

Introduction to Mobile Computing

What Is Mobile Computing?

- What is computing?

Operation of computers

(according to oxfords advance learner's dictionary)

- What is the mobile?

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

- What is mobile computing?

Users with portable computers still have network connections while they move

What Is Mobile Computing?

- **A simple definition could be:**

Mobile Computing is using a computer (of one kind or another) while on the move

- **Another definition could be:**

Mobile Computing is when a (work) process is moved from a normal fixed position to a more dynamic position.

- **A third definition could be:**

Mobile Computing is when a work process is carried out somewhere where it was not previously possible.

What Is Mobile Computing? (Cont.)

- **Mobile Computing** is an umbrella term used to describe technologies that enable people to access network services anyplace, anytime, and anywhere.
- Mobile computing can be defined as a computing environment over physical mobility.

Comparison to Wired Net

• **Wired Networks**

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

• **Mobile Networks**

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

Why Go for Mobile?

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

Types of Wireless Devices

- Laptops
- Palmtops
- PDAs
- Cell phones
- Pagers
- Sensors
- ...

Challenges

- Disconnection
- Low bandwidth
- High bandwidth variability
- Low power and resources
- Security risks
- Wide variety terminals and devices with different capabilities (Device attributes)
- Fit more functionality into single, smaller device

MOBILE COMPUTING

- The user of a mobile computing environment will be able to access data, information or other logical objects from any device in any network while on the move.
- Mobility
 - User Mobility
 - Device Mobility

MOBILE COMPUTING Cont.

- **Anywhere, Anytime Information:** This is the generic definition of ubiquity, where the information is available anywhere, all the time.
- **Virtual Home Environment:** (VHE) is defined as an environment in a foreign network such that the mobile users can experience the same computing experience as they have in their home or corporate computing environment.
 - For example, one would like to put ones room heater on when one is about 15 minutes away from home.

MOBILE COMPUTING Cont.

- **Nomadic Computing:** The computing environment is nomadic and moves along with the mobile user.
 - This is true for both local and remote services.
- **Pervasive Computing:** A computing environment, which is pervasive in nature and can be made available in any environment.
- **Ubiquitous Computing:** A disappearing (nobody will notice its presence) everyplace computing environment. User will be able to use both local and remote services.

MOBILE COMPUTING Cont.

- **Global Service Portability:** Making a service portable and available in every environment. Any service of an environment will be available globally.
- **Wearable Computers:** Wearable computers are those computers that may be adorned by humans like a hat, watch, shoe or clothes (these are wearable accessories).

Mobile Computing Functions

- We can define a computing environment as mobile if it supports one or more of the following characteristics:
- **User Mobility**
- **Network Mobility**
- **Device Mobility**
- **Service Mobility**
- **Bearer Mobility**
- **Session Mobility**
- **Host Mobility (client –server, ip)**

Issues in categories

- Software Issues - Apps
- Technical Issues - Battery, h/w
- Network Issues - connection
- User Interface Issues - understanding
- Security Issues - attacks

1G, 2G, 3G & 4G

Mobile Generations....

Wireless Standards: History

- A new generation of cellular standards has appeared approximately **every tenth year**
 - 1G systems were introduced in **1981**.
- Each generation is characterized by
 - new frequency bands,
 - higher data rates and
 - non-backwards compatible transmission technology.
- 3G is considered successor to 1G and 2G.

1G

- 1G: The original **analog** cellular systems are considered the first generation of mobile telephony (1G).
- In the early 1980s, 1G systems were deployed.
- AMPS

2G

- After 1G, second generation of mobile telephony (2G) came into being.
- The difference between 1G and 2G is in the signaling techniques used:
 - 1G used analog signaling,
 - 2G used **digital signaling**.
 - 2G-based mobile telephony were intended primarily for **voice transmission** and **Data** (low rate)
 - 3G for high speed data rate

2.5G

- 2.5G used some of the advanced technique like **packet-switching**
- This can use some of the existing 2G infrastructure in GSM and CDMA networks.
- GPRS is a 2.5G technology used by GSM operators.
- Some protocols, such as EDGE(Enhanced Data rates for GSM Evolution) for GSM and CDMA2000 1x-RTT for CDMA have data rate of above 144 kbps are considered close to 3G.

2.5G Cell Phone Systems

- between original 2G digital phones and the newer 3G phones.
- bring data transmission capability to 2G phones in addition to normal voice service.
- permits subscribers to exchange e-mails and access the Internet by cell phone.

1. General Packet Radio Service, GPRS

—uses one or more of the eight TDMA time slots in a GSM phone system to transmit data rather than digitized voice.

- data rate is from 20 kbps up to 160 kbps
- typical rate is about 40 kbps, which is more than enough for e-mail and short message service but poor for Internet access.
- involves an automatic rate adjustment algorithm that adjusts the class and data rate to the robustness of the wireless channel.

2. Enhanced Data Rate for GSM Evolution, EDGE

- based upon GPRS system but uses 8-PSK modulation to achieve even higher data rates up to 384 kbps, thereby tripling the rate.
- theoretical max. data rate is 473.6 kbps with all eight slots used
- if implemented, EDGE needs linear power amplifiers at the base station and in the handset.

CDMA2000 –

- ❑ uses 1.25 MHz wide channels
- ❑ packet-based; permits a data rate of 144 kbps
- ❑ uses three 1.25 MHz channels = 3.75 MHz
- ❑ Evolution-Data Optimized,

a recent version has higher rate approaching 3.1 Mbps downlink and an uplink rate up to 1.8 Mbps. These speeds qualify for 3G.

Evolving of 3G Standards: IMT 2000

- 3G has been specified as **International Mobile Telecommunications-2000** (IMT — 2000) as per definition of International Telecommunication Unit (ITU).
- IMT-2000 specifications embody standards for mobile phones and mobile telecommunications services as per ITU

3G goals

- Unifying pre-3G technologies
 - 3G uses CDMA while 1G used FDMA and 2G used TDMA, CDMA
- Making Global roaming feasible
- Higher security level
- Advanced Video:
 - Streaming
 - IPTV

What is 3G?

3G refers to the third generation of cellular wireless standards. Its aim is to

- provide a **wide range of data rates** for internet access to mobile as well as stationary users and
- is able to efficiently support both **Voice & Data application.**

3G Data rate

- 3G data rate
 - a minimum data rate of 2 Mbit/s for stationary or walking users, and
 - 384 kbit/s in a moving vehicle
 - Note: 2G was limited to 128 and 144 kbps respectively
- ITU *does not clearly specify* minimum or average rates

How to use 3G?

- 3G Compatible device
- 3G service provider

First 3G International launch

- The first pre-commercial 3G network was best launched by NTT DoCoMo in Japan branded FOMA, in May 2001 on a pre-release of W-CDMA technology.
- The first commercial launch of 3G was also by NTT DoCoMo in Japan on 1 October 2001, although it was initially somewhat limited in scope.

3G in India

- 20 May 2010: Concluded spectrum Auction
 - Raised 50,968.37 Crore INR
 - Operators: Bharti Airtel, Aircel, Idea Cellular, Reliance Communications, S Tel, Tata Teleservices, Vodafone Essar
- Tata Docomo was first one to launch 😊
- Others to launch soon

Beyond 3G

- Beyond 3G is fourth generation of wireless standards (4G) which is not yet well-defined.
- 4G will be a super-enhanced version of 3G, when all networks are expected to embrace Internet protocol (IP) technology
- IMT-Advanced (under ITU) is currently under study to define the fourth generation (4G) of mobile communications.

INTRODUCTION: 4G

A brief discussion on these terminologies follows

- *Wireless Standard*
- Next generation futuristic wireless system

4G BASICS

- 4G infrastructure shall be all IP-based (including IPV6 and MIPV6)
- This shall develop into an optimized packet-switched networks supporting high data speed.
- Expected data rates for 4G are:
 - 100 MBPS for high mobility devices and
 - 1 GBPS for slow moving objects or stationary objects

4G EXPECTED FEATURES (*INFERRED FROM VARIOUS RESEARCH PAPERS*)

- 4G shall co-exist and interwork with 2G and 3G systems as well as satellite, WLAN, IEEE 802.16e (WMAN – WiMAX)
- Achieve local/global roaming capabilities
- 4G shall have clear advantages in terms of bandwidth, coverage, power consumption and spectrum usage

4G EXPECTED FEATURES

(*INFERRED FROM PAPERS*) CONTD...

- 4G shall be “Always Best Connected” i.e. the user shall be connected through best network.
- A 4G terminal shall support multi-mode, multi-access and reconfiguration capabilities.
- 4G shall combine existing and emerging services such as voice, data, streamed multimedia, sensory, e-health, and social networking on mobile devices at best.
- 4G envisages that mobile services shall be available on Mobile Cloud.
 - With mobile cloud the various developers and service

5G Basic

5G is based on OFDM (Orthogonal frequency-division multiplexing), a method of modulating a digital signal across several different channels to reduce interference. 5G uses 5G NR air interface alongside OFDM principles. 5G also uses wider bandwidth technologies such as sub-6 GHz and mmWave.

Feature: 5G density enables up to 100 times more connected devices in the same physical area that 4G LTE operates, connecting up to 1 million devices in a square kilometer, while maintaining 99.999% availability. This density creates business advantages for mobile workforces and connected IoT devices.

Speed: 5G has the potential for download speeds between 10 and 20 Gbps, or 100 times faster than 4G. 5G upload speed is the rate at which data is transmitted from your device up to the network and your targeted endpoint (cloud storage, for example, or another device).

5G Basic

3 Key Benefits of 5G :

- 1>Much higher data rates (1-20 GB), enabling consumers to download content more quickly.
- 2>Much lower latency (1 ms), allowing users to experience less delay/lag when requesting data from the network — a latency of milliseconds, imperceptible to humans.
- 3>Increased capacity as the network expands.

Disadvantage: Cost: 5G networks are more expensive to build and deploy than 4G LTE networks. This means that it may take some time for 5G to be widely available. Range: 5G signals do not travel as far as 4G LTE signals. This means that 5G coverage may be more limited than 4G LTE coverage.

5G use drains your smartphone battery faster than 4G-LTE.