4th Year IT-IS-SW

Final Revision 2

Hand Off

انتقل من BS لـ BS تابعة لـ Cell تابعة

- A handoff refers to the process of transferring an active call or data session from one cell in a cellular network to another or from one channel in a cell to another.

يستخدموا Freq مختلفة

- Changing frequency resources from one cell to another adjacent cell by a MS with an active call attenuation يوصل Freq يستخدموا نفس

- Handoff depends on:
  - Cell size
  - Boundary length
  - Signal strength
  - Fading
  - Noise

mel ⇒

- Signal strength is affected by:
  - Height of the transmitting antenna
  - Presence of hills, valleys, and tall buildings
  - Atmospheric conditions

- **MS periodically measures signal strength of BS of the cell where MS is currently located**
- If signal strength drops below a threshold, the MS will ***handoff*** to another adjacent cell (BS)

Handoff Types

- **Hard handoff** (break before make)
  - Release current radio resource from BS before acquire new resources from next BS
  - → FDMA and TDMA
- **Soft handoff** (make before break)
  - Communicate with both current and next BS for a short time period
  - → CDMA → 2.5 G

Frequency Reuse

تعريف

- A frequency band or channel in a cell can be *reused* in another cell if those cells are apart and there would be no interference
  ← بعيده
  بس لازم أحقق reuse distance

- In real world, there are two parameters that determine the coverage of each base station and interference to other calls
  BS بأثر على بناء

① ➢ **Path Loss**

model that describes signal attenuation between Tx and Rx antennas as a function of the propagation distance and other parameters

هام ← $L(dB) = 10n\log_{10}(d) + C$

- n → path loss exponent (2 to 4 in free space and 4 to 6 in indoor environments) من 9
- d → distance between Tx and Rx
- C → constant for system loss

② ➢ **Link budget**

formal way for calculating the Signal to Noise Ratio (SNR) and determine how much antenna transmitter power is needed

Distance Reuse

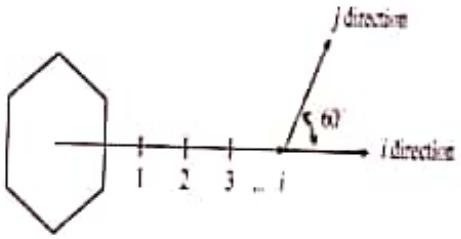
The closest distance between the centers of two cells using the same frequency

$$D = \sqrt{3NR}$$

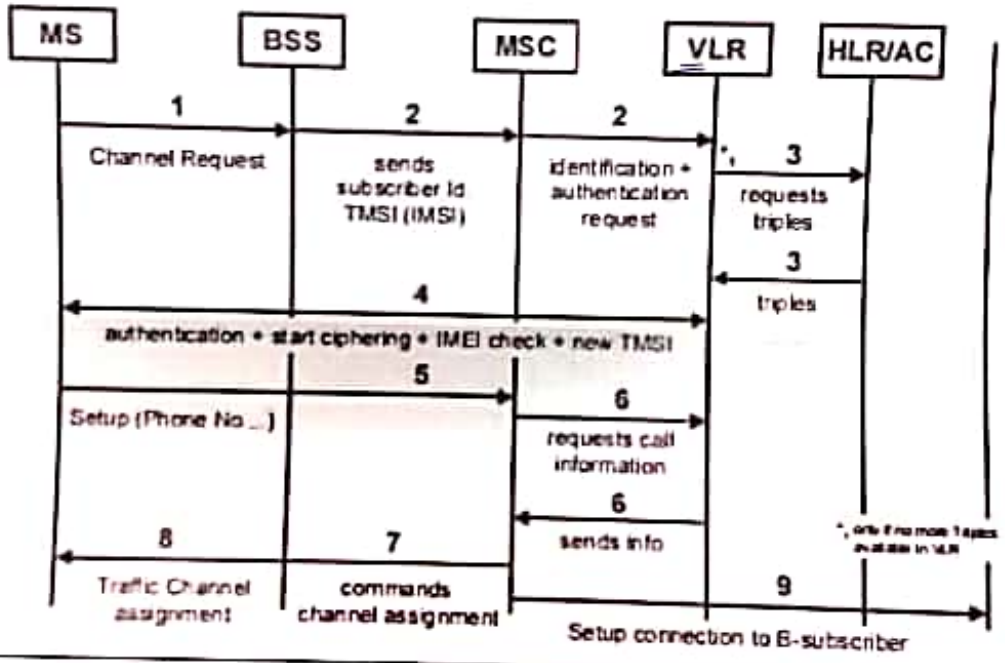
- **N (number of cells in a cluster)**
- **R (cell radius)**

Cluster of cells

- Group of cells using different frequencies
- Cluster size N is usually set to 1, 3, 4, 7, 9, ...
- $N = i^2 + ij + j^2$ → ΓLe
  - i is number of cells in along direction
  - j is number of cells in direction 60^o to direction of i



Steps of Call Setup



Two operations that network can identify subscriber location

Location update	Paging
MS sends location to BS	Cellular network sends location request to BSs to find user
Power Cost on user	Network Overhead and Cost

- Techniques of Location update
  - **Global**: all subscribers update their location
  - **Local**: subscriber chooses and where to update location
  - **Static**: predetermined set of cells at which location updates must be performed
  - **Dynamic**: location update is generated by MS based on its mobility

Location Management Scheme

Techniques	Description	Disadvantage
1. Never Update Scheme	• MS never tells its home MSC where it is • When network needs to forward new call to MS, it *pages* all service area	• Very expensive for network
2. Always Update Scheme	• Whenever MS detects that it entered a new cell, it sends a location update to MSC	• Expensive to MS
3. Location Area Scheme	• Divide service area into *location areas* (LAs) • When an MS enters a new LA, it updates its location with MSC (usually the manager of the LA) • When the network needs to find an MS, it pages its current LA	• Cost of paging related with number of cells in location area

4. Reporting Cell Scheme	• Select subset of cells as reporting cells • Vicinity is all non-reporting cells reachable from reporting cell • MS update location when it moves to new reporting cells • Cellular network pages MS in reporting cell and its vicinity	• Cost of paging related with size of vicinity
5. Time based Scheme يحدد وقت معين ويعمل update	• MS updates its location every T units of time • When Cellular system has incoming call from MS, it pages cell where last update was made • If MS is not found, Cells with the previous update is paged Until MS is found	• Cost of paging related with length of T unit
6. Movement Based Scheme كل مجموعة خطوات بلغت الى للك معين	• MS has counter that is increased by 1 when MS crosses to a new cell • When counter reaches a threshold, MS updates its location and resets counter to zero	• Cost of paging related with size of counter

WLAN

- Based on the IEEE **802.11** standard but with different version

	802.11 a	802.11 b	802.11 g	802.11 n
Frequency Range	5-6 GHz	2.4-5 GHz	2.4-5 GHz	2.4-5 GHz
Speed	Up to 54Mbps	Up to 11Mbps	Up to 54Mbps	Up to 200Mbps

- Easy installation, cost efficient
- Wireless stations are either *wireless access points (AP)* , *host devices*
- 802.11 b use DSSS (direct sequence spread spectrum in physical layer)
- Spectrum divided into 11 channels with different frequencies
- AP admin choose frequency for AP
- Interference and collision possible (if channel can be same as that chosen by neighboring AP)

Wifi Connection Steps

1. **Beacon frame** is sent periodically from AP to announce its presence and provide the SSID and other parameters for hosts within range (host listening for beacon frames)
2. **Authentication frame** is sent by host to the AP containing its identity (MAC address)
3. AP responds with an **authentication response** frame of its own indicating acceptance or rejection
4. **Association request frame** is sent from host with its supported data rates, and the SSID of the network to AP and request for IP address with DHCP
5. If **request is accepted,** AP reserves memory and establishes an association ID for the host through an **association response frame**

PASSIVE and ACTIVE Scanning

host الي طريقة ← active, Passive

Passive Scanning

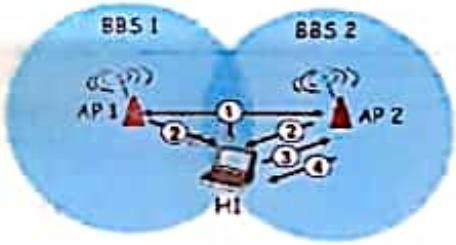
host → Passive

1. Beacon frame sent from AP
2. Association request frame sent from host to select AP
3. Association response frame sent back from AP to host if connection is accepted

Active Scanning

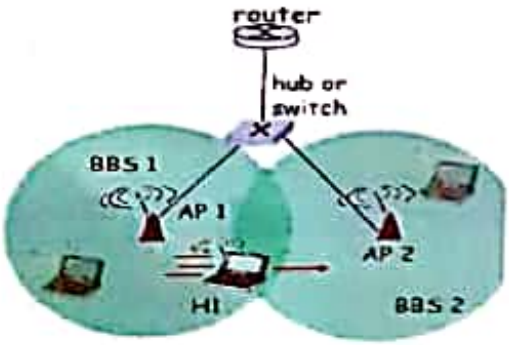
host → active

1. Probe Request frame broadcast from host
2. Probes Response frame sent from APs
3. Association request frame sent from host to select AP
4. Association response frame sent back from AP to host if connection is accepted



WLAN Handoff

- H1 can detects weakening signal from AP1 → BS كأنه
  - If SNR decreases, BER increases عاملين مهمين
  - Because of, node moves away from BS عشان اتحقق من weak signal
  - When BER becomes too high
  - Then, host must switch to lower transmission rates but with lower BE



Power Management in WLAN

- node-to-AP: "I am going to sleep until next beacon frame" (power management bit in header)
  - ✓ AP knows not to transmit frames to this node
  - ✓ node wakes up before next beacon frame (every 100 msec)

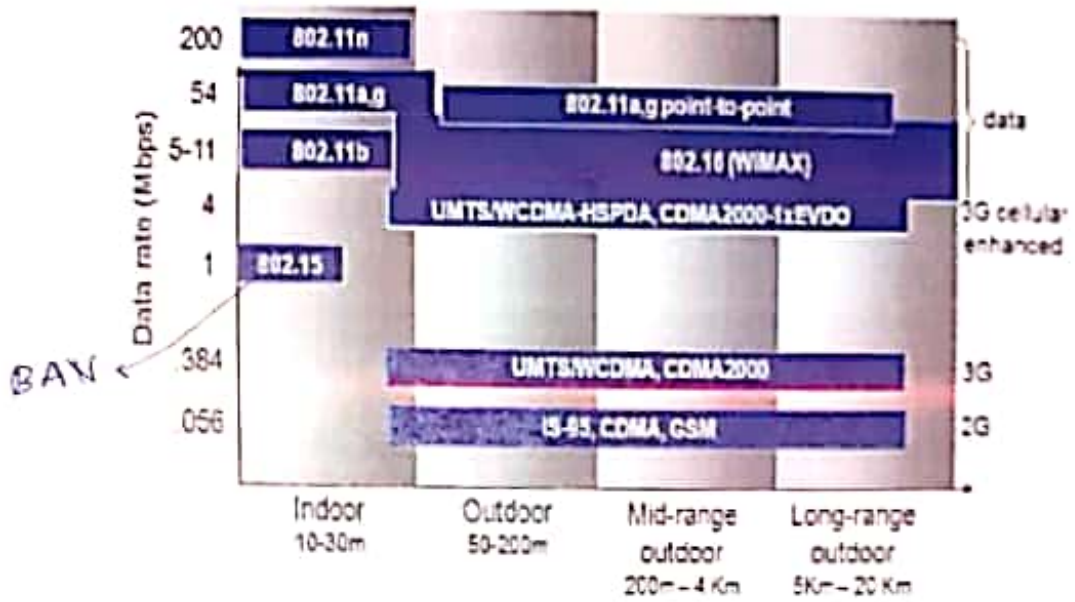
- beacon frame (AP-to-node): contains list of mobiles with buffered AP-to-mobile frames
  - ✓ node will stay awake if AP-to-mobile frames to be sent
  - ✓ otherwise sleep again until next beacon frame

PAN Network → Bluetooth

- IEEE 802.15
- less than 10 meters
- technology used to replace cables of mouse and keyboards
- used in ad-hoc (no infrastructure)
- Bluetooth involved (2.4-2.5GHz and up to 721kps)
- use master and slave model
  - ✓ slave request permission to send to master
  - ✓ master grants requests

WiMax Network

- IEEE (802.16)
- like 802.11 cellular network base station model
- transmission between hosts to/from BS using (omnidirectional antenna)
- transmission between BS each other using (point to point directional antenna)
- unlike 802.11
  - ✓ range 6 miles (city – with 14Mbps



Cellular Network Generations

1G Systems

- Used for analog services (Radio broadcasting, Phone Voice Call)
- Use FDMA

2G Systems

- Used for voice channel
- Combined use of FDMA and TDMA
- Use **GSM** (global system for mobile communication technology)

2.5G Systems

- Used for voice and data channel (2G extensions)
- Use CDMA-2000 with data rates up to 144K
- Use **GPRS** (general packet radio service) and **EDGE** (Enhanced data rates for global evolution) technologies that enhance modulation of GSM and increase data rates

3G Systems

- Used for voice and data channel
- Use CDMA-2000 with TDMA with data rates up to 14Mbps
- Use **UMTS** (Universal Mobile Telecommunication Service) with high speed uplink and downlink packet access (3Mbps)

CSMA (carrier sense multiple access)

- Don't collide with ongoing transmission by another node
- But with no collision detection (problem)
- Can't sense all collisions in any cases like hidden terminal or fading

CSMA-CD

(Sender)

1. If sense channel is idle for **DIFS** then transmit entire frame
2. If sense channel is busy then
    - Start random backoff time (delay or random time)
    - Timer counts down while channel is idle
    - Transmit when timer expires
    - If no ack , increase random backoff interval and repeat step 2

(Receiver)

1. If frame received OK then return ACK after **SIFS**
    - ACK needed due to hidden terminal problem

CSMA-CA

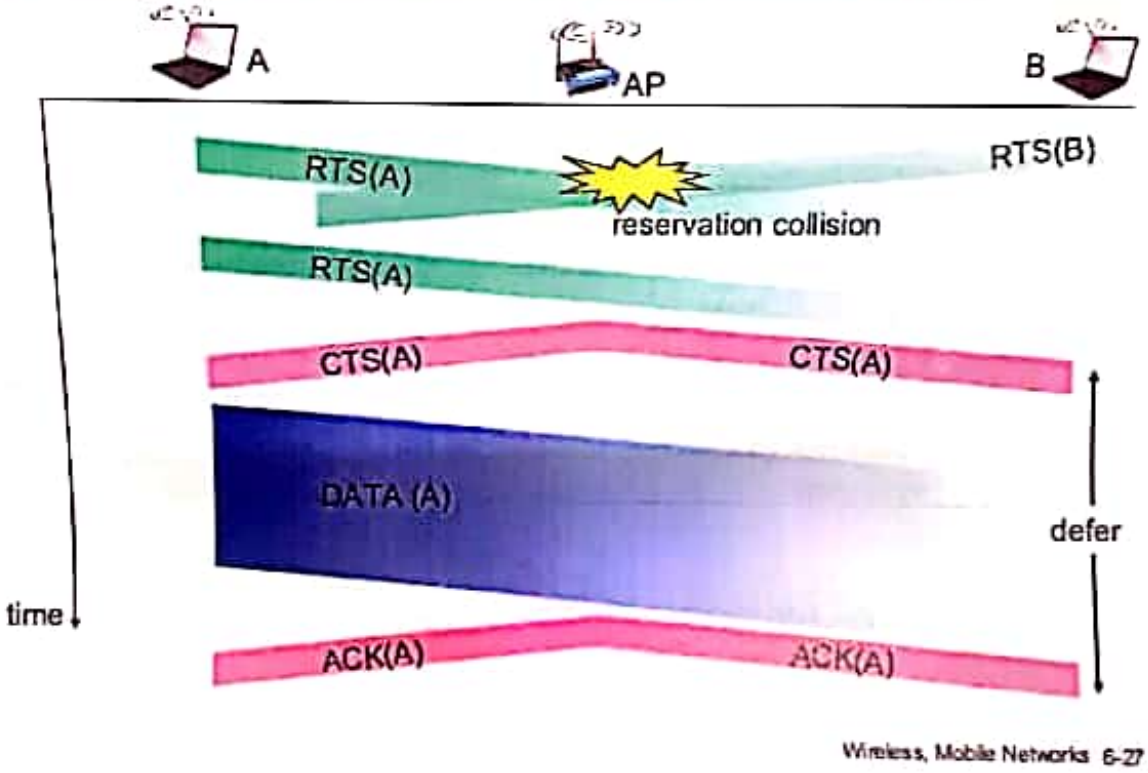
(Sender)

- First transmit small packet RTS (request to send) to receiver or BS using CSMA
- RTS packets may collide with each other but they short

(Receiver)

- BS or receiver broadcast CTS (clear to send) in response of certain RTS
- CTS heard by all nodes in the range of BS or receiver

Collision Avoidance: RTS-CTS exchange



Wireless, Mobile Networks 6-27

Choose

1. Validating the information of subscriber originating the call is done by
   a) BS b) MSC c) HLR / auC d) VLR

2. Which standard uses DSSS process
   a) IEEE 802.11 a b) IEEE 802.11 b c) IEEE 802.11 g d) IEEE 802.15

3. The cluster cell structure identified by i=4 and j=2 contains ..... cells
   a) 28 b) 19 c) 6 d) none

4. ..... scanning frame are sent from Aps to hosts
   a) Passive b) Active c) handoff d) none

5. IEEE 802.11 standard, ... is responsible for collision avoidance
   a) MS b) BS c) MSC d) PSTN

6. IEEE 802.11 standard, ACK is considered a
   a) Broadcast message b) Multicast message c) Unicast message d) All

7. ..... use IEEE 802.15
   a) PAN b) WAN c) WLAN d) WiMax

8. IEEE 802.11 standard, RTS is considered a
   e) Broadcast message f) Multicast message g) Unicast message h) All

9. CSMA/CD used in → wireless
   a) LAN b) WAN c) WLAN d) None
   wired ←

10. SIFS time delay used in CSMA CA at
    a) sender b) receiver c) a and b d) none

11. SIFS time delay used in CSMA CA before sending
    a) ACK b) DATA c) A and B d) None

MCQ

Consider a cell of 4 channels, if 18 requests are generated by users per half an hour, and the average holding time is 200 sec then:

1. Average call arrival rate λ is **Erlang**

a) 36	b) 2	c) 100	d) 800

2. The blocking probability Bc is %

a) 4	b) 9.5	c) 1.2	d) 12

3. The QoS is %

a) 96	b) 98.8	c) 90.5	d) 100

A user multiplexed-based system, shown in figure 1, has total bandwidth of 30MHz and contains 20 control channels per cell with equal channel spacing of 30KHz. The area of each cell is equal to 8Km² and total area 3600km²

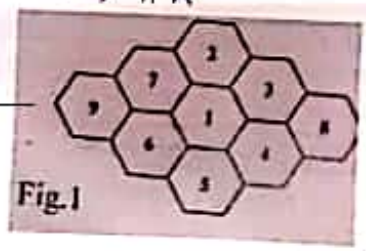


Fig.1

4. Total number of required cluster cells

a) 20	b) 9	c) 50	d) 10

5. The cell radius km

a) 1.6	b) 33.8	c) 12	d) 8

6. The reuse distance km

a) 62.3	b) 8.3	c) 175.6	d) 36

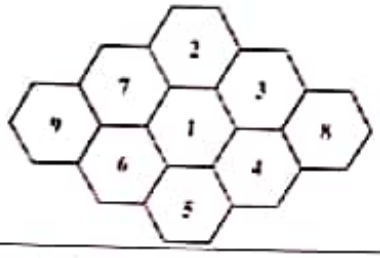
7. Total number of traffic channels/cell

a) 820	b) 91	c) 1000	d) 100

8. If each channel is multiplexed among 5 users, then the total number of calls by each cell is

a) 455	b) 164	c) 2000	d) 500

The system shown in the figure below has a total bandwidth of 12 MHz and contains 20 control channels with equal simplex channel width of 30 KHz. The area of each cell is 8 km2 (R=1.75 km), and cells are required to cover a total area of 3600 km2. Calculate the following:



9. Number of cells in the system.

a) 500	b) 1000	c) 450	d) 100

10. Number of traffic channels per cell.

a) 20	b) 10	c) 100	d) 200

11. Which of the following is a universally adopted shape of cell?

a) circle	b) hexagon	c) triangle	d) square

12. What is the condition for handoff?

a) Move to different cell with idle	b) remain in same cell with call	c) Move to different cell with call	d) remain in same cell with

13. Hexagon shape is used for radio coverage for a cell because

a) Maximum coverage area	b) Fewer number of cells required	c) No intersections	d) All

14. ..... Set of properties that distinguish between mobile computing and station system

a) Dimension of mobility	b) Mobility condition	c) all spectrum	d) none

15. ..... is the ability of mobile software to obtain location information

a) Location awareness	b) localization	c) Location sensitivity	d) none

16. mobility includes moving between different

a) networks	b) application	c) geographic area	d) All

17. QoS provide information about .....

a) Bandwidth	b) probability of connectivity loss	c) traffic measurements	d) All

18. Battery management is the job of .....

a) network	b) base station	c) OS	d) none

19. mobile computing differs from station devices in all the following except

a) functional requirement	b) non-functional	c) design	d) tasks

20. ..... affects memory and CPU capacities

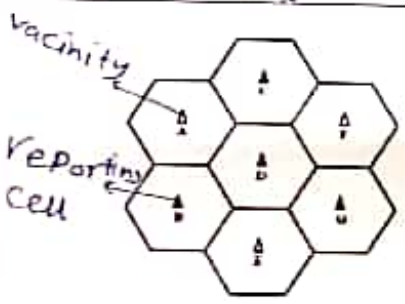
a) Mobility	b) Size of device	c) Platform proliferation	d) none

21. VLR and HLR in wireless mobile communications are

a) gateway	b) database	c) routers	d) none

22. ..... Used to store location of MS where billing and access information are maintained

a) VLR	b) HLR	c) AUC	d) none



Scenario 1 uses reporting cells scheme. Mobile user starts in cell G at time 08:00. Moves to cell F at time 10:00. Moves to cell C at time 10:45. Moves to cell F at time 11:45. Moves to cell G at time 13:00. Moves to cell F at time 17:00. Moves to cell G at time 18:00.

Scenario 2 uses location area scheme. Cells {1, 5, 6, 7} belong to location area LA1. Cells {2, 8, 9, 10} belong to location area LA2. Cells {3, 4, 11, 12} belong to location area LA3. **Starting from the top**, mobile user starts in cell 2 at time 08:00. Moves to cell 3 at time 10:00. Moves to cell 12 at time 10:45. Moves to cell 9 at time 11:45. Moves to cell 4 at time 13:00. Moves to cell 1 at time 17:00. Moves to cell 2 at time 18:00.

23. In scenario 1, at time 10:45, ... the cell at which location updates will be sent to the network.

a) C	b) G	c) B	d) E

24. In scenario 1, at time 15:00, ... the cell at which location updates will be sent to the network.			
a) B	b) F	c) G	d) C
25. In scenario 1, If a call is placed to the mobile user at time 13:15, which cells will be paged			
a) G	b) E	c) F	d) All
26. In scenario 2, at time 10:50, ... the cell at which location updates will be sent to the network.			
a) LA2	b) LA1	c) LA3	d) none
27. In scenario 2, at time 17:15, ... the cell at which location updates will be sent to the network.			
a) LA2	b) LA1	c) LA3	d) None
28. In scenario 2, If a call is placed to the mobile user at time 13:15, which cells will be paged			
a) 1,3,4,11	b) 3,4,11,12	c) 1,5,6,7	d) 2,8,9,10