# Mobile Computing and the IoT
# Wireless and Mobile Computing

## Revision Class

George Roussos

g.roussos@dcs.bbk.ac.uk

Birkbeck
UNIVERSITY OF LONDON

# Overview

- Syllabus summary
  - Wireless + mobile
    - Device components + IoT Architecture
    - Communication principles
  - RFID
  - Location sensing
  - Privacy
- Exam question styles

# Devices and Architecture

- Components of mobile/IoT devices
- Role and power consumption characteristics
- Example configurations
- Template of IoT architectures

# Wireless Communication

- Signal propagation through the air
- Factors that influence the signal
  - fading (frequency dependent)
  - shadowing
  - reflection at large obstacles
  - refraction depending on the density of a medium
  - scattering at small obstacles
  - diffraction at edges
- Especially difficult case: multi-path
  - examples

# Wireless comms

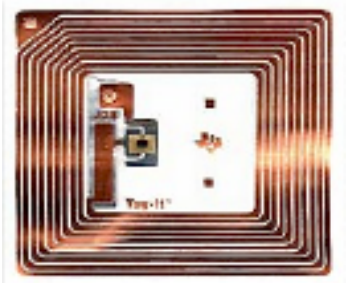
- Hidden and exposed terminal
- Far and near terminal
- Sharing the air i.e. ways of multiplexing communication
  - space ($s_i$)
  - time (t)
  - frequency (f)
  - code (c)
- Cellular GSM networks as an example

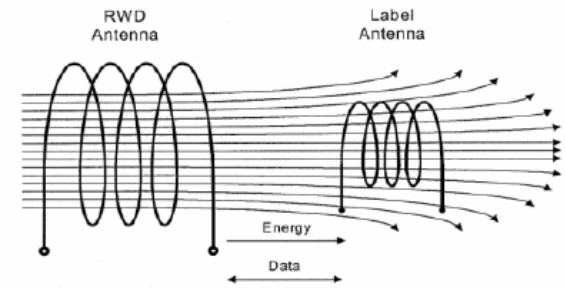
# Mobility support

- Mobile IP
  - Actors and roles
  - Basics of operation
  - What does it give us over standard IP
- Locator/Identifier Separation Protocol

# RFID Operating Principle

- Tag and reader components
- Energy transmission techniques
- RFID types
  - Magnetic (near) field (LF or HF)
  - Electric (UHF)
- Choice influences parametres of operation
  - e.g. range, bandwidth, size
- Standard types





# RFID flavours

- Classification (e.g. HF, UHF etc)
- Advantages and disadvantages
- Appropriate uses

- Gen2 tags in more detail
  - Memory organisation
  - Numbering scheme
  - Inventory and singulation protocols

# RFID Applications

- Typical Requirements
  - Memory capacity, bandwidth, security, range
- RFID technology selection

# Location sensing

- Location sensing techniques
  - Triangulation
    - Principle of operation (without the math)
  - Proximity
  - Scene analysis
- Location sensing systems
  - Properties, examples
  - Advantages and disadvantages of each

# Location sensing

- Choosing the right one for a specific application
  - Properties of location systems
  - Limitations of specific systems
  - Implications of location data for privacy
- Extra emphasis on GPS due to its importance
  - principle of operation, timings, influence on accuracy of environment

# Privacy

- Initial entitlement:
  - Allocation of property rights
  - Who should get the initial right to control the information generated by location sensing?
- Coercion and choice:
  - If you want discount you will get the technology.
- Societal overrides:
  - When does society, regardless of your preference, get access to the data anyway?
- Look for example in past guest lectures e.g. Eric+Richard, Neal; and in RFID apps +++

# Question from past exam

- Explain how encapsulation works in Mobile IP and what is its effect on the original source and destination addresses of the processed packet. (8 marks)

# Answer

- The process of incorporating an original IP packet (less any preceding fields such as a MAC header) inside another IP packet, making the fields within the original IP header temporarily lose their effect.
- Showing this on a figure can help.

# Question from past exam

- Suggest an appropriate passive RFID tag type for the implementation of an intelligent transportation system such as the Oyster card. Justify your choice in terms of information capacity, range and speed of communication and security. (8 marks)

# Answer

- Any of the ISO standards at HF frequencies would satisfy the requirements of the application as they would provide superior storage capacity (up to 4k), short range and medium throughput communication.

# Essay question

Mobile and pervasive computing systems and the Internet of Things are innovative and valuable technologies but they can also be used to collect massive amounts of information about personal habits and activities. Such data can be stored and processed to provide a detailed historical record of one's behaviour and to create profiles that predict individual choices. As a result these technologies set unique challenges for the protection of personal privacy and offer novel opportunities to violate the fundamental rights of citizens.

As a consequence, the collection of such data requires decisions to be made by all societies affected, setting the framework of their safe operation and regulating their processing.  Discuss the key issues of this debate with reference to the three fundamental choices that must be made. Present your argument of what an appropriate and fair solution should be.