

4th Year IT-IS-SW

## **Final Revision 1**

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## Mobility

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- **Mobile** means moving
- **Computing** means using computer during mobility
- **Mobile condition** -> set of properties that distinguishes between mobile user and user of stationary computing system
- **Dimension of mobility** -> set of properties that distinguishes between mobile computer and stationary computing system
- Mobile computing differs than other systems in all function requirements (design, tasks, operations)
- Mobility includes
  - Moving between different geographical locations
  - Moving between different networks
  - Moving between different applications

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## Mobile Condition

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1. The mobile user is moving, at least occasionally, between known or unknown locations.
2. The mobile user is typically not focused on the computing task.
3. The mobile user frequently requires high degrees of responsiveness from the system.
4. The mobile user is changing tasks frequently and/or abruptly.
5. The mobile user may require access to the system anywhere and at any time.

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## Advantage of mobile computing system

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- Small size
- The mobility nature of their use
- Functionalities are suited to mobile user
- Wireless connectivity

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## Mobile Wireless

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- Mobile computing devices connected with other devices through wireless network
- **BUT** mobile computing devices don't need to be wireless
- Wireless Communication differ from other communications is that communication channel is space itself

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## Dimension of mobility

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- Tools that allow us to qualify our problem of building mobile software application
- Dimension of mobility are not completely orthogonal with respect to each other
- Some of these dimensions are limitation of mobile devices
- Dimensions are
  1. Location awareness,
  2. Wireless Connectivity,
  3. Limited device capabilities (particularly storage and CPU),
  4. Limited power supply,
  5. Support a wide variety of user interfaces (Multimodal UIs),
  6. Variety of Platforms,
  7. Active Behavior.

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## Location awareness (acquiring positions)

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- **Localization** (different bossiness of mobile applications based on location of user such as Uber, Careem)
- **Location sensitivity** (ability of device or mobile application to obtain location information)
- Location sensing technology
  - Triangulation
  - Proximity
  - Scene analysis

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**QoS (quality of service)**

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- Bad weather, climate conditions or moving from physical location to another and causes some disconnected time from network
- QoS is provided by network operator
- **QoS measurements**
  - Available bandwidth
  - Risk or probability of connectivity loss
  - Statistical traffic measurements
- Network connectivity and QoS should be taken while designing mobile application (designing application should be dynamically adapt their feature and functionality to available bandwidth)

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**Limited device storage and CPU and limited power supply**

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- Battery management is OS Job
- Battery life is major challenge
- Small physical size limitation imposes boundaries of storage and CPU
- Some of data may need to store on another node on network (Server)
- Not all function and data carried on mobile because of storage limitation

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**Platform proliferation**

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- Platforms should provide
  - Monitoring of remaining power and other related power information
  - Allow multiprocessing and multithreading
- It is important to design and develop mobile devices independent of the platforms (UML based design)

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**Active transactions**

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- Passive transaction
- Active transaction
  - Synchronous
  - Asynchronous

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**Passive transactions**

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- The user must initiate all the transactions (stationary system)

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**Synchronous active transactions**

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- Transaction is initiated by system
- Require timely response from the user
- Interaction between system and user in sequential and serial manner
- Transactions are established between system and single user and may replicated for many users

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**Asynchronous active transactions**

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- Transaction work just like messaging systems
- May be a composition of 1-n receivers or 1-n topics or 1-n messages
- Interaction between system and user in sequential and serial manner
- Transactions are being successful if responses from users are not received within some time frame specified by the system

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**Architecture of mobile software applications**

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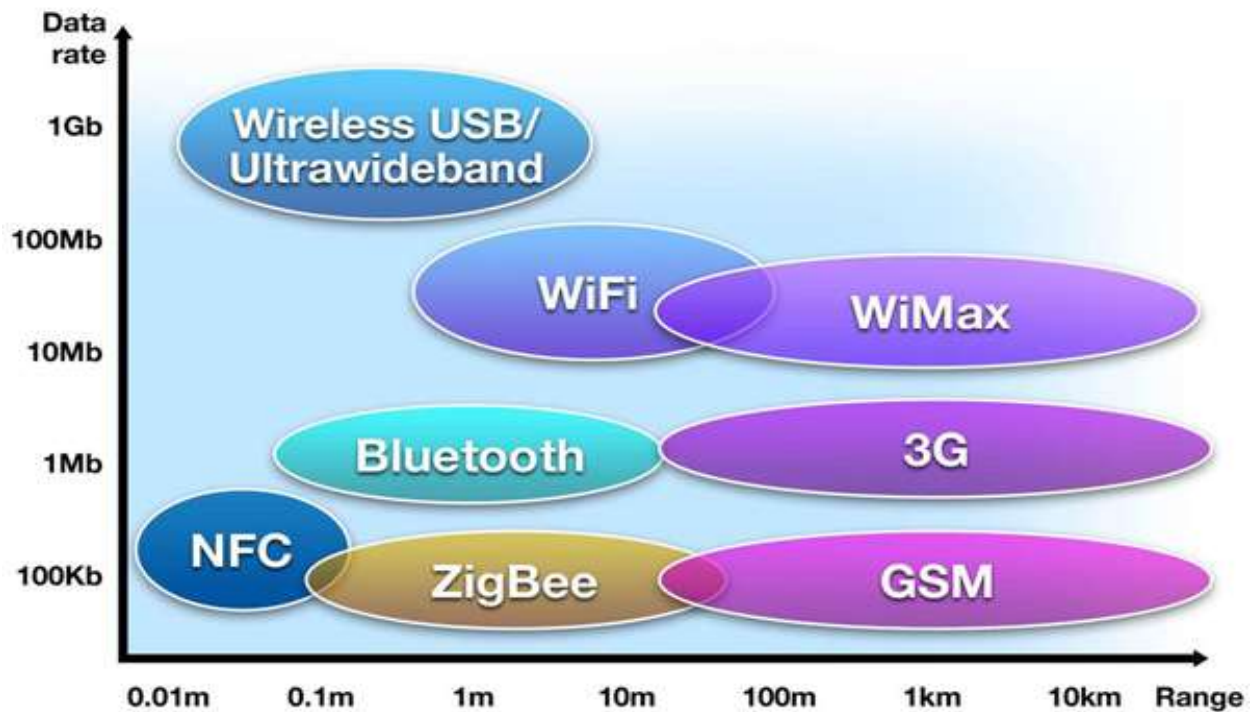
- High level plan of what the application will be
- **Architecture style** is high level abstraction of the system and how its component collaborate
- **Architecture patterns** are design patterns that addressing and handling specific problem with mobile application

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**Difference between satellite systems**


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<b>Wireless Network</b>	<b>Type of Nodes</b>	<b>Use Line of sight</b>	<b>Mobility</b>	<b>Range</b>	<b>Stability</b>	<b>Applications</b>
<b>Cellular</b>	Cell phones (voice or data)	No	Move freely	Wide range (bandwidth very low)	Static	Voice calls Cellular phones
<b>WLAN</b>	Access points and mobility devices	No	Move freely	Local limited range	Static	Motorola's ALTAIR, Proxim's range LAN,
<b>WSN</b>	Sensor nodes	No	Station no mobility	Very Limited Range	Static	Book stores Or Defense applications
<b>MANETs</b>	Mobile	No	Move freely	Limited Range	Dynamic	Defense applications  Crisis-management  VANETs
<b>VANETs</b>	Vehicles	No	Move freely	Limited Range	Very Dynamic	Traffic Efficiency Active Safety Public Service



### Difference between components of Cellular Network

Base Station (BS)	Base Station Controller (BSC)	Mobile Switch Center (MSC)	Telephone Network (PSTN)
<ul style="list-style-type: none"> <li>➤ Support <u>Multiple users</u> (MSs)</li> <li>➤ Responsible for sending packets between wired network and wireless host</li> <li>➤ Consists of a <u>tower</u> and <u>antenna</u></li> </ul>	<ul style="list-style-type: none"> <li>➤ BSs connected via <u>wire</u> to base station controllers</li> </ul>	<ul style="list-style-type: none"> <li>➤ Responsible for routing calls, SMS, and data</li> <li>✓ Home Location Register (HLR)</li> <li>✓ Visitor Location Register (VLR)</li> <li>✓ Authentication Center (AuC)</li> </ul>	<ul style="list-style-type: none"> <li>➤ telephone network or Internet backbone</li> <li>➤ used to connect different MSCs</li> </ul>

## Wireless Link

- used to connect mobiles to base station
- used as backbone link
- multiple access protocols coordinate link access
- various data rates based on transmission distance

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### Difference between static multiple access technique

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Frequency Division Multiple Access (FDMA)	Time Division Multiple Access (TDMA)	Code Division Multiple Access (CDMA)	Orthogonal (OFDM)
Allocated frequency band is divided into sub-band/channels	BS assigns time slots for users in a round-robin fashion	BS assign a code for users and is mixed with each bit before transmission	One signal is composed of a number of modulated orthogonal carriers
Each user is assigned a channel	One channel is used by many users	Each user is assigned a unique code	Each user is assigned a channel

Note: مہم

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- **Cell** basically represents the area that can be covered by a transmitting station, usually called a base station (BS).
  - **radius of the cell** is equal to the reachable range of the transmitted signal.
  - Each cell serves multiple Mobile Subscribers (MS) by connecting them to **single BS**
  - Each MS subscribes to **only one MSC**
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**Write types of signals ?**


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<b>Control Signal</b>	<b>Data (User) Signal</b>
Used to control bearer traffic (Establish Session, Terminate Session, authentication, subscriber info, call parameter negotiations)	Used for subscriber traffic (voice & data)
May be downlink or uplink	May be downlink or uplink

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**Compare between downlink and uplink ?**


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<b>Downlink Signal</b>	<b>Uplink Signal</b>
Signal Follows (BS → MS)	Signal Follows (MS → BS)
Channels used are either <i>control</i> or <i>data</i>	

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**Write main steps to establish call setup**


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**Call Setup:**

1. Validate information of subscriber originating the call (authentication)
2. Find the cell where the receiver is currently located (location management)
3. Allocate downlink and uplink channels (resource management)
4. Maintain the call if receiver moves while call is active (handoff/admission control)

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## Notes مهمة جدا

- **Erlang:** A servicing channel that is kept busy from an hour

$$a = \lambda T$$

- **Erlang B ( $B_c$ ):** is the blocking probability, probability of loss or probability of rejection for an arrival call

➤ Call is blocked if all  $n$  channels are occupied when the call arrives

$$B_c = \text{Erl}(n, a) := \frac{\frac{a^n}{n!}}{\sum_{i=0}^n \frac{a^i}{i!}}$$

$$QoS = 1 - B_c$$

- **Erlang C:** is the probability of an arrival call being delayed
- **Capacity ( $n$ ):** is the number of channels required for the cell based on traffic load and blocking probability

$$n(a) = \min\{i = 1, 2 \mid \text{Erl}(i, a) < B_{c \max}\}$$


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**Choose**

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1. QoS =  
a) **1- Erlang B**      b) 1 + Erlang B      c) 1-Erlang A      d) none
2. Why neighboring stations are assigned different group of channels in cellular system?  
a) **Minimize interference**      b) Maximize cell      c) Maximize throughput      d) Minimize area
3. Which of the following is a universally adopted shape of cell?  
a) circle      b) **hexagon**      c) triangle      d) square
4. 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 idle
5. Frequency division multiple access (FDMA) assigns \_\_\_\_\_ channels to \_\_\_\_\_ users  
a) many, many      b) Individual, many      c) many, individual      d) **Individual, individual**
6. During the period of call, other users can share the same channel in FDMA.  
a) True      b) **false**
7. In CDMA many users can access the same channel in same time  
a) **True**      b) False
8. 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**

9. .... Set of properties that distinguish between mobile computing and station system  
 a) **Dimension of mobility**      b) Mobility condition      c) all spectrum      d) none
10. .... is the ability of mobile software to obtain location information  
 a) Location awareness      b) localization      c) **Location sensitivity**      d) none
11. Traffic intensity is expressed in  
 a) Erlang      b) MHz      c)  $\lambda/\text{sec}$       d) **a and c**
12. mobility includes moving between different  
 a) networks      b) geographic area      c) application      d) **All**
13. QoS (Quality of Service) tools are managed by .....  
 a) **network**      b) mobile      c) OS      d) none
14. QoS provide information about .....  
 a) Available bandwidth      b) probability of connectivity loss      c) statistical measurements      d) **All**
15. Battery management is the job of .....  
 a) network      b) base station      c) **OS**      d) none
16. mobile computing differs from station devices in all the following except  
 a) functional requirement      b) **non-functional**      c) design      d) tasks
17. .... affects memory and CPU capacities  
 a) Mobility      b) **Size of device**      c) Platform proliferation      d) none

18. VLR and HLR in wireless mobile communications are  
a) Gateway                      **b) database**                      c) routers                      d) none
19. .... act as router and used for routing calls  
a) Base station                      b) Base station controller                      **c) Mobile switch center**                      d) none
20. .... Used to store location of MS where billing and access information are maintained  
a) VLR                      **b) HLR**                      c) AUC                      d) MSC
21. The set of properties that distinguishes the mobile user from the typical user of stationary computing system  
**a) Mobile condition**                      b) Dimension of mobility                      c) A and B                      d) None
22. The connectivity to the network is not a prerequisite for being a mobile computing  
**a) True**                      b) False
23. Mobile computing devices don't need to be a wireless  
**a) True**                      b) False
24. Wireless communication systems are mobile computing systems  
a) True                      **b) False**
25. Mobile computing system can be considered a stationary computing system if we stop moving it  
**a) True**                      b) False
26. .... can obtain latitude and longitude with accuracy 1-5 meter  
a) Scene analysis                      b) Triangulation method                      c) Proximity based method                      **d) GPS**

27. Storage and processing issues are largely addressed by  
a) **Operating system**      b) Network Operator      c) Dimension of mobility      d) None
28. Power consumption issues are largely addressed by  
a) **Operating system**      b) Network Operator      c) Dimension of mobility      d) None
29. Stationary application users have more efficient user interface than mobile computing system  
a) **True**      b) False
30. In Active Transaction, all transactions are initiated by the user  
a) True      b) **False**
31. The high-level plan of what the application will be like is called  
a) **Architecture of mobile software app.**      b) Architecture Pattern      c) Architecture style      d) None
32. .... are considered as the closer shapes to a circular area  
a) Square      b) Triangle      c) **Octagons**      d) Rectangle
33. Each MS subscribes only MSC  
a) **True**      b) False
34. There are 1000 users subscribed to a cellular network. The call request rate for each user is 2 call requests per week. For each cell, the average call duration is 10 min. Then the average call arrival rate is  
a) **0.198**      b) 1.98      c) 19.8      d) none