RFID Transportation Applications in Operations, Safety, and Security

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Introduction

- Applications in Transportation Operations
  - Operations information courtesy of Jonathan Gifford and Cristina Checherita at George Mason University
  - Full version on TRB website-

- Applications in Transportation Security
- Applications in Transportation Safety
- Information Security for RFID
- Overview of the breakout session
Types of RFID Applications in Transportation Operations

● Payment:
  – Toll payment (E-ZPass and FasTrak);
  – Transit fare and parking fee (SmartTrip card);
  – Electronic payment (Exxon/Mobile SpeedPass for gasoline purchase).

● Access control:
  – Automated parking management system (IRIS in London);
  – Automated baggage handling systems (Las Vegas Airport);

● Some potential applications
  – Airport employee location, tracking and access restriction;
  – RFID-enabled electronic tickets.
    • Contain flight information, passenger ID
    • Confirm passengers in authorized areas, allow walk-on boarding
Types of RFID Applications in Transportation Operations cont’d

- **Commercial Vehicle Fleet Management**
  - Commercial Drivers License (CDL) used in combination with RFID
  - Electronic pre-clearance of trucks (PierPass at ports of Los Angeles and Long Beach) verifying identity of driver, truck, and trucking company before allowing entry

- **Transit Fleet Management**
  - AVL (also used in rail)
  - Stop annunciation
  - Signal priority/schedule adherence
Technological and Cost Challenges

- **Technological challenges:**
  - Read rates are still slow;
  - Reliability may be low except for slow moving objects in ideal environments;
  - Interference from other devices, especially given the proliferation of wireless technology.

- **Cost of implementation:**
  - Still prohibitively expensive for all but high-value products (e.g. Delta Airlines, the first US carrier to test RFID baggage handling has “indefinitely deferred” testing);
  - The major cost factor of RFID tag implementation projects may be in their integration within existing processes, or incurred in process reengineering, rather than in specific hardware or additional network and computing equipment;
  - Inclusion of cryptographic features to increase security also increases costs.
Sample RFID-Based Security Applications

- Tracking, monitoring and reporting systems for HAZMAT, high risk items
  - Locate items
  - Tamper detection and reporting
  - Unauthorized movement
  - Inventory control
- Customs and border crossing for individuals
  - Secure Electronic Network for Travelers Rapid Inspection (SENTRI)
    - Pre-screened travelers cross Mexican border in dedicated lanes using RFID tag-enabled ID card; RFID transponder on vehicle
  - NEXUS program
    - Pre-screened travelers cross Canadian border; NEXUS ID card has embedded RFID chip; dedicated lanes, marine program for boaters in development
- Customs and border crossing inspections and procedures for shipping/freight
US Government Encouraging RFID-Based Security Applications

- Customs-Trade Partnership Against Terrorism (C-TPAT)
  - DHS program, voluntary (for now…)
  - Addresses supply chain and cargo security; customs and border crossings for cargo
  - Participating companies receive reduced inspections and expedited border crossings

- DHS Supply Chain Security Best Practices Catalog addresses RFID as acceptable solution to comply with C-TPAT requirements
  - RFID and electronic seals can be used to manage inventory discrepancies, manifest and invoice information at distribution center
  - RFID-based electronic tracking can be used for compliance
RFID Security Applications Issues

- RFID technology needs to be compatible among carriers, trading partners involved in shipping and transport
  - Need for standards and interoperability
  - Standards are developed for different features of RFID including air interfaces, transmission protocols, data syntax, structure, and encoding, test methods
  - Standards may be optimal for certain applications and multiple standards may be necessary

- International harmonization of both standards and frequency allocations/regulations are needed for tagged assets that cross international borders
  - Includes pallets, containers, chassis, trailers, railroad cars etc.
  - Different Countries allocate different frequency bands and different regulations for RFID use
    - Affects range
    - Affects tag readability
    - Determines whether device can be used at all (tag can be in an unauthorized frequency band, power level, modulation)
Examples of Safety Applications

- Automotive anti-theft devices
- Tread Act for tires (Transportation, Recall, Enhancement, Accountability and Documentation) – mandates auto mfg. track tires in case of safety recall
  - Michelin using RFID to comply, also coupling with sensors to alert driver of unsafe tire condition
- Commercial vehicle mainline automated clearance
  - Transponder read at weigh station, automated check of size, weight, registration, safety records etc.
  - Sensors monitoring tire and brake condition, load shifting, etc. send information via RFID at weight/inspection station possible
- Traffic signal priority for emergency responders
  - Also used by public transit for schedule adherence
Risks in Using RFID for Applications—The Need for Information Security

- Safety and security are a “two edged sword” in RFID
- RFID can be used to implement safety and security applications for transportation
  - HAZMAT tracking, shipping container tamper detection
- RFID can also create a safety or security risk
  - Unauthorized party can read a tag: identify item worth stealing
  - RFID tag can be used for unauthorized tracking
- RFID systems for security and safety applications need information security
  - Tags can be cloned, counterfeited
  - Accountability and tracking can be spoofed
  - Attacks on safety systems (man-in-middle, denial of service) can make safety applications very dangerous!
Information Security Applications

- **Blocker tag**
  - Device developed by RSA Security Inc. for privacy
  - Passive device that simulates multiple Electronic Product Code (EPC) tags that effectively block reader from obtaining data
- **Kill command**
  - EPC tag can be “killed” (no longer responds to reader) when a kill command/PIN number are applied by reader
  - Only required feature on EPC tags, additional security is optional
- **Challenge-Response authentication**
  - Used in devices like toll tags, SpeedPass, electronic payments
- **ACCESS command** (optional in EPC standard)
  - ACCESS command +PIN = secure state
  - Only certain commands will function when in secure state
- **Password protection for tag read**
- **FIPS Level 3 compliant tags**
  - Tamper detection and data destruction
Information Security Issues for RFID

- Most security requires cryptographic functions
  - Computational power of tags is extremely limited
  - Available power for tag is limited
- Information security features raise cost
  - RFID tags for some apps are useful if inexpensive and/or disposable
- Security can limit usefulness of tags
  - Cryptographic processing takes time, increases volume of data and reduces read rate
- Encryption can provide authentication, data protection, but key management can be difficult
  - Public key (asymmetric key) cryptography requires too much power, computation
  - Secret key management (symmetric) requires distribution, storage etc.
- Encryption not a cure-all
  - Unauthorized party may not be able to decrypt specific information, but can use signature to track items, obtain inventory count (consider shipments of military ordinance or HAZMAT)
- RFID is only one component of system that needs securing
Recent Activity in RFID Security

- 1.1 M grant from NSF for research to prevent cyber-thieves from cracking security and stealing data from RFID devices
  - Grant awarded to UMass (Amherst), JHU, RSA Security
  - 4 year project
- NIST released “Guidance for Securing RFID Systems”
  - Special publication 800-98
  - Draft document out for comment until Oct 27
Operations, Safety, and Security Breakout Session Overview

- 4 presentations
  - *Potential Application of RFID in Road Asset Management*, Dr. Kelvin Wang, University of Arkansas
  - *RFID at the Southern Border: Operations, Safety and Security*, Robert Harrison, University of Texas (Austin)/RFID Initiatives at DHS, Dr. Gary Becker, DHS
  - *Exploring RFID Applications for Commercial Vehicles’ Remotely Operated Compliance Stations*, Dr. Amr Oloufa, University of Central Florida

- Research opportunities for operations, safety, and security applications
  - State of the practice for RFID in transportation, technical challenges
  - Information security needs
  - Standards development needs
  - Strategies for incorporating RFID in transportation applications

- Future of RFID in transportation operations, security, and safety applications
  - New applications
  - Opportunities for research