Mobile and Ubiquitous Computing

Introduction to the Module

Dr. Mirco Musolesi

UNIVERSITY OF BIRMINGHAM

Teaching Material

- No textbook
- Papers (required readings)
- Additional reference books
- Slides

Office Hours

- Thursdays 5-7pm
- Office: 1.38
- When you contact me by email, please add the string "MUC" in the subject of your message if possible

Assessment

- Continuous assessment (20%)
  - Programming projects in Android
- Final written exam (80%)

Topics will include:

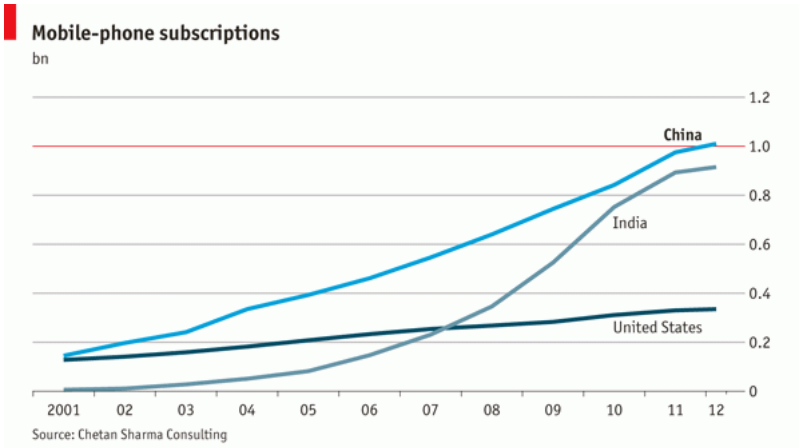
- Wireless Technologies
- Ubiquitous Systems
- Sensing technologies
- Location-based systems
- Machine learning for mobile systems
- Privacy
- Mobile for Developing World

Smart Phones: the Computing Platform of the Future

Smart Phones: **the** Computing Platform

Some Numbers

- Number of worldwide mobile cellular subscribers increased from 34 million in 1993 to nearly 5.5 million subscribers by 2011.
- The number of cellular subscribers surpasses the number of wired phone lines.



Source: The Economist

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Location-based Social Network Systems

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Geographic Recommender Systems

NETFLIX

yelp

foursquare

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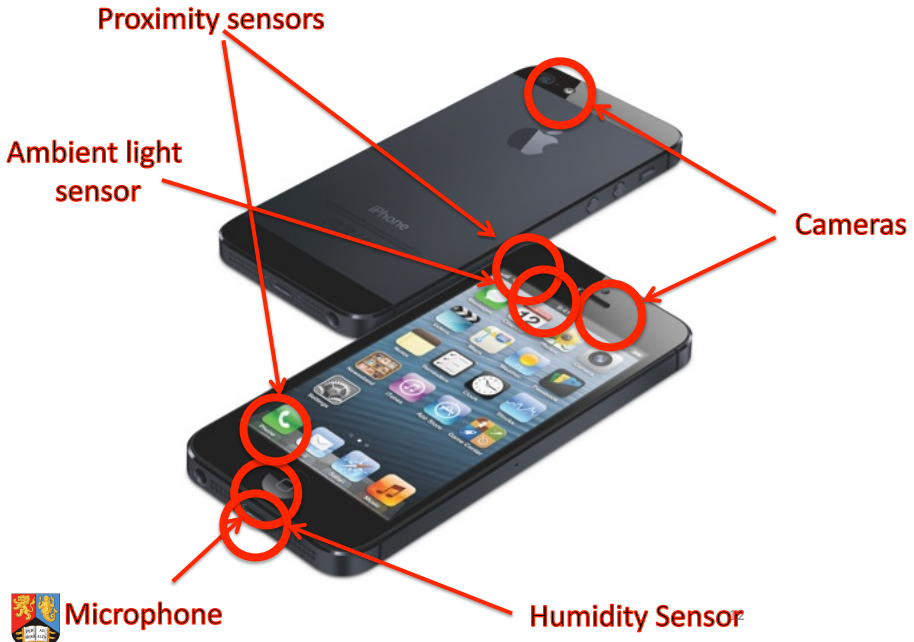

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Credit: CNet

Accelerometer
GPS
Gyroscope
Bluetooth [colocation]

Fundamental Challenges in Mobile Computing

- Mobile devices are resource-constrained
- Mobile connectivity is highly variable in performance and reliability
- Mobile devices are inherently less secure

M. Satyanarayanan. Fundamental Challenges in Mobile Computing. Proceedings of PODC'96. 1996.

Mobile Devices are Inherently Resource Constrained

- Mobile devices rely on batteries
- Energy consumption due to:
  - Computation (CPU, co-processors)
  - Display
  - Communication
  - Sensing
- Energy-efficient algorithms are needed

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Mobile Devices are Inherently Resource Constrained

- Computational constraints
  - But, for example, in the Samsung Galaxy SIII you have1.4 GhZ quad-core Cortex A-9 +GPU
- Memory constraints
  - But, for example, in the Samsung Galaxy SIII you have1GB or 2GB of RAM

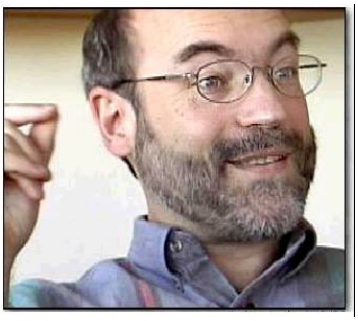
Mobile Connectivity is Highly Variable in Performance and Reliability

- Various types of connectivity:
  - Cellular (GSM, 3G, 4G, etc.)
  - WiFi
  - Bluetooth
  - Near Field Communication (NFC)
  - …
- Constraints related to:
  - Coverage issues
  - Trade-offs: energy consumption, throughput, costs

Mobile Devices are Inherently Less Secure

- Wireless not wired communication
  - Eavesdropping
  - Need for encrypted communication
- Devices can be stolen
  - Devices might also be accessible by everyone (for example, sensors)

Ubiquitous Computing



Mark Weiser (1952-1999)

"The most profound technologies are those that disappear."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A Definition of Ubiquitous Computing

- "Ubiquitous computing enhances computer use by making many computers available throughout the physical environment, while making them effectively invisible to the user" (Mark Weiser)
- Pervasive computing is a synonym of ubiquitous computing

Issues in Designing Ubiquitous Computing Systems

- Distributed systems issues:
  - Remote communication
  - Fault tolerance
  - Remote information access
  - Distributed security
- Networking issues:
  - Wireless communication
  - Transport layer for wireless channel

Issues in Designing Ubiquitous Computing Systems

- Databases issues:
  - Disconnected operations
  - Weak consistency
- Energy issues:
  - Adaptation in terms of communication
  - Intelligent uploading of data
  - Hardware aspects

Issues in Designing Ubiquitous Computing Systems

- HCI issues:
  - Limited interface
  - Interaction with the devices (input, etc.)
  - Ergonomics
- Privacy issues:
  - Location sharing
  - Activity recognition
- Security issues:
  - Encrypted communication

Suggested Readings

Mark Weiser. The Computer for the 21th Century. Scientific American. September 1991.

Mark Weiser. Some Computer Issues in Ubiquitous Computing. Communications of the ACM. Vol. 36. Issue 7. July 1993.

M. Satyanarayanan. Pervasive Computing: Vision and Challenges. IEEE Personal Communications. Vol. 8 Issue 4. August 2001.