Internet and Mobile Services

Course Overview, Motivations and Introduction

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Contact Details

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- Availability Hours: Tue 14.00-16.00
  - by prior arrangement via e-mail

- Course web site
  - http://www.inf.unibz.it/~ricci/MS/
Course Structure

- **Lectures:** 24 hours
- **Labs:** 12 hours

**Timetable:**
- Lectures: Fri 14.00-16.00 - Room E420
- Labs: Tue 17.00-18.00 – Room E431
- Lab starts from October 6th

**Assessment:**
- Final oral exam 50 % of mark
- Project in small teams (max 2 students) 50 % of mark
Objectives

- This course presents mobile applications and illustrates how to build them exploiting various mobile communication technologies.
- To provide practical knowledge required for designing and building successful mobile applications in the Java 2 Micro Edition platform.
- There will be illustrated a number of examples and general principles for the design and the development of user friendly applications.
- We shall cover the economic-social motivations for the development of Mobile Services – you will understand the open opportunities for developing such applications.
- To illustrate some advanced characteristics of mobile applications, such as location-based adaptation, personalization, and ubiquitous computing.
What you will learn

- How to build a **Java application** that runs on your mobile phone and interacts with other applications (server)
- How to use the **Java Wireless Toolkit** (now **Java ME SDK**) and **IDE** (NetBeans)
- Understand what is **Mobile Commerce**
- Have a broad spectrum of the various types of **applications** that have been designed for wireless devices and contexts
- Learn how your mobile phone can make and receive calls or send and retrieve data
- Have an introduction on other application models: WAP and **Android**
Syllabus

- **Java 2 Platform, Micro edition (J2ME):** and various optional packages
- **MIDlet development with the Wireless Toolkit and IDE**
- **Wireless standards and technologies**
- **Mobile Commerce and applications**
- Porting applications on real devices
- Context-aware and location-based services
- Workflow for designing usable mobile applications
- **WAP and Android**
Books and Material

- The two books that will be used are
  - **1) For J2ME programming:**
    - We plan to cover the chapters 1-11: Introduction, User interfaces, persistent storage (record store and files), http connections, messaging (SMS)
  - **2) For Wireless Technologies:**
    - J. Schiller, Mobile Communications, Addison Wesley, 2003 (2. edition)
    - We plan to cover: wireless transmission, medium access control and telecommunication systems (GSM, GPRS)
  - Additional useful articles and tutorials will be also indicated on the course web site.
Lectures and Labs

- In the lectures I will present the various topics
- I will try to mix the part of the course devoted to the programming techniques and wireless technologies with discussions on:
  - Applications
  - Market Trends
  - Gizmos
- In the lab you will practice J2ME programming
  - Solving programming exercises
  - Working on your projects
- The lab starts from the 2\textsuperscript{nd} week!
Exam

- The exam consists of two parts
  - Project in small teams (max 2 students) - max 15 points
  - final written exam - max 15 points
- You must pass both of them (minimum is 9 points)
- The final grade is obtained as
  - Final grade = Project_Grade + Written_Grade
- In the project you will design and develop a useful application (e.g. consulting the bus schedule from your mobile phone)
- You will present the projects at the final Lecture.
Introduction to Mobile Services
Base Transceiver Station

- **Base Transceiver Station (BTS)** is the equipment which facilitates the wireless communication between user equipments and the network.

- **User equipment**: mobile phone, computer or device with WiFi and WiMAX connectivity.

- The network can be that of any of the wireless communication technologies like GSM, UMTS, WiFi, WiMAX.
**FDD/FDMA - example GSM**

**FDD = Frequency division duplex**
Both partners have to know the frequency in advance

**The base station allocates the frequencies**

**full-duplex** means that you use one frequency for talking and a second, separate frequency for listening. Both people on the call can talk at once.

CB radios are **half-duplex** devices – only one can talk
Access methods SDMA/FDMA/TDMA

- **SDMA (Space Division Multiple Access)**
  - segment space into sectors, use directed antennas
  - cell structure

- **FDMA (Frequency Division Multiple Access)**
  - assign a certain frequency to a transmission channel between a sender and a receiver
  - permanent (e.g., radio broadcast), slow hopping (e.g., GSM), fast hopping (FHSS, Frequency Hopping Spread Spectrum)

- **TDMA (Time Division Multiple Access)**
  - assign the fixed sending frequency to a transmission channel between a sender and a receiver for a certain amount of time.
Access method CDMA

- CDMA (Code Division Multiple Access)
  - The channel is not divided by time or frequency but ...
  - All terminals send on the same frequency probably at the same time and can use the whole bandwidth of the transmission channel
  - each sender has a unique random code, the sender XORs the signal with this random code
  - the receiver can “tune” into this signal if it knows the pseudo random code, and can decode the signal.
Medium access control

- Medium access control comprises all mechanisms that regulate user access to a medium using SDM, TDM, FDM or CDM
- MAC is a sort of traffic regulation (as traffic lights in road traffic)
- MAC belongs to layer 2 (OSI Model): data link control layer
- The most important methods are TDM
- TDM is convenient because the systems stay tuned on a given frequency and the use the frequency only for a certain amount of time (GSM)
GSM Architecture

- **Cell Transmitter & Receiver**
- **Interface to Land Telephone Networks**
- **Hierarchy of Cells**
- **Stolen, Broken Cellphone List**
- **Encryption, Authentication**
- **List of Subscribers of One Operator**
- **List of Roaming Visitors**

**Definitions:**
- **BTS:** Base transceiver station
- **BSC:** Base station controller
- **BSS:** Base station subsystem (BTS+BSC)
- **MSC:** Mobile switching center
- **GMSC:** Gateway MSC
- **SIM:** Identifies a subscriber
- **DATA RATE:** 9.6 Kbps

**Additional:**
- **MS:** Mobile station
- **HLR:** Home location register
- **VLR:** Visited location register
- **EIR:** Equipment identity register
- **AUC:** Authentication center

**Source:** UWC
GPRS General Packet radio Service

- **General Packet Radio Service (GPRS)** is a mobile data service available to users of GSM (2.5 G).
- GPRS data transfer is typically charged per megabyte of transferred data.
- GPRS can be utilized for services such as WAP access, SMS and MMS, but also for Internet communication services such as email and web access.
- GPRS is packet-switched - multiple users share the same transmission channel, only transmitting when they have data to send.
- Data transfer speed ranges between 9 to 171 kbit/s (depends on slots and codec used).
For the most part, in Europe at least, the mobile Internet has used the WAP (Wireless Application Protocol).

WAP deliver content services as WML (Wireless Markup Language).

http://www.provincia.bz.it/mobile
More recent WAP application

[Schneider, 2009]
Mobile Information Device Profile

Optional Packages

MIDP

Game
User Interface
Media
Application Management
End-to-End Security
Local Data Storage
Push Registry
Connectivity
OTA Provisioning

CLDC
KVM
Smart labels (HF tags)
Phone with RFID reader

- A ‘service discovery’ application quick read the tag
- The sharp vibrations and flashing lights indicates that a tag is found
- It has the ability to read *and* write to tags
- Makes it potentially useful for a number of applications.
RFID

- RFID (Radio Frequency Identification) technology enables identification from distance
- Unlike earlier bar-code technology it does not require line of sight (LOS)
- RFID tags support a larger set of unique IDs than bar codes
- RFID can incorporate additional data (e.g., manufacturer, product type)
- An RFID reader can detect many different tags located in the same general area
- RFID tags can be manufactured now at low prices – can compete with traditional technologies.
June 2007: the total number of cellular connections in the world reached **3.25 billion** (source: Reuters) ~ half of the world population!
Mobile Internet

- The **mobile Internet** is made up of a group of related infrastructure, protocol and device technologies, allowing the end-user to access various types of data services from their mobile devices.

- **Services:**
  - Web-style information content, information services (e.g., train schedule or train delays)
  - Email services, social networking
  - Games

- **Accessed using a range of devices from**
  - Limited, first-generation WAP (Wireless Application Protocol) phones
  - Today’s sophisticated "smart" phones (replacing the old PDAs)
  - But also computers with wireless connection (netbooks, laptops).
OS Market Share - Internet Access

- Windows dominates
- IPhone and Java ME are leading the mobile internet

http://marketshare.hitslink.com
Paradigm Shift

- Every new generation of technology challenges our world view and paradigms
- A **paradigm shift** occurred when people transitions from listening to the radio to watching television programs
- Another example is when people went from using standalone personal computers to accessing the Internet
Mobile communication

- Two aspects of mobility:
  - *user mobility*: users communicate (wireless) “anytime, anywhere, with anyone”
  - *device portability*: devices can be connected anytime, anywhere to the network

- Wireless vs. mobile

<table>
<thead>
<tr>
<th>Wireless</th>
<th>Mobile</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>✗</td>
<td>✗</td>
<td>stationary computer</td>
</tr>
<tr>
<td>✗</td>
<td>✓</td>
<td>notebook in a hotel (tel. access)</td>
</tr>
<tr>
<td>✓</td>
<td>✗</td>
<td>wireless LANs in buildings (or WiMax)</td>
</tr>
<tr>
<td>✓</td>
<td>✓</td>
<td>Smart Phone (e.g. iPhone)</td>
</tr>
</tbody>
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- The demand for mobile communication creates the need for integration of wireless networks into existing fixed networks:
  - local area networks: Millimeter Waves
  - Internet: Mobile IP extension of the internet protocol IP
  - wide area networks: e.g., internetworking of GSM and ISDN
Applications - Just some of them ...

- **Vehicles**
  - transmission of news, road condition, weather, music via DAB
  - personal communication using GSM
  - 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

- **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, ...
Typical application: road traffic

UMTS, WLAN, DAB, DVB, GSM, cdma2000, TETRA, ...

Personal Travel Assistant, PDA, Laptop, GSM, UMTS, WLAN, Bluetooth, ...
Semantic Peer-to-Peer Communication

Attention! Risk of aquaplaning 100 meters ahead!!!

GPS: Position of Bike

GPS: Position of Car

Aquaplaning Sensor

Semantic Peer-to-Peer Connection

© W. Wahlster
Flu Data Goes Mobile

- Help track the spread of infectious diseases including swine flu
- Users can zoom in and out on a map to find geographically relevant information about infectious disease outbreaks
- Users can also submit information regarding a recent outbreak in their area
- Provide experts with new sources of epidemiological information
- Based on [http://www.healthmap.org/en](http://www.healthmap.org/en)
- A simple text-messaging system to alert those with basic mobile phones of outbreak information is also on the agenda.

Always Best Connected

- DSL/ WLAN: 3 Mbit/s
- GSM/GPRS: 53 kbit/s, Bluetooth: 500 kbit/s
- UMTS, GSM: 115 kbit/s
- LAN: 100 Mbit/s, WLAN: 54 Mbit/s
- GSM/EDGE: 384 kbit/s, DSL/WLAN: 3 Mbit/s
- GSM: 115 kbit/s, WLAN: 11 Mbit/s
- UMTS, GSM: 384 kbit/s
Quiz

- What do you do if you handy fall in the WC?
  - Switch it off
  - Remove the battery
  - Put the handy bowl of dry rice - it will dry up 😊
Services

- Location aware services
  - The information provided is adapted to the local environment (e.g. *shops around you*)

- 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 Cherry 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
MobiDay User Functions

**Patient**
- Receive and read messages
  - advices or tips sent by the medical staff
- Fill-out questionnaires on the quality of life
- Check next activities in her hospital workflow

**Medical staff**
- Send messages to the patients
- Manage the patient's workflow
- Manage the patients (e.g., assign them to experiments)
- Check patient's location
Interruptibility

'I'm eating right now. Can you call me back when I'm not eating?'

'You haven't spoken to me in weeks!' 'I didn't want to interrupt you!'
System Architecture

MobiDay Client

MobiDay Web

MobiDay Server

ONCONET Server

CHES Server

WORKFLOW

PATIENT DATA

MESSAGES

FEEDBACK

RESULTS

ACTIVITIES

RESULTS

QUESTIONNAIRES

MESSAGES

FEEDBACK

RESULTS

ACTIVITIES

MESSAGES

FEEDBACK

RESULTS

ACTIVITIES

MESSAGES

FEEDBACK

RESULTS

ACTIVITIES

MESSAGES
Localization with RFID
Questions

- Make a list of mobile applications that come to your mind and group them into different categories (see slide 25 for a list of categories – to be extended).
- What is the goal of MAC (medium access control) and what are the main approaches we have discussed?
- Imagine an application scenario for mobile services in a train (list applications, their functions and the type of devices that are needed).
- What is an ad-hoc network?
- Is WAP a failure? Why? Is there still a potential? Compare it with J2ME.
- Is there any fully wireless technology? Make an example. Is GSM fully wireless or not? Explain what communications are wireless and what are not.