval in the range [0,cw]; cw is contention window



cw = 31

B1 and B2 are backoff intervals at nodes 1 and 2

CSMA/CA – Group Activity 1



- Choose values of the backoff counters so that the above timing diagram is valid.

Clicker-4 - Contention Window

- **Question: How to choose the range for cw?**

1. Choose from a fixed small interval, say [0..16].
2. Choose from a fixed large interval, say [0..256].
3. Choose depending upon the number of stations.
4. Choose from a dynamic interval; begin with a small interval and increase it upon each collision.
5. Begin with a large interval and decrease it with each successful transmission.

802.11 - Congestion Control

•Contention window (cw) in DCF: Congestion control achieved by dynamically choosing cw

•*large* cw leads to larger backoff intervals

•*small* cw leads to larger number of collisions

Binary Exponential Backoff in DCF:
When a node fails to receive CTS in response to its RTS, it increases the contention window
cw is doubled (up to a bound CWmax)
Upon successful completion data transfer, restore cw to CWmin

Reflection

- What did I learn in today's class?
- Each student to mention one point.

- Take-home questions:
  - What is the need for DIFS?
  - Is there a need for shorter IFS (silence periods)?