

Mobile Computing and the IoT

Wireless and Mobile Computing

RFID Applications

Identification Friend or Foe



- Introduced during WWII to distinguish between own and enemy aircraft
- Uses the Radar system
- In common use today for air traffic management
- Employs the secondary surveillance radar
- Air traffic management uses Mode 3/A or S
- Uses a lot of power

Classic applications

- Access control
- Animal tagging
- Toll collection

Access control

- Authentication and access control
- Reader operates door locks or entry portals
- Same principles as ticketing



Car immobilizers

- Battery operated
- Usually integrated into key fob
- Controls access to the vehicle
- Variations of this used for fuel payment e.g. Mobil Speedpass
- Has been cracked (description at <http://rfidanalysis.org/>)



Livestock tagging



- External tag (ear, legs)
- Passive tags require no battery
- Used to track animals
- In some cases additional sensors can be used
 - temperature sensor for birth prediction

Asset Tracking



- Tag and trace assets of different types
 - documents (close proximity e.g. Hitachi mu-chip)
 - clothing garments in transit (DHL warehouse robot)
 - food (kaiten sushi bars)
- Pretty much anything big enough and valuable enough

Libraries

- Tag books for managing loans
 - Self checkout
- Stock taking
- Misplaced items
- Standardization by ISO
- Facilitates inter-library loans



Payment

- Toll collection
- Contactless smart cards
- Ticketing
- Cash/Credit transactions

Automated Toll Collection



- Automated collection of motorway toll fees
- Battery powered device on the vehicle
- Interrogator installed at the toll portal
- Credit stored in the tag and fees deducted at every passage



Contactless Smart Cards



- ISO/IEC 14443 specification
- Passive tags, do not require battery
- Very popular for ticketing across the world
- May store credit
- Alternative to contact smart cards

Ticketing



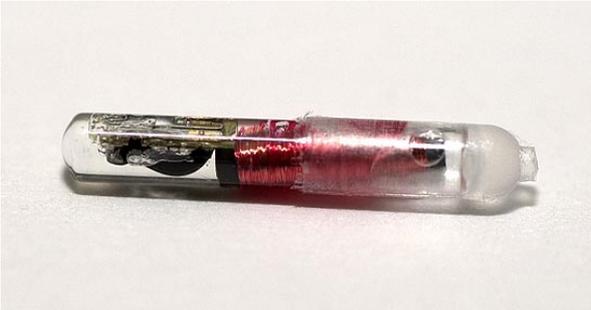
- Mostly ISO-based
- Requires token and extensive reader infrastructure
- No battery
- Read-write applications
- Many form factors for readers
- Oyster card system in London: 14M users, 16k Readers

Payment



- Sony FeLiCa chip used NTT DoCoMo in their FOMA platform for point of sale payment
 - Near Field Communication (NFC) technology standardised
- European Central Bank explores its use in euro notes
- Injectable RFID tag used for payment in Baja Beach Club (Barcelona, Spain, and Amsterdam, The Netherlands)
 - Provides access to VIP room

Tag people



- Verichip RFID tag FDA approved for use with humans
- Many applications claimed:
 - Medical, medication, surgery
 - Kidnap victims
 - Nightlife
 - Track offenders (150k people currently tagged in the UK)
 - Identification
- Highly hackable (more on this at the end)

E-Passport



- ICAO specification
- US mandate
- Many countries currently implementing (US first issue 14 Aug 2006)
- Based on the ISO 14443B spec
- Heavily revised security measures
- Relies on global PKI infrastructure



Recent applications

- Anti-counterfeiting
- Museums/art/learning
- Consumer retail
- Supply chains

Pharmaceuticals



- Anti-counterfeiting a priority
- Additional applications
 - correct medication
 - inventory management
 - recall
- Issues related to effects of radiation on drugs



Museum exhibits



- Tags in the floor read by displays on wheels at the Okayama City Digital Museum
- PDA recognizes specific exhibits at Granite State MetalWorks
- San Francisco MOMA installation that displays live social networking information

Location tags



- Affix tags at locations
- Tags transmit location identifiers thus allowing locations sensing
- Extensive installation at Shinjuku in Tokyo
- Same idea used indoors at the Exploratorium to create an interactive museum guide

Art



- Bruce Sterling's Spime: objects with dual physical and digital identities
- Meghan Trainor RFID sculpture series With Hidden Numbers
 - Objects in the work contain RFID tags that trigger audio streams
- Mediamatic
 - iTea
 - Drop your conference badge in the tea cup
 - The system retrieves your name and searches the web for info about you which is displayed



Toys and storytelling



- Kingdom of the Knights
- Playmobil castle with locations and characters tagged
- Placing character at location triggers action
- Music, speech, magic effects
- Found to augment the experience

Retail



- Consumer applications: smart self, smart shopping cart, inventory tracking
- Large scale trials (Metro Supermarket, Germany)
- Actual implementations (Mitsukoshi Department Stores in Japan)
- Makes sense for high-value items only
- Passive (no battery) tags should cost less than 5 cents



Supply-chain applications



- Drivers:
 - Reduce shrinkage
 - Monitor inventory
 - Efficient replenishment (Just In Time processes)
 - Storeroom and store-front
 - Vendor-managed inventory
- Current stock error 8-12%
 - Replace POS estimates

More about supply-chains



- Introduced by US Army after first Gulf War
- Wall-Mart has set deadline in 2005 for top 100 suppliers
- IBM, SAP, Sun, Microsoft, BT all offer solutions
- M&S is running now item-level trials to validate business case