Mobile Middleware Course

Introduction and Overview

Sasu Tarkoma
Contents

- Course outline
- Motivation
- Mobile middleware overview
Course Overview

- 3 credit course

- Three components
  - Lectures
  - Assignment (four exercises)
  - Literature (three papers and course book)

- Grading based on
  - Exam (60%)
  - Assignment (40%)
12.3 Introduction and assignments

19.3. Platforms, Middleware, Protocols

Assignment slot 1 (Hello World)

26.3. Patterns

Assignment slot 2 (client-server comms)

2.4. easter

9.4. Applications: Carat and energy awareness

Assignment slot 3 (HTTP to sensor data)

16.4. Applications and Summary

23.4. Assignment slot 4: Mockup app based on sensor data (map of friends’ positions)

Final submission in May

Exam: 3.5. 9:00 A111
Course Book

- Mobile Middleware – Architecture, Patterns, and Practice published by Wiley
  - Publication date 27.3.2009
  - Available through Helka with AD account

- Several papers to read
Included chapters

- Chapter 1: Introduction
- Chapter 2: Architectures (note 2.6 described old systems)
- Chapter 3: Support Technologies 3.1-3.3, 3.6
- Chapter 4: Principles and Patterns
- Chapter 8: Data Synchronization
- Chapter 10: Application and Service Case Studies
Additional reading

- Mobile platforms survey, 2011.
- CoAP specification (not for exam)
Assignment

- Android development supported on the department computers.
- You can also develop for IOS, Windows Phone, Meego etc. using your own hardware.
- Server resources provided by the department.
- Usage of 3rd party open source code is allowed, but remember the licencing policies.
- MIT licensing of your code encouraged.
Exercise sessions

- Exercise sessions 19.3. 26.3. and 9.4. and 23.4. at 14-16, location TBA.

- Traditional exercise style.

- Some exercises require returning the source code and/or automatic validation of the developed software.
Grading of the Exercises

- Four exercises
- Part 1: Sensor monitor
- Part 2: Client-server comms with CoAP
- Part 3: HTTP access to sensor data
- Part 4: Demo application based on sensor data (example: map of friends’ positions)
- Each step gives one point + one point for overall design and implementation
- Max points 5
Contacts

- Lectures and general course related issues
  - Prof. Sasu Tarkoma (@helsinki.fi)

- Exercises
  - Petri Savolainen (@hiit.fi)
Introduction to Mobile Middleware
Motivation

- Mobile computing has become one of the breakthrough technologies of today
  - Over 4 billion mobile phones in use
  - Tens of billions of downloads from Apple Appstore
  - Current trend is converged communications
  - Web resources integrate seamlessly with mobile systems
  - Mobile systems are increasingly dependent on software

- We give an overview of mobile middleware technology
Mobile software

- Mobile software is a growing area
  - Development processes, tools, APIs are crucial for the ecosystem
  - Integration with Web resources

- Key applications
  - Voice
  - Multimedia
  - Messaging
  - Web sites, mashups, services
  - Location-based services

- Forthcoming features
  - Context-awareness, adaptability, smart spaces
  - Internet of Things
Mobile Evolution

- 1st generation (1990-1999)
  - Text messages (SMS) and mobile data. Speeds up to tens of Kbps.

  - Limited browsers, WAP, iMode, and MMS. Speeds up to 144Kbps.

- 3rd generation (2003-2008)
  - Mobile platforms, middleware services. Series 60, J2ME, Android, iPhone. Speeds up to several Mbps.

- 4th generation (2008-)
  - Adaptive services, user interfaces, and protocols. Context-awareness, always-on connectivity. Speeds up to hundreds of Mbps.
  - Emergence of app stores.
  - Versatile devices: smartphones, pads.
  - Cloud-assisted applications with social networks.
Toward Internet of Things

- Global connectivity
- Personal mobile
- Digital Society
- Places
- People
- Things
- Hundreds of Billions
- 7 Billion
- ~0.5 Billion

Year:
- 1875
- 1900
- 1925
- 1950
- 1975
- 2000
- 2025

~0.5 Billion Places
7 Billion People
Hundreds of Billions Things
Example IoT products and services

- M2M traffic solutions (security, healthcare, energy, …)
- Cosm (Pachube) Web service for connecting sensor data
  - www.cosm.com
- There gateway for home automation and monitoring
  - http://therecorporation.com/fi
- Rymble By Symplo
  - http://www.rymble.com/
- NEST learning thermostat
- Withings products
- Karotz By Aldebaran Robotics
  - http://www.karotz.com/home
- Green Goose
  - http://greengoose.com/
- Google Q
- And many emerging products based on 802.15.4, WiFi, RFID and NFC, and the power of the cloud
Wireless Technologies

- Global System for Mobile (GSM),
- General Packet Radio Service (GPRS)
- Universal Mobile Telecommunications System (UMTS)
- Long Term Evolution (LTE)
- Wireless LAN (WLAN)
- Worldwide Interoperability for Microwave Access (WiMax)
- Ultra-wideband (UWB)
- Wireless Personal Area Network (WPAN)
- Bluetooth, Wibree
- RFID
WiMAX

Bandwidth
200 Mbps
54 Mbps
5-11 Mbps
4 Mbps
1 Mbps
384 Kbps
56 Kbps

Range
10 - 30 m
50-200 m
200 m-4 km
5 km -20 km

802.11n
802.11a, g
802.11b
802.15.1

LTE: 4G, 100Mbps down, 50 Mbps up
802.11a,g point-to point
WiMAX
UMTS/WCDMA-HSDPA, CDMA 2000-1xEVDO
3G enhanced
LTE Advanced: 4G, 1 Gbps
UMTS/WCDMA, CDMA 2000
IS-95, CDMA, GSM
3G
2G
Current state of the art

- **Communications**
  - WiFi and LTE for mobile data
  - WiFi and Bluetooth for local communications (also NFC)

- **Applications**
  - More APIs available, cloud integration
  - Fragmentation and control challenges

- **Cloud-based APIs, storage, control functions**
  - Cloud offerings from operators and manufacturers
  - Cloud in the access network

- **Mobile traffic**
  - Machine-to-machine as a new component in mobile traffic
  - Increasing video component
Views to Mobile Software

- Distributed
  - Device
  - Device neighbourhood
  - Web and the Cloud

- Current topics
  - Sensing (pollution, health, medical, …)
  - Offloading and partitioning
  - Energy consumption
  - Indoor positioning
  - Cloud integration
  - Software defined networking (SDN)
  - Wireless video
  - …
Mobility in the Internet

- This topic pertains to mobility of
  - Networks
  - Hosts
  - Transport connections
  - Sessions
  - Objects (passive, active)
  - Services
  - Users

- Many solutions are needed on multiple layers
  - Link layer, network, transport, application
Role of Software and Algorithms

- Software has an increasingly important role in mobile devices
  - Increase in device capabilities
  - Interaction with sensors and other devices
  - Integration with the Web and cloud

- Applications and services
  - Development processes
  - Testing of mobile sw
  - Deployment and management
The Hourglass

- Diverse applications
- Divergence
- Transport Layer (TCP/IP)
- Convergence
- Diverse physical layers

Middleware
Middleware

- Widely used and popular term
- Fuzzy term
- One definition
  - “A set of service elements above the operating system and the communications stack”
- Second definition
  - “Software that provides a programming model above the basic building blocks of processes and message passing” (Colouris, Dollimore, Kindberg, 2001)
Why Middleware?

- Application development is complex and time-consuming
  - Should every developer code their own protocols for directories, transactions, ..?  
  - How to cope with heterogeneous environments?  
    - Networks, operating systems, hardware, programming languages

- Middleware is needed
  - To cut down development time
    - Rapid application development
  - Simplify the development of applications
  - Support heterogeneous environments and mask differences in OS/languages/hardware
Middleware cont.

- Middleware services include
  - directory, trading, brokering
  - remote invocation (RPC) facilities
  - transactions
  - persistent repositories
  - location and failure transparency
  - messaging and events
  - Security
  - synchronization
- Network stack (transport and below) is not part of middleware
Mobile Platforms

- Collections of central services and libraries with both reactive and proactive functions
- APIs typically logically centralized
- Distributed between elements of the environment
  - Multi-tier client-server
  - Peer-to-peer
  - Hybrids
- The platform running on the mobile terminal and the characteristics of the device determine how service is rendered for the end user
Platforms

- **2009**
  - Java Micro Edition (Java ME)
  - iOS
  - Symbian and Series 60
  - Windows Mobile
  - Linux Maemo (MeeGo)
  - Android
  - BREW
  - WAP

- **2012**
  - iOS
  - Android
  - Windows Phone 7 and 8
  - HTML5 web apps
Next

- Platforms, middleware, protocols
- Principles and Patterns
- Examples