

# WIFI

## → Types of connections

- Point-to-Point (line of sight)
- Diffusion networks (no physical relationship, eg. 802.11)
- Semi-diffusion networks (some limitations on position e.g. infrared)

## → Cell

Smallest physical entity that allows the access to mobile entities (not point-to-point connection). Terminal oriented or defined by a base station.

Cell coverage size is variable, depends on tech and number of users.

### Advantages:

- capacity, users, less power, robustness

### Disadvantages:

- uses cabled network between cells, many handovers, interference.

## → Wireless Networks

Designed according to number of users and coverage area.

Types: WLAN (campus), PANs (personal), Cellular, Satellite, WSN

## Frequency bands:

2.4 - 2.4835 GHz  $\rightarrow$  IEEE 802.11

5 GHz  $\rightarrow$  IEEE 802.11, HyperLAN

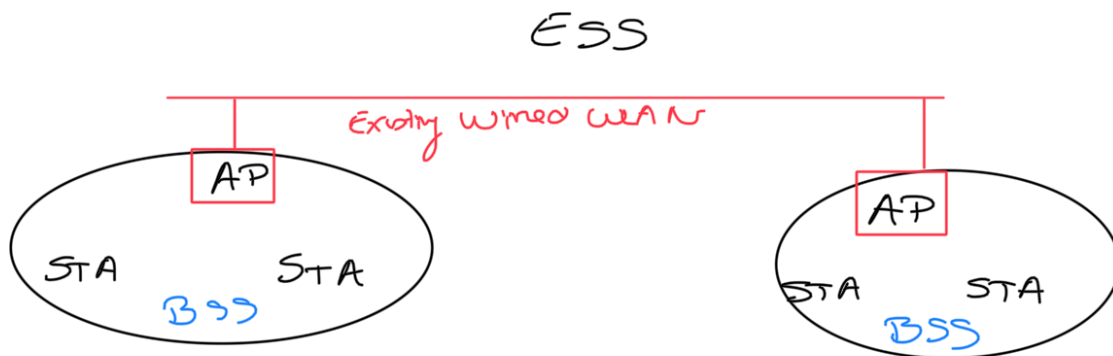
## $\rightarrow$ 802.11

Standard: Focus on link and physical layers of the network stack.

5 physical layers:

- Freq. hopping spread spectrum
- Direct seq. spread spectrum
- infrared
- 11 Mbps - 2.4 GHz
- 54 Mbps - 5 GHz

## $\rightarrow$ 802.11 Architecture



BSS  $\rightarrow$  Basic Service Set

ESS  $\rightarrow$  Extended Service Set

STA  $\rightarrow$  Mobile terminal

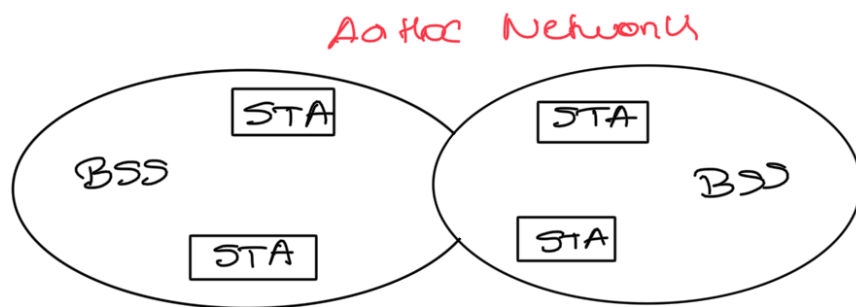
AP  $\rightarrow$  Access point

DS  $\rightarrow$  Distribution system (entity that contains interconnects APs. Interconnects multiple BSS. Logically separates the wireless medium from

the distribution system.

An AP is a STA that provides access to the DS by providing DS services in addition to acting as a STA.

Data moves between BSS and DS via an AP.



↳ Infrastructure vs Ad Hoc mode

stations communicate with one or more access points

multi-hop,  
requires no  
infrastructure.  
rarely used.  
Based on  
independent BSS.

→ 802.11 Channels

2.4 GHz : 511Hz apart (best 1, 6, 11)

5GHz (5.2 - 5.7) : 511Hz apart

→ 802.11 MAC Overview

- Collision avoidance (RTS & CTS)
- Automatic repeat request

- Two operating modes (infra-structured (AP) or ad-hoc (no AP)).

- MAC management
- Fair control access
- Protection of data
- Reliable data delivery.

### 802.11 Frames

Three types:

- control: RTS, CTS, ACK
- Management
- Data

### → MAC Layer

- Asynchronous data service (DCF)
  - CSMA / CA
  - RTS (CTS)
- Timing - controlled service (PCF)
  - Polling
- Inter-frame spacing (IFS)

**Carrier sense multiple access**: before transmitting a packet, sense carrier (if idle, send; if busy, wait for medium to be idle). Wait for ack (if there is one, you are done, else assume collision and re-send).

**Exponential backoff**: force station to wait a random amount of time to reduce chance

of collision.

Use of **RTS** and **CTS** to avoid collisions (controlled by RTS threshold, number of retries is limited)

**Synchronization**: TSF → beacons of the AP are sent in well-defined instants. (content of packet is that instant).

## **Power management** (infrastructure)

- APs buffer packets to stations in power saving mode (beacons, multicast and broadcast).

- STA in power saving mode wake up periodically to listen for beacons.

- TSF assumes AP and STAs are in sync.

→ How does a station connect to an AP?

**SSID**: mechanism used to segment wireless networks.

Each AP is programmed with a SSID that corresponds to its network.

## ↳ Association Management: Scanning

**Scanning** is needed to:

- Find and connect to network
- Find a new AP in roaming

**Passive scanning**: STA simply listens to beacons and gets info of the BSS. Saves power

**Active scanning**: STA transmit probe request, elicits probe response from AP. Saves time.

### ↳ Association Management: joining

- STA must associate with AP before they can use the network.

- re-association (roaming): association is transferred.

- Disassociation: station or AP can terminate the association.

- STA can detect AP based on scanning.

### ↳ Roaming

STA changes network (BSS). It may go outside the coverage area of AP but still under coverage of other AP → reassociate the STA with the new AP allows the communication to continue.

1. STA decides signal with current AP is bad

2. STA does scanning to find new AP

3. STA reassociates with new AP.

- a. with positive answer: STA changes network to new AP, AP informs ESS

- b. without positive answer: STA does new scan.

### ↳ Attachment to a BSS

- Scanning / Probing

- Authentication / Association

→ Wi-Fi 'extenders'

- Inexpensive
- Setup new SSID and forward info to original
- Multi-hop

→ **Easy Mesh** : multiple APs at home or small office.

↳ uses: - discovery

- push-button configuration

- backhaul communication

Architecture : - controller (must have one).

- agent

- device