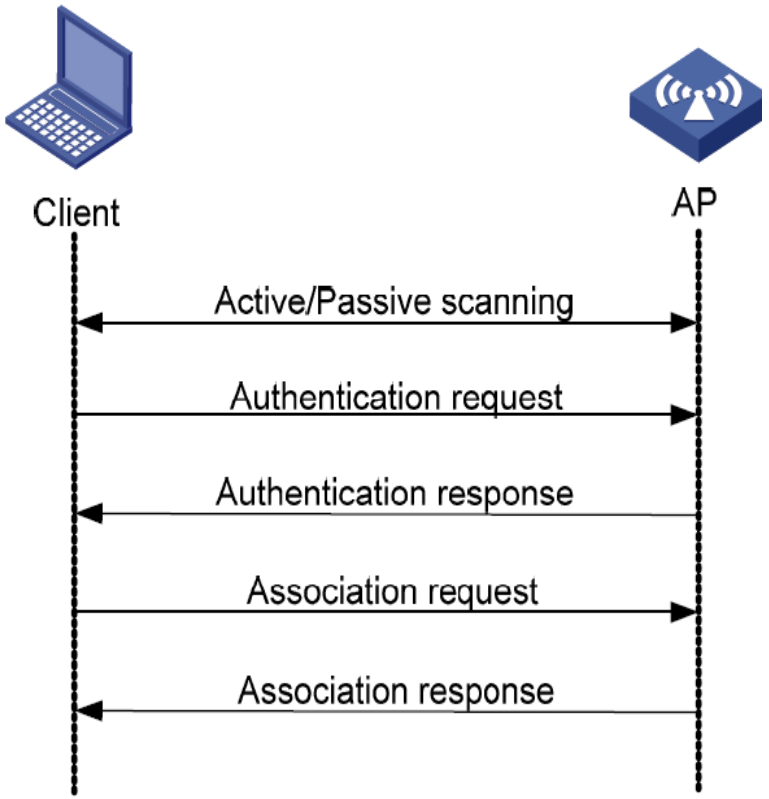
Introduction to Wireless LAN II

WLAN MAC LAYER

- Medium Access Control (MAC) – sub layer of Data Link Layer
- In WLAN, MAC layer is responsible to control how the MSs behave towards the channel.
- Some of the tasks of MAC layer in WLAN:
  - Scanning
  - Authentication
  - Association
  - Power saving mode



MAC Layer Operation Mode

- In WLAN, the medium to be access is the Radio Frequency (RF), which is a shared medium.
- All MS and AP can only hear one frequency at a time to communicate with each other, there must be turns for the MS to use the RF – avoid collisions.
- Reason to avoid collisions
  - Degrade performance.
  - To avoid packet/data loss at receiver.

MAC Layer Operation Mode

- Coordination Function
  - Process for the MS to take turns using the medium
  - A way to avoid collisions
- In IEEE 802.3 wired network, the *Carrier Sense Multiple Access/ Collision Detection (CSMA/CD)* is used to detect collision
- In wireless networks IEEE 802.11 , it is impractical to transmit and receive on the same radio channel at the same time
- In wireless networks, CSMA/CD is not suitable
  - MS cannot transmit data and listen to any collisions at the same time
  - The medium itself can only be used for either one of this process; receive or transmit
  - we cannot assume that all stations hear each other (which is the basic assumption of the collision detection scheme)

IEEE 802.11 Coordination Function

- For WLAN, *Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) is used* to avoid collision

- IEEE 802.11 standard defines two types of coordination function;
  - **Distributed Coordination Function (DCF)** – for asynchronous contention based distributed access to the channel.
  - **Point Coordination Function (PCF)** – for centralized, contention-free access

Distributed Coordination Function (DCF)

- CSMA/CD is used to handle collisions after it occurs (by retransmitting the damaged packet) but CSMA/CA avoids the collisions altogether
- **DCF** adopts the IEEE 802.3 CSMA/CD mechanism with several modifications, known as the **CSMA/CA**
- **DCF** is used specifically for the contention-based channel access method

Distributed Coordination Function (DCF)

- Any MS can attempt to transmit data at any time it wanted
- Problem occurs when two computers start to transmit data at the same time, where a collision will occur
- To avoid collisions, the MS must firstly listen to the network (carrier sense) to make sure no other MS are transmitting data

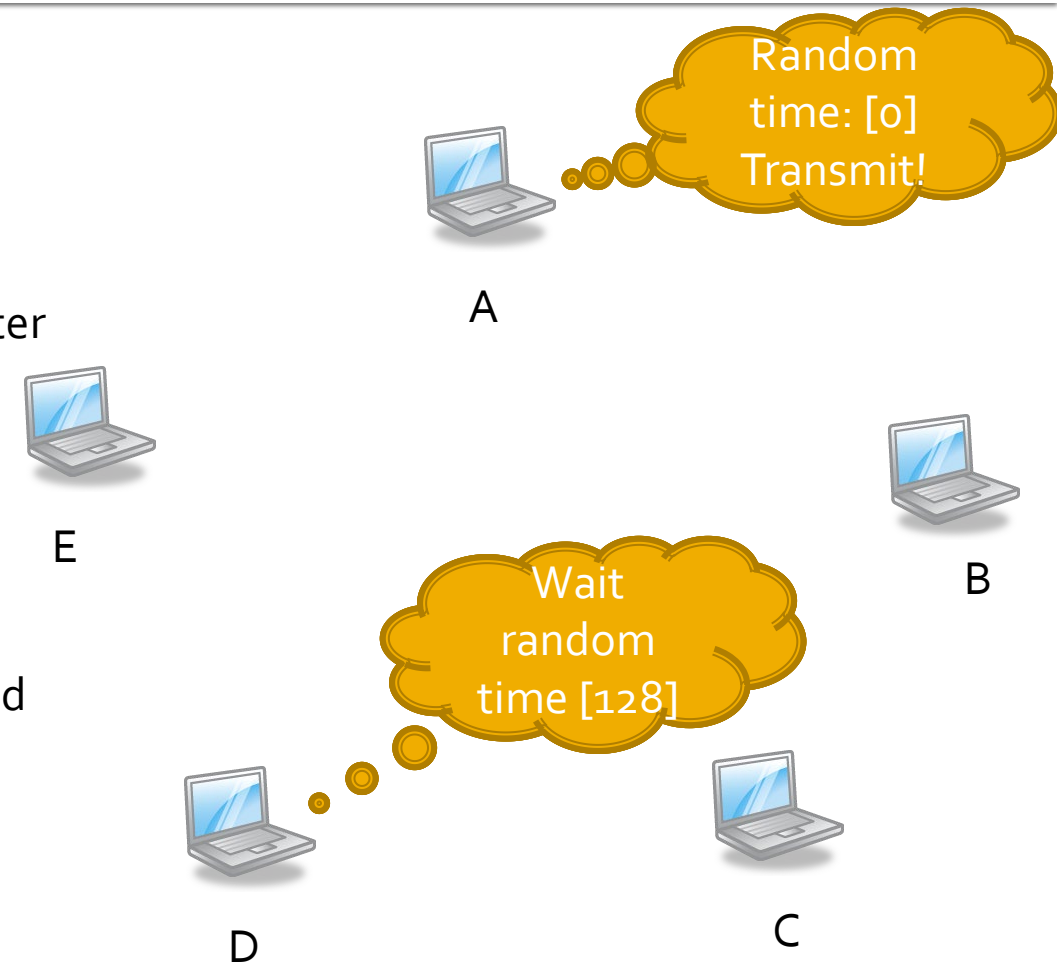
Distributed Coordination Function (DCF)

A and D wants to transmit data

A and D identifies the network is idle

A and D do not transmit data directly after identifying that the network is idle. Instead A and D wait for a random amount of time (contention period)

When the network is identified as idle for the contention period of time, the node with the shortest contention period will transmit the data



Distributed Coordination Function (DCF)

- CSMA/CA has all the MS to wait for a random amount of time, T_{wait} before transmitting data
- T_{wait} consists of **DCF Interframe Space (DIFS)** and **Backoff Interval (BI)**, shown as below equation

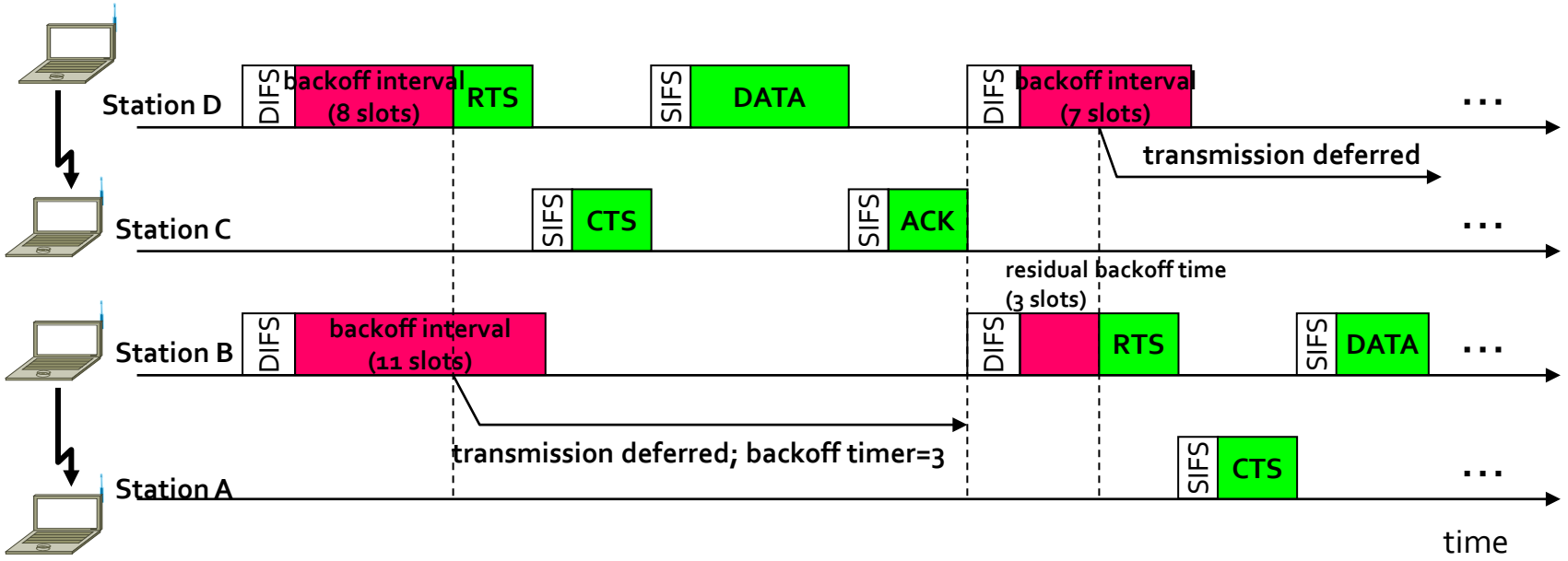
$$T_{wait} = \textbf{DIFS} + \textbf{Backoff Interval (BI)}$$

- BI is random number, generated from a range of values called the Contention Window (**CW**).
- Extra notes:

http://www.invocom.et.put.poznan.pl/~invocom/C/P1-4/p1-4_en/p1-4_8_2.htm

Distributed Coordination Function (DCF)

Scenario:
Firstly, Station D wants to send data to Station C
After data is successfully from D to C, B is then transmitted data to A



RTS : Request to Send, CTS:Clear to Send

Point Coordination Function (PCF)

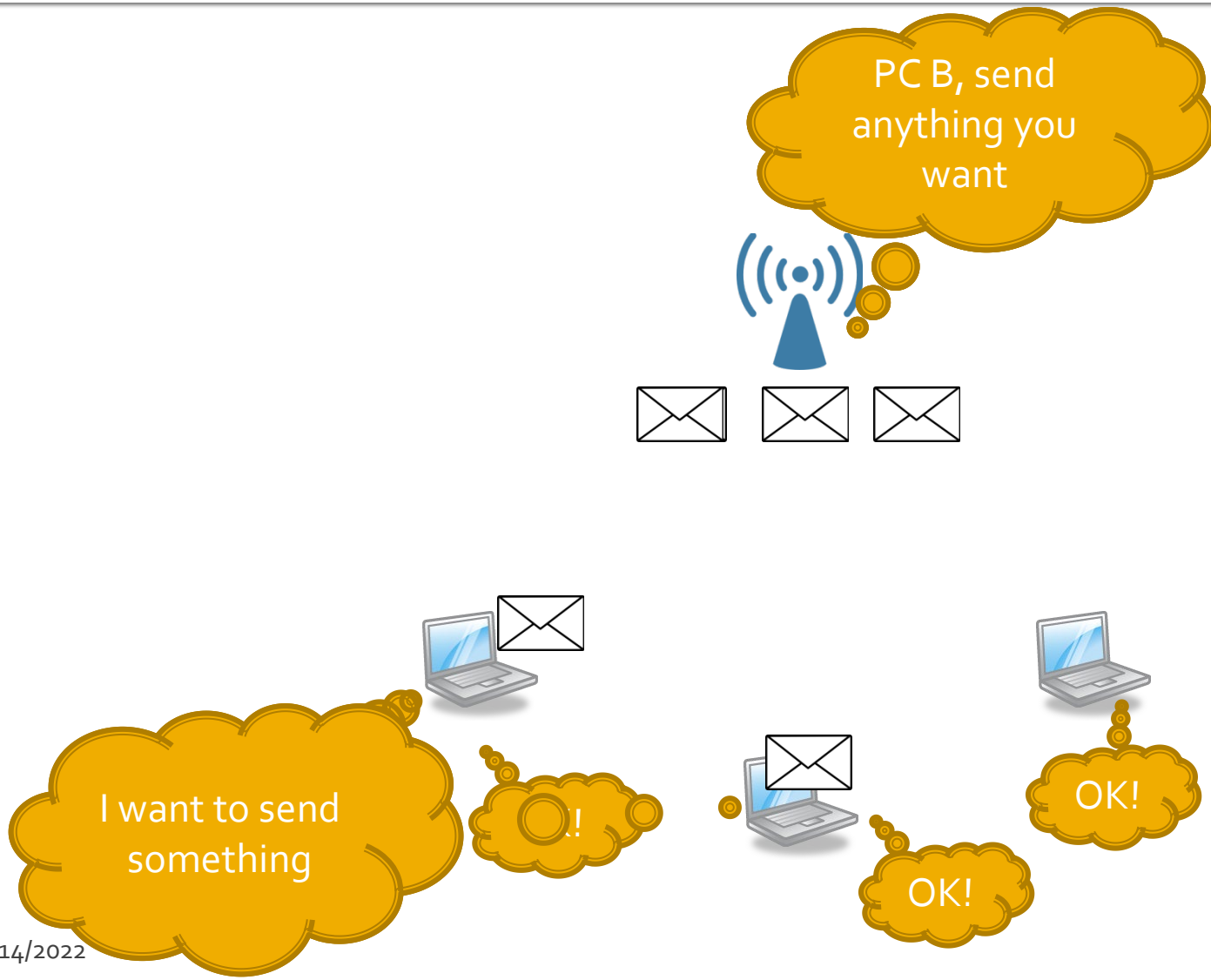
- contention-free based method to access the channel
- a point coordinator, usually an AP is required to coordinate the polling process
- AP follows the **PCF Interframe Space (PIFS)** interval as a basis for accessing the medium
- The AP senses the medium at the beginning of each contention-free period
- If the medium is idle after the **PIFS** interval, the AP sends a beacon frame to start polling

Point Coordination Function (PCF)

- One of the fields of the beacon frame contains a value that indicates the length of time that **PCF** (polling) will be used
- When the MS received the beacon frame, the MS must not do any transmission for that length of time
- Then the AP sends out another frame to a specific MS, granting permission to transmit data to any destinations
- If it has nothing to send, the MS will send back a null data frame back to the AP
- each MS on the wireless network will be asked in sequence, whether they wanted to transmit data.
- If an MS wants to transmit the data, the network will give permission to the MS to transmit data, while the other MS must wait.

- http://www.invocom.et.put.poznan.pl/~invocom/C/P1-4/p1-4_en/p1-4_8_2.htm

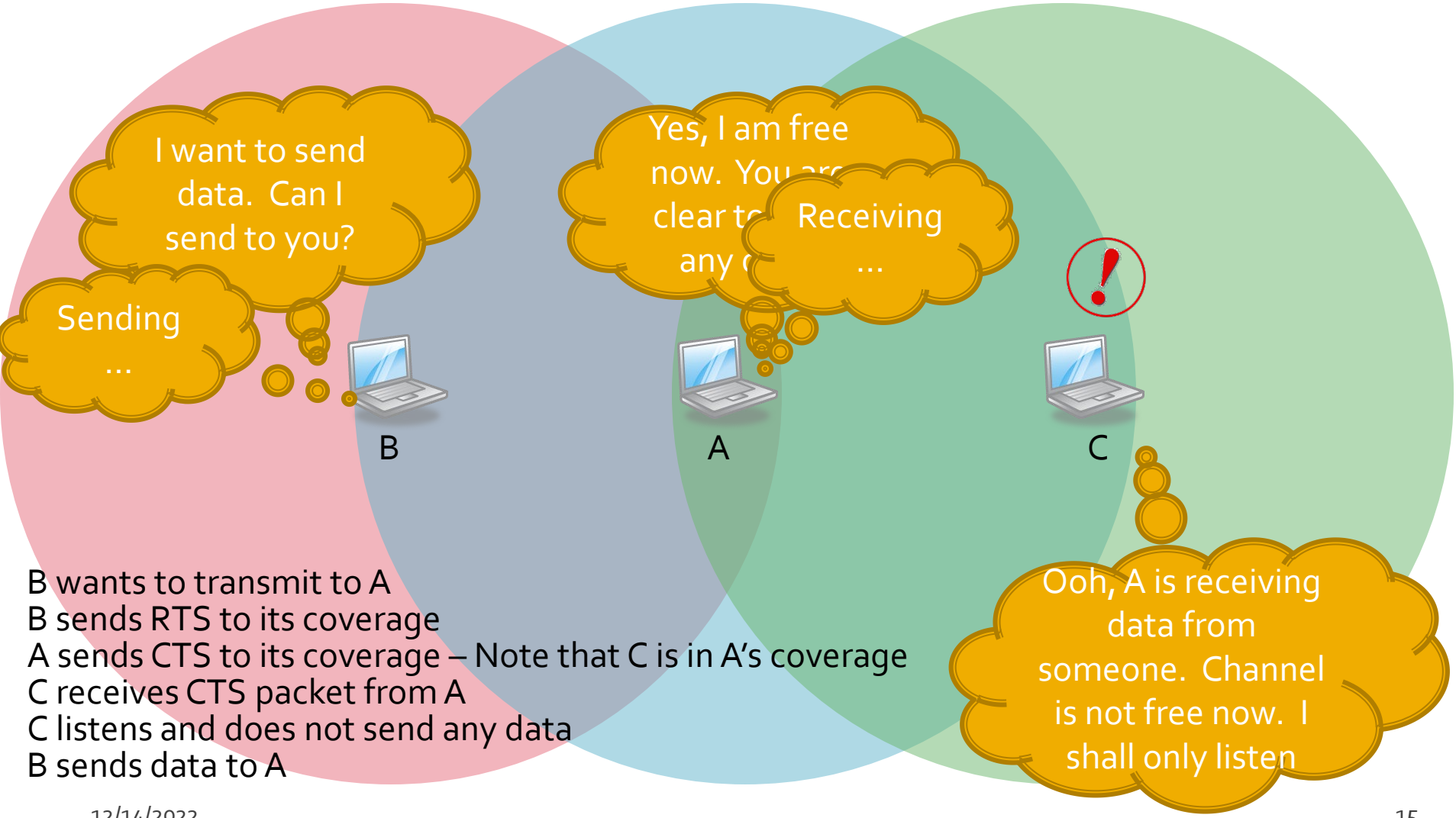
Point Coordination Function (PCF)



Request to Send/ Clear to Send (RTS/CTS)

- RTS/CTS is another option for collision avoidance.
- RTS/CTS is used for Hidden Node scenario

Request to Send/ Clear to Send (RTS/CTS)



B wants to transmit to A
B sends RTS to its coverage
A sends CTS to its coverage – Note that C is in A's coverage
C receives CTS packet from A
C listens and does not send any data
B sends data to A