

# CSE 303

## Concepts and Tools for Software Development

Magdalena Balazinska

Winter 2007 - Lecture 13

Societal Implications of Computing

Impact of Computer Engineering Solutions

# Midterm Logistics

- Next Friday, February 9th, in class
- Closed books, closed laptops
- Bring 1 piece of paper (letter size) with notes
  - You can write on both sides
- Practice midterms
  - Are posted on the class website
  - Sample midterm 1: skip question 5b

# Content for Our Midterm

- Lectures 1 through 14 (this Monday)
- Overall, midterm will be similar in style to the practice midterms
  - But specific questions may be of a different style
- Expect questions on linux commands, shell scripts, utilities, regular expressions, and C

# Societal Implications of Computing

- Why are we studying this?
- Educated computer scientists must think about broader implications of what they do
  - Because it affects other people's lives
  - Because it affects their lives

# Three High-Level Topics

- Impact of computer engineering solutions
  - Gain broad education necessary to understand the impact of computer engineering solutions in global, economic, environmental and societal contexts
- Ethics
  - Identify ethical issues
  - Discuss possible courses of action
- Knowledge of contemporary issues
  - Discuss various contemporary issues related to the societal implications of computing

# Evaluation

- We will have 4 in-class discussions
- 10% of your grade: 3-page paper
  - There will be three questions
  - One question per high-level topic
  - Please write between 0.5 and 1 page for each question (10 pt font, single-spaced, 1" margins)

# Today's Topic: RFID

## Radio Frequency Identification (RFID)

Using radio frequency (RF) signals

To identify (ID) objects

Does not require line-of-sight

(Some materials courtesy of Prof. Gaetano Borriello)

# RFID Basics

## RFID systems comprise tags and readers

- Tags are placed on objects
- Readers placed in the environment interrogate tags

## Tags can be active or passive

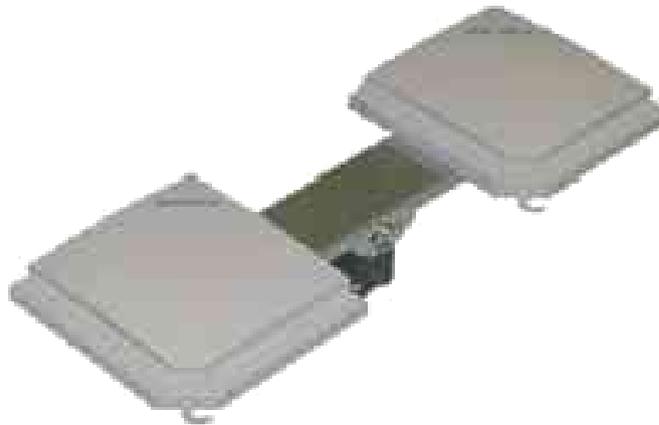
- **Active tags: longer read-range (up to 300 feet)**
  - Battery powered, expanded capability, expensive
- **Passive tags: shorter read-range (1 foot to a few meters)**
  - Receive power from RF field, limited capability, cheap
- Each tag has a unique ID (typically 64 to 128 bits)
- Tags can include other information besides ID (< 2KB)

# RFID Components

RFID Reader



RFID Antennas



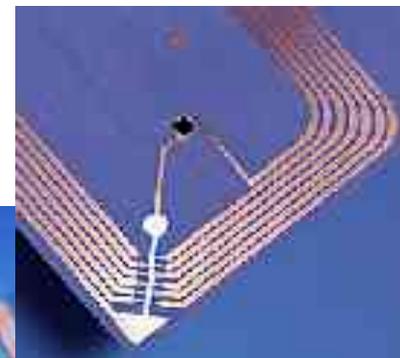
Active Tag



Passive Tag



# A Wide Variety of Tags



# Communication Between Reader and Tag

## HIGH-FREQUENCY SYSTEM

**1** An integrated circuit sends a digital signal to a transceiver, which generates a radio-frequency signal that is transmitted by a dipole antenna.

### READER

Integrated circuit

Tag identifier code  
02201901201

Digital signal

Transceiver

Dipole antenna

Power

Data

Reflected signal

**6** The reader's transceiver detects the reflected signals and converts them to a digital signal that is relayed to the integrated circuit, where the tag's unique identifier is determined.

**5** The variations in the amplitude of the reflected signal, in what is called backscatter modulation, correspond to the pattern of the transistor turning on and off.

**4** The transistor gets turned on or off by the highs and lows of the digital signal, alternately causing the antenna to reflect back or absorb some of the incident radio-frequency energy from the reader.

**2** The electric field of the propagating signal gives rise to a potential difference across the tag's dipole antenna, which causes current to flow into the capacitor, the resulting charge is trapped there by the diode.

**3** The voltage across the capacitor turns on the tag's integrated circuit, which sends out its unique identifier code as a series of digital high- and low-voltage levels, corresponding to ones and zeros. The signal moves to the transistor.

Current

Diode

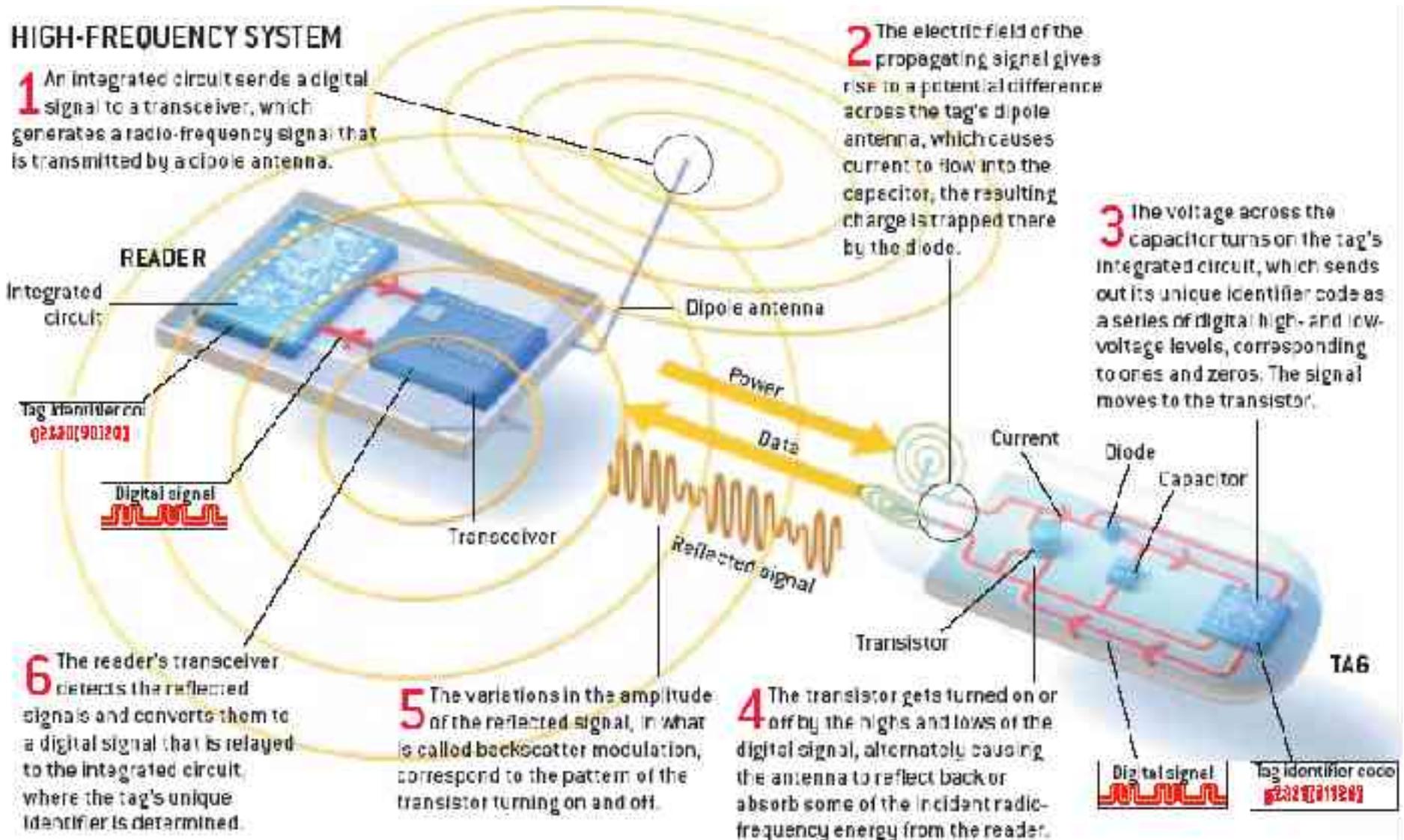
Capacitor

Transistor

TAG

Digital signal

Tag identifier code  
02201901201

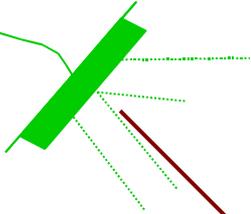


# Example of RFID Deployment

RFID Reader



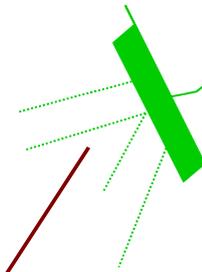
RFID Antenna



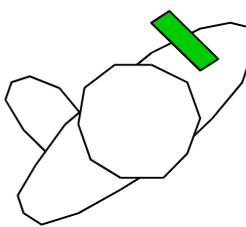
RFID Reader



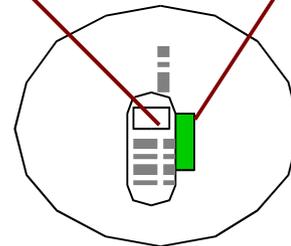
RFID Antenna



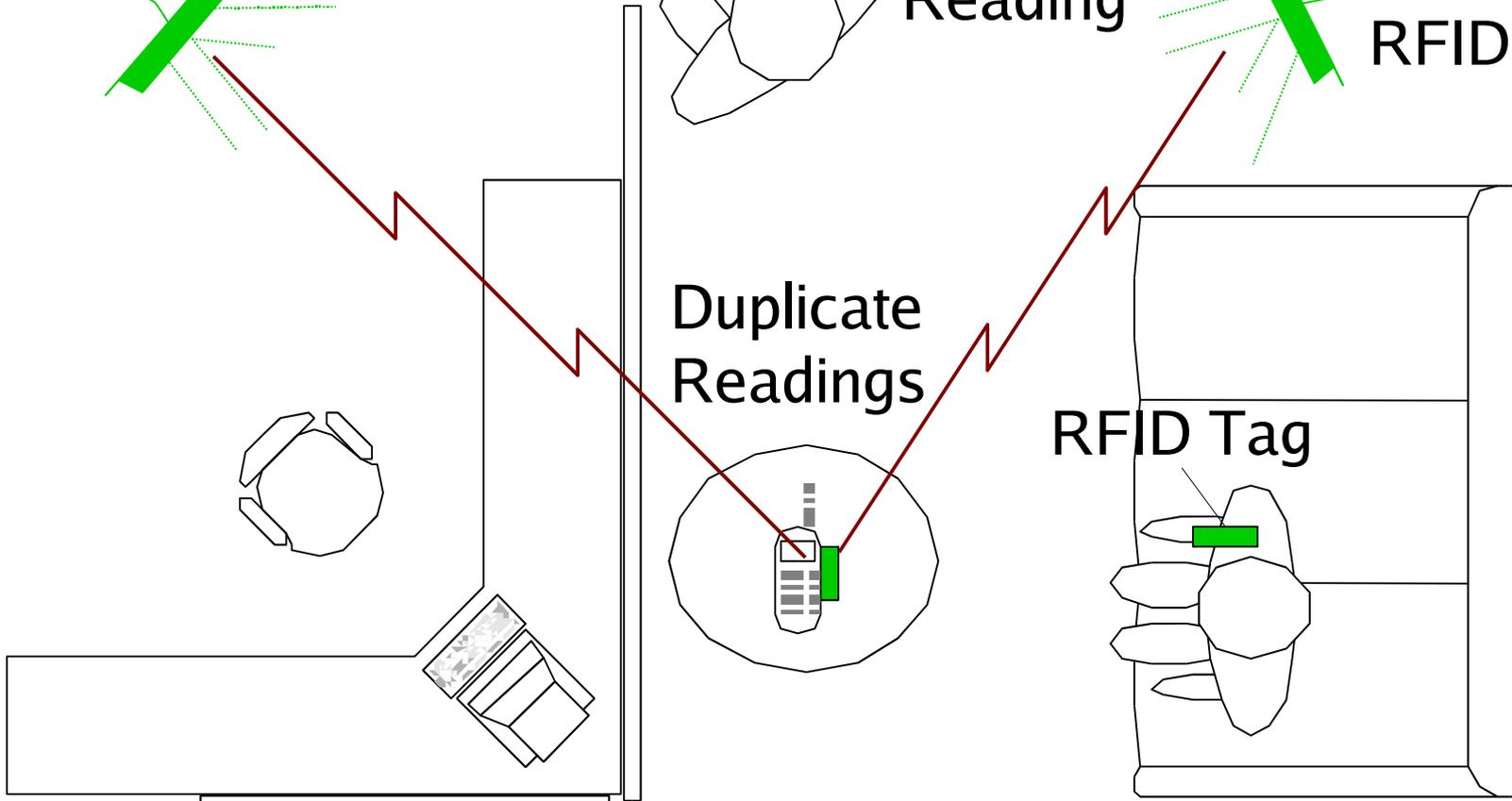
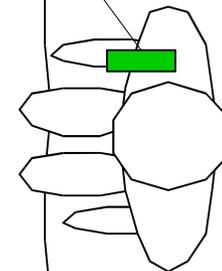
Missed Reading



Duplicate Readings



RFID Tag



# Elements of an RFID System

- **Tags:** carry unique identifiers
- **Readers:** detect tags in their vicinity
- **Networking infrastructure**
  - Reader is connected to a network and communicates tag IDs to interested parties
- **Databases**
  - Collect the “read events” and log them with time/place
- **Applications and their user interfaces**
  - Use the data in various ways

# Existing RFID Applications

- Supply-chain management
- Package tracking
- Airline tickets, luggage
- Pharmaceuticals
- Medical: patient id
- Asset tagging, archiving
- Identifying pets
- Tracking library books
- Anti-counterfeiting
- RFID tags inside passports
- Toll collection (highways)



# Market-Driven Technology



- 6 of top 7 retailers worldwide support RFID
  - > \$1 trillion revenue
- 100s of manufacturers and retailers

# Other Useful Applications?

- Elder care (UW & Intel Seattle)
  - What objects people use is a good indicator of what they are doing
- Study human social dynamics (UW & Intel Seattle)
  - How social groups form and evolve with time
- Woodland Park Zoo: track visitors
- Speed pass at gas stations (Exxon Mobile)
- Help people monitor their outdoor workout
  - iPod with reader
  - Nike shoes with active RFID tags

# Implications of RFID

- As previous examples show, RFID enables many apps that can make our lives better
- But, there are serious security problems
  - Possible to intercept communication between reader and tag (need cryptography)
- There are very serious privacy problems
  - Opportunities for mining and surveillance
  - Example: Nike+iPod story
- There are also great reliability problems
  - What are the implications of wrong information?

# Many Privacy Challenges



# Other Implications of RFID

- **Health considerations**
  - Must stay at least 9" away from an RFID antenna
- What are the implications
  - For technology, business and society
  - Of **having a “number on everything”**?
- RFID Enables
  - Merging physical and virtual worlds
  - Every object is an index into a world-wide database
  - Every object has its own history
  - Tracking objects over their entire lifetime
  - Analyzing trends in user habits

# Extra Information

- Google for: RFID
- RFID Ecosystem project: <http://rfid.cs.washington.edu/>
- **Security Analysis of a Cryptographically-Enabled RFID Device.** S. Bono, M. Green, A. Stubblefield, A. Juels, A. Rubin, and M. Szydlo. Usenix Security. 2005
- iPod + Nike security analysis project  
<http://www.cs.washington.edu/homes/yoshi/papers/>
- EPCGlobal <http://www.epcglobalinc.org/home>
- RFID ConsortiUm for Security and Privacy  
<http://www.rfid-cusp.org/>