Internet and Mobile Services

Course Overview, Motivations and Introduction

F. Ricci
Contact Details

- Francesco Ricci
  - Room 204 (POS)
  - fricci@unibz.it
  - 0471 016971
- 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: Tue 9.30-11.30 – Room 412
  - Labs: Tue 11.30-12.30 – Room 431
  - Lab starts tomorrow October 6th
- **Assessment:**
  - Final written exam 50 % of mark
  - Project in small teams (max 2 students) 50 % of mark
Objectives

- This course deals with mobile services 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, context-awareness, 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 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 i.e. HTML+CSS web applications
Syllabus

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

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)

3) For general concepts of mobile development

Additional useful books, articles and tutorials will be also indicated on the course web site.
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.
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)
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.
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 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.
GSM Architecture

CELL TRANSMITTER & RECEIVER

HIERARCHY OF CELLS

DATA RATE: 9.6 Kbps

STOLEN, BROKEN CELLPHONE LIST

INTERFACE TO LAND TELEPHONE NETWORKS

PHONE

SIM: IDENTIFIES A SUBSCRIBER

LIST OF ROAMING VISITORS

Encryption, Authentication

LIST OF SUBSCRIBERS OF ONE OPERATOR

BTS Base transceiver station
BSC Base station controller
BSS Base station subsystem (BTS+BSC)
MSC Mobile switching center
GMSC Gateway MSC

MS Mobile station
HLR Home location register
VLR Visited location register
EIR Equipment identity register
AUC Authentication center

SOURCE: UWC
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](http://www.provincia.bz.it/mobile)
More recent WAP application

[Schneider, 2009]
Java Editions

- The Java 2 Platform is split into three editions:
  - **Java 2 Standard Edition (J2SE)** - Desktop-based applications
  - **Java 2 Enterprise Edition (J2EE)** - Server-based applications
  - **Java 2 Micro Edition (J2ME)** - For handheld and embedded devices
- Each edition provides a complete environment for running Java-based applications including the Java Virtual Machine (JVM) and runtime classes
- What separates one edition from another, then, is primarily the *set of class libraries* that each edition defines
- *You can think of J2ME as a subset of J2SE and J2SE as a subset of J2EE.*
Why Java?

- **High-end smart phones** have gotten a lot of attention.
- But **these only represent a small fraction of the overall mobile space**.
- Mobile phones based on the Java Micro Edition (Java ME) platform, including RIM's Blackberry, Nokia, Sony Ericsson, and many other manufacturers, represent about **2.6 billion devices or two thirds of the total installed base**.
What Java Offers on Wireless Devices

- **Dynamic delivery of content:** new application, services and content can be downloaded dynamically
- **Security:** class file verification, a well-defined application programming interface, security features, ensure that applications cannot harm the device or network
- **Cross-platform compatibility:** standardized language features and libraries implies that the application can run on different devices and OS
- **Enhanced user experience and interactive content**
- **Offline access:** applications can be used without active network connection
- **Object oriented:** good abstraction mechanisms and higher level programming constructs
- **Large developer community:** more than 3 millions Java developers worldwide.
Third Party Application Development

- Advertise App on Web Page
- User Selects App
- JAM Downloads App

Web Page
 descriptors File
Jar File
Network Transfer
Java Application Manager
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.
- Example application: http://www.openbeacon.org/
Mobile Subscribers hit 5 Billion Mark

- Mobile subscribers will surpass 5 billion in 2010 (that's over 70 percent of the world population) and growing rapidly, led by China and India.

- The worldwide number of **PCs** in-use is around 1 billion.

http://mobithinking.com/
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:**
  - **Information:** web-style information content, information services (e.g., train schedule or train delays)
  - **Communication:** email services, social networking
  - **Transaction:** B2B, B2C, C2C

- **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).
Mobile Phones Users

- Half a billion people accessed mobile Internet worldwide in 2009 - usage will double within five years as mobile overtakes the PC as the most popular way to get on the Web
- By 2011, over 85 percent of new handsets will be able to access the mobile Web.
- SMS is still king of mobile messaging with five trillion messages sent in 2009. Despite the popularity of mobile email, IM and MMS, SMS is predicted to exceed 10 trillion in 2013
- What do consumers use their mobiles for? According to this US data: 1. calls; 2. SMS; 3. mobile Web; 4. apps; 5. games; 6. social networking; 7. music.

http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats
Mobile phones evolution

- 1983: Analog Motorola DynaTAC 8000X
- 1989: Motorola MicroTAC 9800X
- 1996: Motorola StarTAC – the first clamshell
- 1998: Nokia 9110i – the first smart phone
- 1999: Nokia 7110, the first mobile phone with a WAP browser

Mobile phones evolution

- **1999**: Benefon Esc! - GPS integrated into a mobile phone
- **2001**: Ericsson T39 - the first Bluetooth phone
- **2001**: Sony Ericsson P800 - touchscreen and up to 128mb of memory
- **2002**: Nokia 3510(i) - GPRS internet services to the mass market
- **2002**: BlackBerry 7210 - BlackBerry’s first colour screen
- **2003**: Nokia 6680 - one of the first 3G phones
OS Market Share - Internet Access (Sept 2010)

- Windows dominates
- IPhone and Java ME are leading the mobile internet
- Android (not shown here is 0.2%)

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**
  - **Examples**
    - ✗ ✗ stationary computer
    - ✗ ✓ notebook in a hotel (tel. access)
    - ✓ ✗ wireless LANs in buildings (or WiMax)
    - ✓ ✓ Smart Phone (e.g. iPhone)

- 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 Car

GPS: Position of Bike

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
- A simple text-messaging system to alert those with basic mobile phones of outbreak information is also on the agenda.

http://www.technologyreview.com/communications/23414/
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 😊
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
'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

CHES Server

ONCONET Server

WORKFLOW

PATIENT DATA

MESSAGES

ACTIVITIES

FEEDBACK

RESULTS

RESULTS

QUESTIONNAIRES
Localization with RFID
Questions

- Make a list of mobile applications that come to your mind and group them into different categories.
- 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?
- Was 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.