MOBILE COMPUTING LECTURE NOTES III-CSE



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UNIT - I CONTENTS

- Mobile Communication
- Mobile Computing
- Novel Applications
- Location dependent services
- Effects of device portability
- Wireless n/w's in comparison with fixed n/w's
- Limitations
- Architecture (simple reference model)

Goal of Mobile Computing

- ➤ People and their machines should be able to access information and communicate with each other easily and securely, in any medium or combination of media
 - voice, data, image, video, or multimedia any time, anywhere, in a timely, cost-effective way.

Mobile Computing

- Mobile computing refers to computing in a distributed system in which some processes or processors can move.
 - Moving processes ⇒ logical mobility, realized by agents.
 - Moving processors ⇒ physical mobility, realized by moving devices.
- Mobile computing extends a distributed computing environment with a new dimension of mobility.
 - Most existing mobile computing systems are based on clientserver computing systems.
 - Recent mobile computing solutions consider general distributed computing, namely, peer-to-peer computing environments.
- Many mobile computing techniques have their root in distributed systems.

Distributed system

Definition:

- A distributed system consists of a collection of autonomous computers, connected through a network and distribution middleware, which enables computers to coordinate their activities and to share the resources of the system, so that users perceive the system as a single, integrated computing facility.
- Multiple autonomous components
- Components are not shared by all users
- Resources may not be accessible
- Software runs in concurrent processes on different processors

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Mobile Computing contd..,

- The process of computation on a mobile device
- In mobile computing, a set of distributed computing systems or service provider servers participate, connect, and synchronize through mobile communication protocols
- Mobile computing as a generic term describing ability to use the technology to wirelessly connect to and use centrally located information and/or application software through the application of small, portable, and wireless computing and communication devices

Mobile Computing contd..,

- Provides decentralized (distributed) computations on diversified devices, systems, and networks, which are mobile, synchronized, and interconnected via mobile communication standards and protocols.
- Mobile device does not restrict itself to just one application, such as, voice communication
- Offers mobility with computing power
- Facilitates a large number of applications on a single device

Introduction Mobile Communication

User Mobility:

- Refers to a user who has access to the same or similar telecommunication services at different places.
- user mobility: users communicate (wireless) —anytime, anywhere, with anyonell

Device Portability:

- The communication device moves with or without the user
- device portability: devices can be connected anytime, anywhere to the network
- A communication device can the exhibit one of the following characteristics:
 - Fixed and wired e.g. Typical desktops computer
 - Mobile and wired e.g. some laptops
 - Fixed and wireless e.g. WIRELESS LANS
 - Mobile and wireless e.g. Mobile phones

Mobility Issues

- Bandwidth restrictions and variability
- Location-aware network operation
 - User may wake up in a new environment
 - Dynamic replication of data
- Querying wireless data & location-based responses
- Busty network activity during connections & handling disconnections
- Disconnection
 - OS and File System Issues allow for disconnected operation
 - Database System Issues when disconnected, based on local data

Portability Issues

- Battery power restrictions
- Risks to data
 - Physical damage, loss, theft
 - Unauthorized access
 - encrypt data stored on mobiles
 - Backup critical data to fixed (reliable) hosts
- Small user interface
 - Small displays due to battery power and aspect ratio constraints
 - Cannot open too many windows
 - Difficult to click on miniature icons
 - Input Graffiti, (Dictionary-based) Expectation
 - Gesture or handwriting recognition with Stylus Pen Voice matching or voice recognition

Evolutions of the Mobile Systems

- 1G Analog systems
- 2G systems
 - voice communication
 - Circuit Switched
- 2.5G systems
 - Circuit switching for voice
 - Packet switching for data
- 3G systems
 - Packet switching for voice and data
 - High speed
 - Compatible with different access technologies

Evolutions of the Mobile Systems

- 5. G systems
 - Evolved Radio Interface
 - IP based core Network
 - Compatible with different access technologies
- 4G systems
 - New Air Interface
 - Very High bit rate services
 - Convergence of Wireline, Wireless, and IP worlds

Evolutions of the Mobile Systems

ALD IN TEREACE	2 <u>G</u> (2000)	EARLY3G (2001)	LATE3G (2003)	<u>4G</u> (2005)
AIRINTERFACE				
VOICE	CIRCUIT	CIRCUIT	CIRCUIT	
DATA	CIRCUIT	PACKET	PACKET	PACKET
ACCESSNETWK				
VOICE	CIRCUIT	CIRCUIT	PACKET	PACKET
DATA	CIRCUIT	CIRCUIT		
CORENETWK				
VOICE	CIRCUIT	PACKET	PACKET	PACKET
DATA	O V E R L A Y P A C K E T			13

Novel Applications

Vehicles

- transmission of news, road condition, weather, music via DAB/DVB-T
- personal communication using GSM/UMTS
- position via GPS
- local ad-hoc network with vehicles close-by to prevent accidents, guidance system, redundancy
- vehicle data (e.g., from busses, high-speed trains) can be transmitted in advance for maintenance

Novel Applications [2]

Emergencies

- early transmission of patient data to the hospital, current status, first diagnosis
- replacement of a fixed infrastructure in case of earthquakes, hurricanes, fire etc.
- crisis, war, ...

Traveling salesmen

- direct access to customer files stored in a central location
- consistent databases for all agents
- mobile office

Novel Applications [3]

- Replacement of fixed networks
 - remote sensors, e.g., weather, earth activities
 - flexibility for trade shows
 - LANs in historic buildings
- Entertainment, education, ...
 - outdoor Internet access
 - intelligent travel guide with up-to-date location dependent information
 - ad-hoc networks for multi user games



Location Dependent Services

- Location aware services
 - what services, e.g., printer, fax, phone, server etc. exist in the local environment
- Follow-on services
 - automatic call-forwarding, transmission of the actual workspace to the current location
- Information services
 - "push": e.g., current special offers in the supermarket
 - "pull": e.g., where is the Black Forrest Cheese Cake?
- Support services
 - caches, intermediate results, state information etc. "follow" the mobile device through the fixed network
- Privacy
 - who should gain knowledge about the location

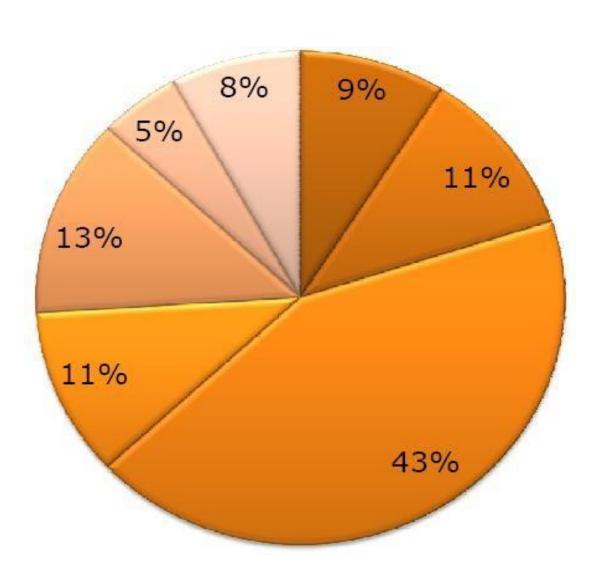
Effects of Device Portability

- Power consumption
 - limited computing power, low quality displays, small disks due to limited battery capacity
 - CPU: power consumption ~ CV²f
 - · C: internal capacity, reduced by integration
 - V: supply voltage, can be reduced to a certain limit
 - f: clock frequency, can be reduced temporally
- Loss of data
 - higher probability, has to be included in advance into the design (e.g., defects, theft)
- Limited user interfaces
 - compromise between size of fingers and portability
 - integration of character/voice recognition, abstract symbols
- Limited memory
 - limited usage of mass memories with moving parts
 - · flash-memory or ? as alternative

Wireless Networks in Comparison with fixed networks

- Higher loss-rates due to interference
 - emissions of, e.g., engines, lightning
- Restrictive regulations of frequencies
 - frequencies have to be coordinated, useful frequencies are almost all occupied
- Low transmission rates
 - local some Mbit/s, regional currently, e.g., 53kbit/s with GSM/GPRS or about 150 kbit/s using EDGE
- Higher delays, higher jitter
 - connection setup time with GSM in the second range, several hundred milliseconds for other wireless systems
- Lower security, simpler active attacking
 - radio interface accessible for everyone, base station can be simulated, thus attracting calls from mobile phones
- Always shared medium
 - secure access mechanisms important

Cellular Subscriber (Sept-2008)



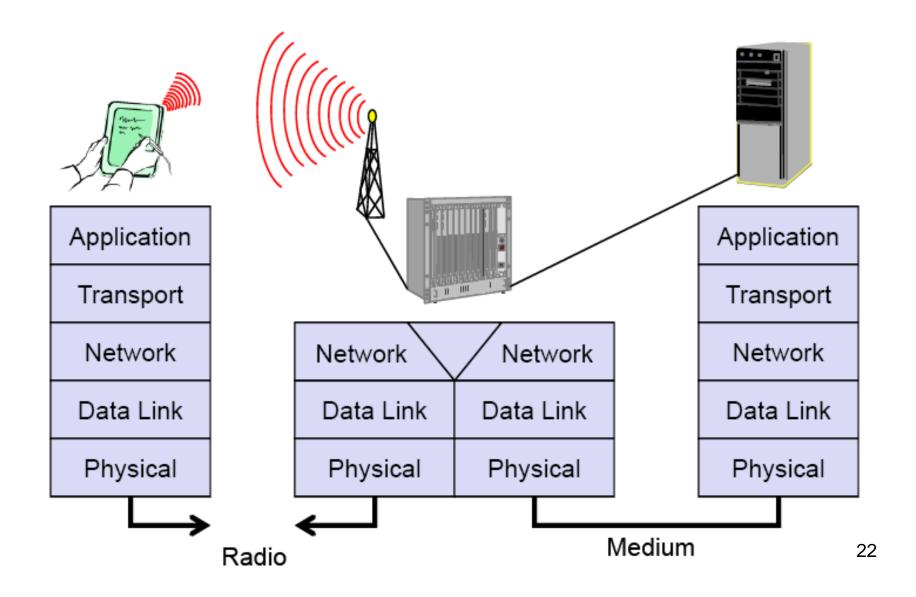
Regions

- Africa
- Americas
- Asia Pacific
- Europe: Eastern
- Europe: Western
- Middle East
- USA/Canada

Limitations of the Mobile Environment

- Limitations of the Wireless Network
 - heterogeneity of fragmented networks
 - frequent disconnections
 - limited communication bandwidth
 - Interference: the quality of service (QoS)
 - Bandwidth: connection latency
- Limitations Imposed by Mobility
 - lack of mobility awareness by system/applications
 - route breakages
 - Dynamic changes in communication environment: variations in signal power within a region, thus link delays and connection losses
- Limitations of the Mobile Computer
 - short battery lifetime
 - limited capacities

Simple Reference Model



Layer functionality

Application layer	service location new/adaptive applications multimedia
Transport layer	congestion/flow control quality of service
Network layer	addressing, routing device location hand-over
Data link layer	authentication media access/control multiplexing encryption
Physical layer	modulation interference attenuation frequency