RFID and NFC
Radio-frequency identification (RFID)
- Wireless and non-contact use of radio-frequency electromagnetic fields to transfer data
  - Between a reader and a tag

- Purpose
  - Automatically identifying and tracking tags attached to objects
RFID tag basics

- RFID tags are composed of two parts:
  1. Integrated circuit chip
  2. Antenna
- Contain electronically stored information which may be read from up to several meters away
- Each tag has a unique number
- There are three common types of RFID tags
  - Active RFID tags (*Built in battery*)
  - Passive RFID tags (No power source req.)
  - Battery assisted RFID tags (Power to start)
RFID tag classification

<table>
<thead>
<tr>
<th></th>
<th>LF</th>
<th>HF</th>
<th>UHF</th>
<th>Microwave</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freq. Range</strong></td>
<td>125 - 134KHz</td>
<td>13.56 MHz</td>
<td>866 - 915MHz</td>
<td>2.45 - 5.8 GHz</td>
</tr>
<tr>
<td><strong>Read Range</strong></td>
<td>10 cm</td>
<td>1M</td>
<td>2-7 M</td>
<td>1M</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Smart Card, Ticketing, animal tagging, Access, Laundry</td>
<td>Small item management, supply chain, Anti-theft, library, transportation</td>
<td>Transportation vehicle ID, Access/Security, large item management, supply chain</td>
<td>Transportation vehicle ID (road toll), Access/Security, large item management, supply chain</td>
</tr>
</tbody>
</table>

Most popular are LF and HF
RFID tag readers

- Reader functions:
  - Remotely power tags
  - Establish a bidirectional data link
  - Inventory tags, filter results
  - Communicate with networked server(s)
  - Can read 100-300 tags per second

- Readers deployment options:
  - Entrance/exit
  - Point of sale
  - Can also be mobile/handheld
RFID tag readers

- Reader functions:
  - Remotely power tags
  - Establish a bidirectional data link
  - Inventory tags, filter results
  - Communicate with networked server(s)
  - Can read 100-300 tags per second

- Readers deployment options:
  - Entrance/exit
  - Point of sale
  - Can also be mobile/handheld
Examples of RFID applications

Dock Door  Conveyor Belt  Forklift

Handheld  Smart Shelves  Point of Sale  Printers

Container, Pallet, Munitions
What is NFC?

- NFC is short-range wireless connectivity technology
- Enables simple and safe two-way interaction of electronic devices
- Based on High Frequency (HF), 13.56MHz, RFID technology

- Operating distance: <10cm
- Data exchange rates: 106, 212 or 424Kbps
- Promoted by the NFC-Forum

http://www.nfc-forum.org/
Near Field Communication Positioning

- Short-range and low-rate technology
NFC Network Topology

- Two communication terminals:
  - Initiator and Target

- The initiator is the one who wishes to communicate and starts the communication
  - The target receives the initiator’s communication request and sends back a reply
  - Prevents the target from sending any data without first receiving a message
NFC Modes

- NFC can operate in the following modes:
  1. Reader/Writer Mode (mandatory)
  2. Card Emulation Mode (optional)
  3. Peer-to-Peer Mode (mandatory)
1. NFC Reader / Writer Mode (Mandatory)

- Reading and Writing NFC tags
  - Called PCD (Proximity Coupling Device)
  - Data format called NDEF (NFC Data Exchange Format)
  - Multiple records can exist on a single tag

- Applications:
  - Read posters
  - Interactive advertising
  - Launch mobile internet, SMS or make a call
2. NFC Card Emulation Mode (Optional)

- Card Emulation Mode
  - Emulates an ISO 14443-4 smart card (proximity cards used for identification)
  - Can store multiple types of cards

- Applications:
  - Contactless Payment – Ticketing
  - Access Control
  - Virtual Key
3. NFC Peer-to-Peer Mode (Mandatory)

- Enables two NFC devices to exchange data:
  - Based on ISO 18092 (NFC Communication modes)
  - Interface and Protocol (NFCIP-1) for interconnection of computer peripherals

- Applications:
  - Setup (secure) Bluetooth / Wi-Fi / etc.
  - long-range connection
  - Data / money transfers
Long-range and high-rate connection establishment via NFC

- Easy-to-use (just put one device close to each other and press the button)
- **Algorithm:**
  1. Touch one device with another
  2. Exchanging information regarding chosen channel, data rate, and security credentials over NFC
  3. Secure BT/Wi-Fi connection is established
- Implemented in Out Of Band (OOB) Secure Simple Pairing (SSP) of Bluetooth v2.1 (2007)
- Implemented in Wi-Fi Protected Setup (WPS) as optional for Wi-Fi and Wi-Fi direct (2006)