

ICT 9025

Mobile Applications & Technologies

Introduction to Mobile Computing

Lecture 1

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What Is Mobile Computing?

- **Computing:**

The use or operation of computers

- **What is the mobile?**

That someone or something can move or be moved easily and quickly from place to place

- **Mobile computing**

The use of portable computers that still have network connections while the users move



What Is Mobile Computing?



- **Mobile Computing** is an umbrella term used to describe technologies that enable people to access network services anyplace, anytime, and anywhere.

Ubiquitous Computing

- **Ubiquitous computing** whereby users have the ability to access computer services and resources all the time in any location
 - The objective is that wherever the user goes, there is a computer that they can use e.g. internet cafe, mainframe terminals
 - **Mobile Computing vs Ubiquitous Computing:**
 - in mobile computing the computer moves with the user,
 - but in ubiquitous computing the user has remote terminals to log in into the same computer/ server.
- Ubiquitous comes from ubiquity (be everywhere)



Ubiquitous Computing [2]

- Ubiquitous computing was first started at the Olivetti Research Laboratory in Cambridge, England
 - where the Active Badge, a "clip-on computer" the size of an employee ID card, was created, enabling the company to track the location of people in a building



Pervasive Computing



- **Pervasive computing** is the growing trend of embedding computational capability (using microprocessors) into everyday objects to make them communicate and perform useful tasks
 - The objective is to provide emergent (new and innovative) services created by mobile devices that interact by ad hoc connections
 - when computers are everywhere inside all things, maybe also within the user.
 - **For example:**
 - Smart Refrigerators
 - Blood Pressure and Sugar Level Sensors

Pervasive Computing [2]

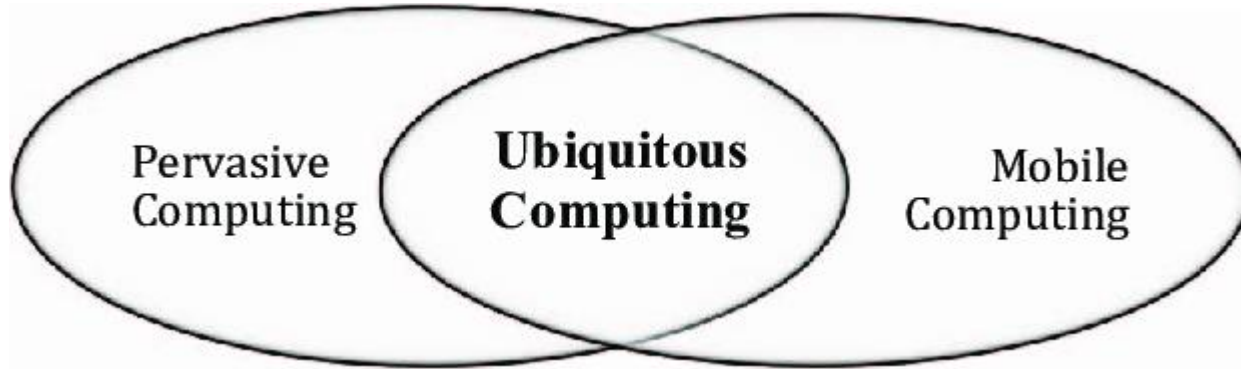


- **Mobile Computing vs Pervasive Computing:**
 - Mobile implies computers are so small and low power that can be carried around, pervasive implies that are so tiny and cheap that can be placed inside things that could need one.
- Pervasive comes from pervade (to spread throughout)

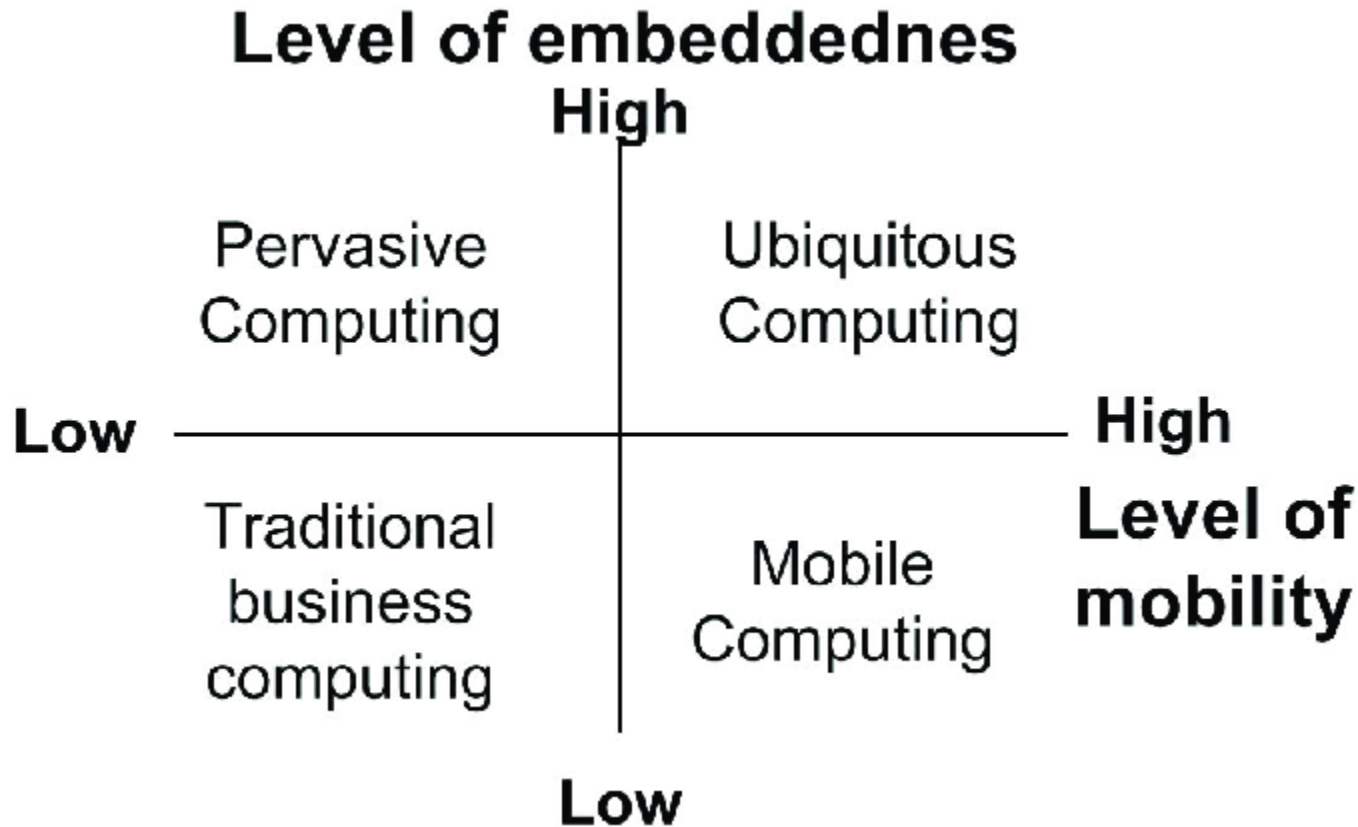
Mobile, Pervasive and Ubiquitous Computing



- Note that Mobile, Pervasive and Ubiquitous Computing have overlapping objectives



Mobile, Pervasive and Ubiquitous Computing [2]



Types of Mobile Computing



- Four Types of Mobile Computing:
 - Fixed and Wired
 - Fixed and Wireless
 - Mobile and Wired
 - Mobile and Wireless

Types of Mobile Computing [2]



- **Fixed and Wired:**

- the devices are fixed at a position, and they are connected through a physical link to communicate with other devices
- **For Example**, Desktop Computer.

- **Fixed and Wireless:**

- the devices are fixed at a position, and they are connected through a wireless link to communicate with other devices
- **For Example**, Communication Towers, WiFi router

Types of Mobile Computing [3]



■ **Mobile and Wired:**

- some devices are wired, and some are mobile. They altogether communicate with other devices.
- **For Example,** Laptops.

■ **Mobile and Wireless:**

- the devices can communicate with each other irrespective of their position. They can also connect to a network without the use of any wired device.
- **For Example,** Smartphones, WiFi Dongle.



Evolution of Wireless LAN

- In late 1980s, vendors started offering wireless products, which were to substitute the traditional wired LAN (Local Area Network) products.
 - The idea was to use a wireless local area network to avoid the cost of installing LAN cabling and ease the task of relocation or otherwise modifying the network's structure.



Evolution of Wireless LAN

- The challenge of interoperability between different wireless LAN products became critical.
 - Interoperability: maintaining connections and compatibility across different devices
- IEEE standard committee took the responsibility to form the standard for WLAN.
 - As a result **IEEE 802.11 series of standards** emerged.



Evolution of Wireless LAN

- WLAN uses the unlicensed Industrial, Scientific, and Medical (ISM) band that different products can use as long as they comply with certain regulatory rules
- WLAN is also known as **Wireless Fidelity** or **WiFi** in short
- There are many products which use these unlicensed bands along with WLAN.



Evolution of Wireless LAN [4]

- Examples include: cordless telephone, microwave oven etc.
- There are 3 bands within the ISM bands:
 - 900-MHz ISM band, which ranges from 902 to 928 MHz;
 - 2.4-GHz ISM band, which ranges from 2.4 to 2.4853 GHz; and
 - the 5.4 GHz band, which range from 5.275 to 5.85 GHz.
- WLAN uses 2.4 GHz and 5.4 GHz bands.
- WLAN works both in ***infrastructure mode and ad hoc mode***



Evolution of Wireless LAN [5]

▪ **Infrastructure Mode**

- Whereby devices on the network all communicate through a single access point, which is generally the wireless router
- Most Wi-Fi networks function in infrastructure mode
- Wi-Fi networks in infrastructure mode are generally created by Wi-Fi routers, while ad-hoc networks are usually short-lived networks created by a laptop or other device



Evolution of Wireless LAN [5]

■ Ad-hoc Mode

- Ad-hoc mode is also known as **peer-to-peer mode**
- Whereby devices on the wireless network connect directly to each other.
 - e.g. If you set up the two laptops in ad-hoc wireless mode, they'd connect directly to each other without the need for a centralized access point.
- Ad-hoc networks don't require a centralized access point



Evolution of Wireless PAN

Wireless Personal Area Network:

- Techniques used for WPANs are infrared and radio waves.
- Most of the Laptop computers support communication through infrared, for which standards have been formulated by IrDA (*Infrared Data Association-www.irda.org*).
- Through WPAN, a PC can communicate with another IrDA device like another PC or a Cellular phone, etc.



Evolution of Wireless PAN [2]

- The other best known PAN technology standard is **Bluetooth**
- Bluetooth uses radio waves instead of infrared.
- It offers a peak over the air speed of about 1 Mbps over a short range of about 10 meters.
- The advantage of radio waves is that unlike infrared it does not need a line of sight.
- WPAN works in **ad hoc mode** only



Types of Wireless Devices

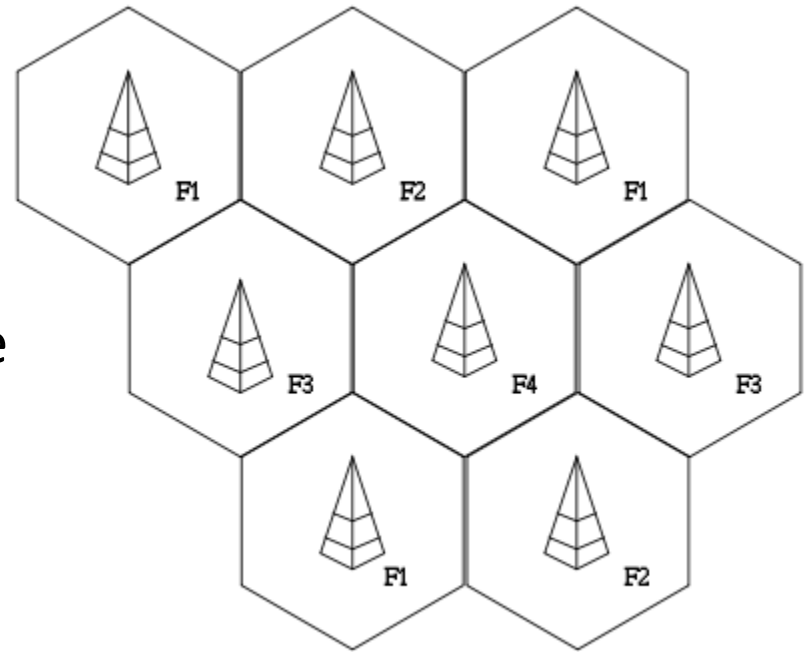


- Laptops
- PDAs
- Cell phones
- Smart phones
- Pagers
- Sensors



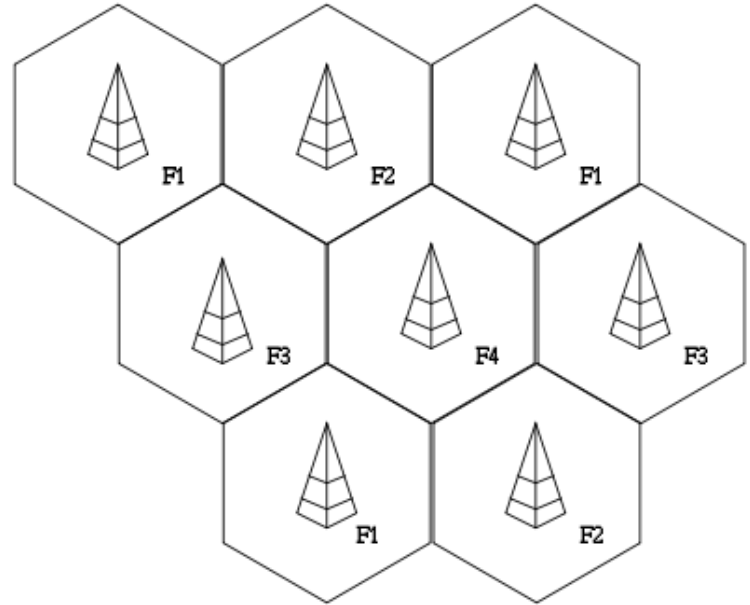
Cellular Network

- A cellular network is a radio network distributed over land through cells
- Each cell includes a fixed location transceiver known as a **base station**. These cells together provide radio coverage over larger geographical areas.



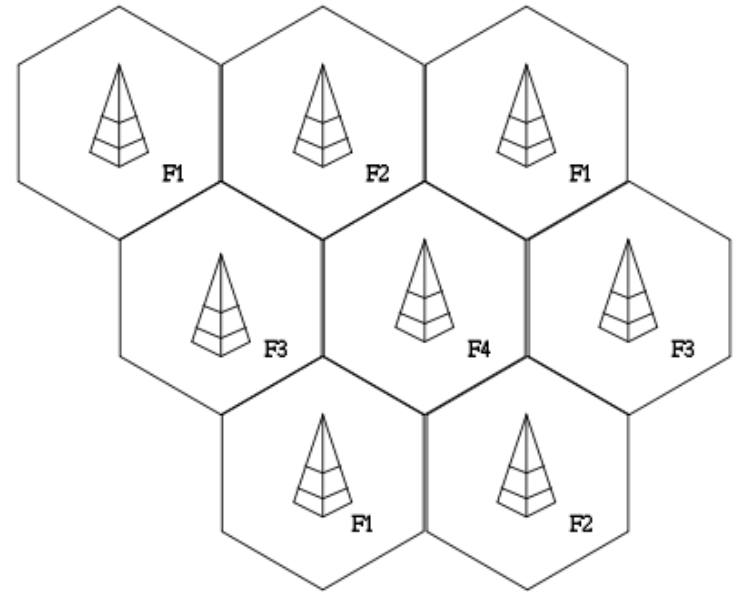
Cellular Network [2]

- Mobile phone providers divide their coverage area into a number of cells and put base stations at approximately the center of each these cells.
- This is done to allocate the permitted frequencies for that provider in each cell and minimize interference.
- The network is called a cellular network, hence the phones are referred to as cellular phones.



Cellular Network [3]

- User equipment (UE), such as mobile phones, is able to communicate even if the equipment is moving through cells during transmission
- Cellular networks give subscribers advanced features over alternative solutions, including:
 - increased capacity
 - small battery power usage,
 - a larger geographical coverage area and reduced interference from other signals





Types of Cellular Networks

- GSM
- GPRS
- CDMA
- MOBITEX
- EDGE

Types of Cellular Networks - GSM



Global System for Mobile Communication

- A network whereby cellular phones connect to it by searching for cells in the immediate vicinity
- GSM phones may be identified by the presence of a Subscriber Identity Module (SIM)
 - it contains a user's subscription information, as well as some contact entries.
 - This allows a user to switch devices without needing to contact the service provider
- GSM supports voice calls and data transfer of up to 9.6kbps

Types of Cellular Networks - GPRS



General Packet Radio Service

- A cellular network which includes packet-switched functionality and therefore promoted the use of the Internet on mobile handsets.
- Has data transmission significantly faster than GSM, which is up to 54kbps.
- The higher data rates allow users to take part in video conferences and interact with multimedia websites and similar applications using mobile handheld devices as well as computers.

Types of Cellular Networks - CDMA

Code Division Multiple Access

- CDMA is a form of multiplexing, which allows numerous signals to occupy a single transmission channel, optimizing the use of available bandwidth.
- CDMA consistently provides better capacity for voice and data communications than other commercial mobile technologies, allowing more subscribers to connect at any given time, and it is the common platform on which 3G technologies are built
- CDMA Provides maximum data rates up to 300 kbps.
- It is more expensive compared to GSM and GPRS.



Types of Cellular Networks - MOBITEX

Mobile Text Transfer System

- A cellular network originally designed for text pagers with 512 bytes of data transmission rate.
- In a Mobitex network, a radio base station, with one or more switches , serves as the transmitter for each single cell (area of coverage) of up to 30 km.
- Users of wireless devices, such as mobile phones and personal digital assistants (PDAs), communicate through the base station nearest to them and can move freely from one cell to another.



Types of Cellular Networks - EDGE



Enhanced Data for Global Evolution

- EDGE is an extension to the GSM/GPRS networks.
- EDGE supports peak theoretical network data rates of 474 kbps, with average throughput of 70 to 130 kbps on both the downlink and the uplink.
- The average rates are fast enough to support a wide range of data services, including streaming audio and video, fast Internet access and file downloads

Types of Cellular Networks – 3G



3rd Generation Mobile Telecommunications (3G)

- 3G is a set of standards and technology that came about such that 3G systems are expected to deliver quality multimedia to mobile devices by way of faster and easier wireless communications as well as “anytime, anywhere” services.
- There are two specifications of 3G:
 - 3GPP
 - 3GPP2

Types of Cellular Networks – 3G [2]



- **3GPP 3G specifications** are focused on evolved GSM networks, known as UMTS (Universal Mobile Telecommunications Systems)
- This includes evolved
 - UTRA (Universal Terrestrial Radio Access),
 - GPRS (General Packet Radio Service),
 - and EDGE (Enhanced Data rates for GSM Evolution)

Types of Cellular Networks – 3G [3]

- **3GPP2 3G specifications**, on the other hand, are designed for CDMA2000 systems, which are based on CDMA (Code Division Multiple Access).
- Of the two, **3GPP** specifications are more widely used since the majority of the cellular networks around the planet are (*or were already*) based on GSM.

Note: GSM, 3G, 4G, 5G etc. will be looked into further in following slides



Benefits of Mobile Networks

- Enable anywhere/anytime connectivity
- Bring computer communications to areas without pre-existing infrastructure
- Enable mobility
- Enable new applications
- An exciting research area



Mobile Networks Compared With Wired Networks

■ **Wired Networks**

- high bandwidth
- low bandwidth variability
- high power machines
- high resource machines
- need physical access (security)
- low delay
- connected operation

■ **Mobile Networks**

- low bandwidth
- high bandwidth variability
- low power machines
- low resource machines
- need proximity
- higher delay
- disconnected operation



Challenges of Mobile Networks

- Disconnection
- Low bandwidth
- Low power and resources
- Security risks
- Wide variety terminals and devices with different capabilities
- need proximity
- higher delay



Security Concerns of Mobile Computing

- **Security issues of Confidentiality:** Preventing unauthorized users from gaining access to critical information of any particular user
- - **Integrity:** Ensuring unauthorized modification, destruction or creation of information cannot take place
 - **Availability:** Ensuring authorized users get the access they require
 - **Legitimate:** Ensuring that only authorized users have access to services
 - **Accountability:** Ensuring that the users are held responsible for their security related activities by linking the user and their activities when necessary.

Security Concerns of Mobile Computing [2]



- **Security issues of Wireless Communication:** preventing wireless networks from intercepted of their radio signals by hacker, and by non-management of its network.
 - Most of wireless networks are dependent on other private networks so the user has less control of security procedures.
 - **Denial of Service (DOS) attacks:** a common attack of all kinds of networks, whereby attackers send large amounts of unneeded data or connection requests to a communication server to slow the network and therefore the legitimate users cannot benefit from the use of the network services
 - **Traffic Analysis:** It's identifying and monitoring the communication between users through listening to traffic flowing in the wireless channel, in order to access private information of users that can be for malicious purposes by attacker.

Security Concerns of Mobile Computing [3]



- **Security issue of Wireless Communication:**
 - **Spoofing:** An attacker impersonating an authorized account of another user to access sensitive data and unauthorized services.

Security Concerns of Mobile Computing [4]



■ **Security Issues of Devices**

- **Malware:** Mobile computing, like any computer software can be damaged by malware such as Virus, Spyware and Trojan.
- **Forced De-authentication:** whereby an attacker convinces the end-user's device to drop its connection and re-connection, then the attacker inserts his own network device between a mobile device and the network.

Security Concerns of Mobile Computing [5]



■ Security Issues of Devices

- **Mobility:** The mobility of users and their data that would introduce security threats based on the location of a user
- **Disconnections:** preventing disconnections when the mobile devices move to different places
 - A **handoff** is the process of transferring an active call or data session from one cell in a cellular network to another
 - A bad hand off may lead to disconnections
 - A well-implemented handoff is important for delivering uninterrupted service to a caller or data session user.

The Needs of Mobile Users



Despite the challenges, mobile computing caters to the following **needs of mobile users**:

- **Internet access**

- Accessing various websites and services via the Internet,
 - Personal Banking, using exercise applications, etc.

- **Entertainment Services**

- Music, Video, Games, Reading etc.

- **Social Platforms**

- Communicating with others online, Social media platforms

The Needs of Mobile Users [2]



Needs of mobile users:

- **Shopping services**
 - Shopping online
- **Emergency services**
 - including access to healthcare services
- **Educational services**
 - File sharing, video conferencing, researching etc.

The Needs of Mobile Users [3]



Needs of mobile users:

- **Work Services**
 - Using office applications, File Sharing, Online File Backups, Video Conferencing, Researching,
- **Planning and Scheduling**
 - Planning activities, getting news, searching for jobs etc.
- **Global Position System (GPS)**
 - searching for locations, etc.
- **Self-expression**
 - Creating online content: video, audio, photography, art. Sharing comments, stories, opinions.