# RFID Applications in Transportation Operations

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# 1. Types of RFID Applications in Transportation

- **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);
  - Airport employee location, tracking and access restriction;
  - Airport access by shuttle-bus/taxi;
  - RFID-enabled electronic tickets.
- **Fleet management:**
  - Commercial driver's license (CDL);
  - Electronic pre-clearance of trucks

# 2. Electronic Payment Systems

- **Toll payment:**
  - Methods of Payment: (i) cards for simple pre-paid access to an area, or (ii) a freeway “toll tag” used as to debit an account;
  - E-ZPass and FasTrak systems - used in some regions of the United States to collect highway and bridge tolls;
  - Increase the range and speed of reading so that drivers do not have to slow down as much.

# Electronic Payment Systems- cont.


- **Transit Fare:**
  - SmarTrip is a contactless smart card, used as a rechargeable farecard for metro, bus and parking access in Washington DC metropolitan area. Its embedded chip keeps track of the value of the card; it is easy and fast (works with a touch even through a wallet to the circular target panels on top of faregates); if it is lost, the owner does not lose the value; can be used as a single fare pass for metro, bus and parking.
- **Electronic payment:**
  - Exxon/Mobil first introduced the Speedpass transponder device in 1997 to allow drivers to make credit gasoline purchases by waving a key fob in front of the gas pump; The program has gown to an estimated 6 million drivers today.

# 3. Access control

- **Automated parking management system:**
  - The Integrated Recognition and Identification System (IRIS) combines automatic number plate recognition (ANPR) technology with RFID;
  - The ANPR installation automatically captures and stores the number plate of a registered vehicle and cross checks it with the database of registered vehicles. If the two match, the parking barrier opens automatically;
  - Part of an effort to reduce vehicle crime in the UK, 22 percent of which occurs in car parks.

# Access control – cont.

- **Automated baggage handling systems (Las Vegas Airport)**
  - Las Vegas' McCarran International is phasing in a baggage screening and tracking system using RFID;
  - The RFID system includes scanning arrays on baggage sorting conveyors, sort allocation computers, and software controls. It will also provide select ID for baggage that sets off an alert going through the explosives detection system;
  - The RFID tag is embedded in the paper tag that is attached at curbside or at the check-in counter. It uses ultra-high frequency radio waves, which provide a higher level of certainty than conventional RFID tags;
  - The project also includes the upgrade of an existing facility to create a receiving area for baggage from select local hotels, enabling hotel guests to check their bags at their hotel and not have to pick them up until they arrive at their destination.


# Access control – cont.

- **Airport employee location, tracking and access restriction (potential application)**
  - The RFID access control and tracking system can assure that only authorized personnel can enter restricted areas. To enable rapid response during an emergency, the system can quickly identify the location of key personnel, and continuously track employees working in critical or sensitive areas.

# Access control – cont.

- **RFID-enabled electronic tickets** (potential application)
  - Travel providers can issue electronic tickets in the form of RFID tags. These tags could be provided in form factors such as a clip-on badge, wrist band, or badge with a necklace;
  - The RFID "ticket" could be programmed with passenger identification and flight information at the ticket counter or curb-side check-in. Passengers could then be restricted to the concourses and gate areas appropriate for their departure;
  - At the gate, the RFID reader could be used in lieu of ticket collection to facilitate efficient walk-on boarding. The passenger database linked to the RFID reader could assure the correct person is allowed on-board.

# 4. Fleet Management

- **Commercial Driver's License/Truck Clearance**
  - PierPass Inc. to rollout its voluntary security program at the Ports of Los Angeles and Long Beach. The setup will use RFID tag on trucks to verify the identity of the truck, the driver and the trucking company before entry is allowed to all 12 terminals at the two facilities.
  - Similar to the FasTrak and E-ZPass systems. When a tagged truck is at the terminal point of entry, an electronic reader automatically scans the RFID tag. The truck driver simultaneously inserts his or her CDL into the reader to verify that they have authorized business at the terminal.

# Fleet Management – cont.

- **International Border and Cargo Pre-Clearance System (Washington)** – to be designed and installed by TransCore

  - Facilitate the movement of commercial vehicles traveling from Puget Sound seaports (Seattle and Tacoma) to U.S. Customs facilities at Blaine, Washington
  - Allow the U.S. Customs service to use electronic vehicle identification to preview manifest information for up to 1,000 truck-borne containers.
  - Compliant trucks will be able to bypass the weigh stations, and the State Patrol will be able to electronically review safety and driver permit information
  - Enable the State Patrol to determine the contents of containers.

# 5. Advantages of RFID use in transportation operations

- Reduce transaction costs in terms of time and cognitive effort (e.g. the case of payments):
  - no need to worry about each use/access-payment or holding sufficient cash;
  - improved travel time: the automatic toll payment saves time as there is no need to pay cash and to stop for payment;
- Reduce congestion: RFID can be utilized as real-time locators in congestion pricing systems (HOT lanes);
- Easier access: universal access to different public transportation modes and facilities (bus, metro, parking); can facilitate flight boarding.

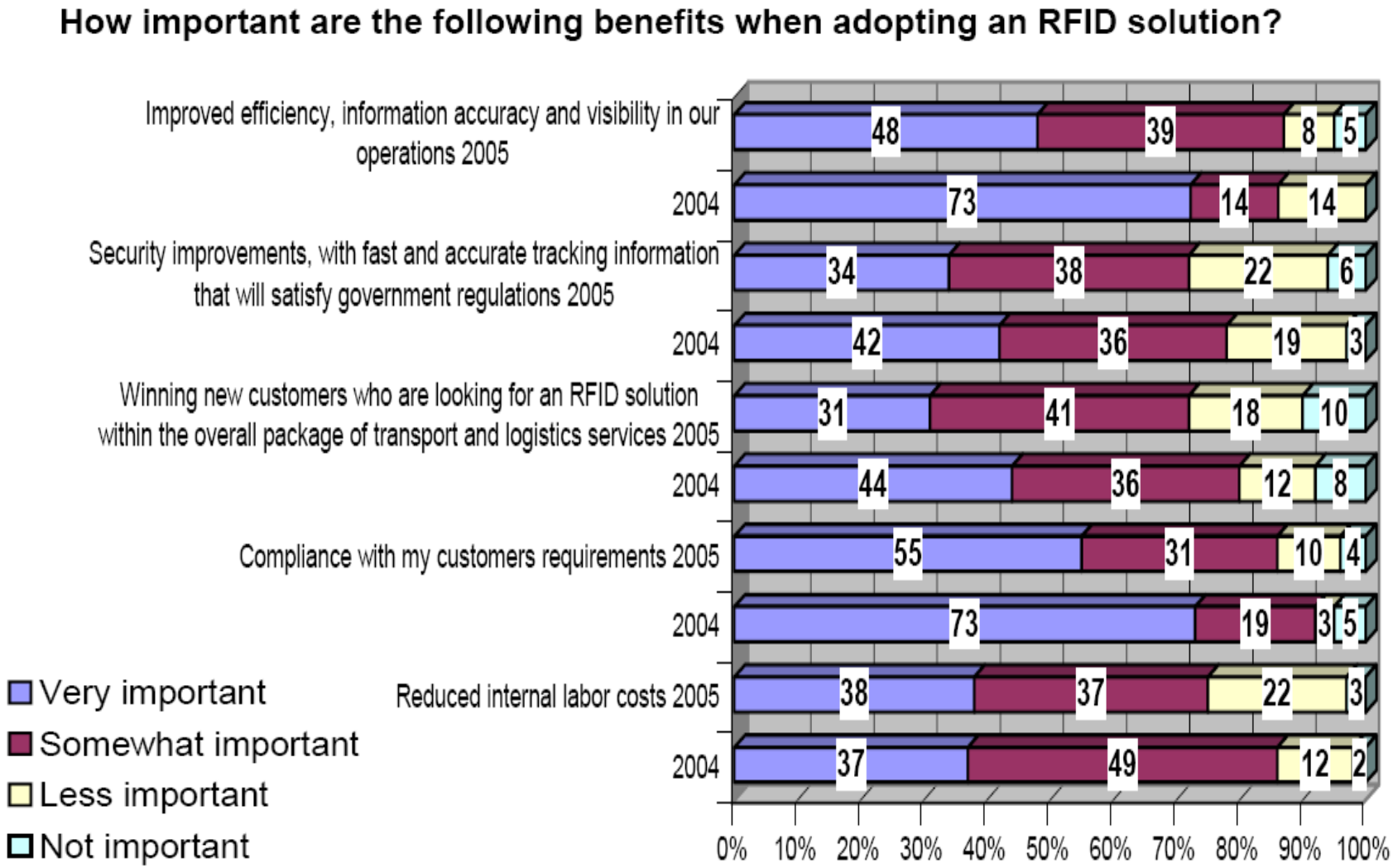
# Advantages of RFID – cont.

In baggage handling systems:

- Higher accuracy in reading tags than bar coding;
- Speed up the process: virtually instantaneous reading of multiple tags in the vicinity of the reader;
- Read/write tags**:** Store data that can be altered

  or even re-written over the original data as baggage passes along various check points (bar code - read only);
- No requirement of line-of-sight scanning or human intervention which allows automating the process.

# Advantages of RFID – cont.
# Survey of transportation and logistics industry



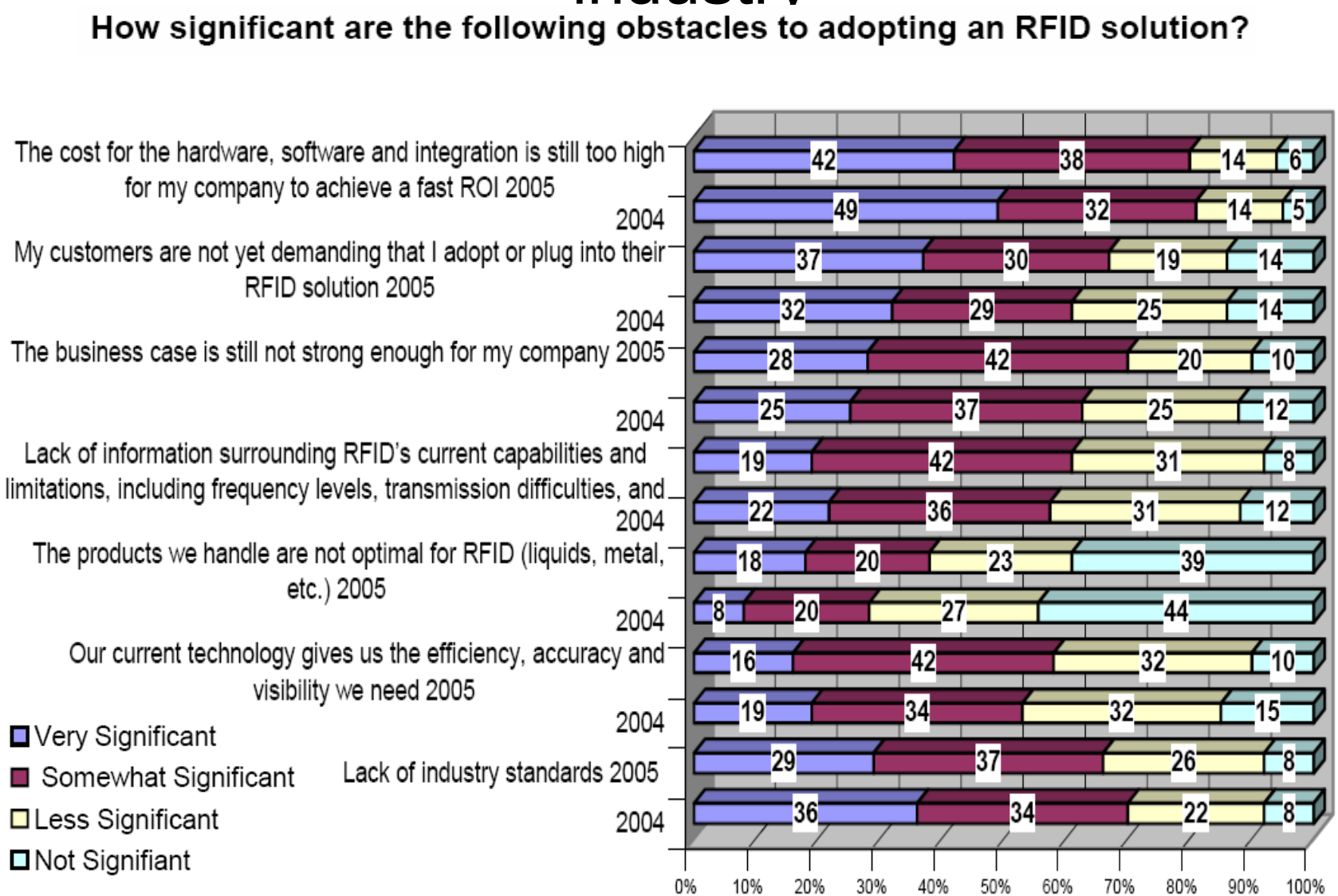
# 6. Challenges of RFID use in transportation operations:

- Technological challenges;
- Cost of implementation;
- Transaction Security;
- Privacy issues/individual rights;
- Institutional challenges/multi-application issues;
- Regulations/standards.

# Challenges – cont.

- **Technological challenges:**
  - Read rates are still slow;
  - Reliability may be low (20-30% for scanning cargo) except for slow moving objects in ideal environments;
  - Interference from other devices, especially given the proliferation of wireless technology.
  - Problems implementing large-scale projects (in 2005 United Airlines abandoned RFID baggage handling system at Denver International Airport after spending $230 million over 10 years)
- **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.

# Challenges of RFID – cont.
# Survey of transportation and logistics industry



# Challenges – cont.

- **Transaction Security**
  - The chip can be read by anyone with a radio frequency device operating at the correct frequency, unless additional security is used, e.g.
    - combine a RFID badge with some other authenticator, like a PIN number;
    - change frequently the data on the RFID tag;
    - use an encryption algorithm to transmit data between the RFID tad and the reader devise).
  - Cloning and ID theft is an issue particularly for RFID tags in building access cards or contactless payment systems;
  - The 40-bit encryption of the Texas Instruments RFID transponders used in the Exxon/Mobile SpeedPass was cracked by four students from Johns Hopkins University and two researchers from RSA Laboratories.

# Challenges – cont.

- **Privacy issues/individual rights**
  - Use of personally identifiable information, without knowledge or consent of the individual;
  - Although there is a general acceptance of RFIDs in toll collection, the immediate data management practices, as well as downstream dissemination, aggregation and additional use, are unknown;
  - RFID applications make it possible to track people through the RFID tags they carry with or on them (baggage handling in airports; E-ZPass).

# Challenges – cont.

- **Institutional challenges:**
  - Working across multiple jurisdictions: e.g. E-ZPass, FasTrak
  - Multi-application issues:
    - combining databases from applications run by different institutions/companies – data sharing and access control;
    - Conflicting procurement requirements

# Challenges – cont.

- **Regulations/standards**
  - Should the use of RFID, and generally of new technological devices, be regulated by the government, especially regarding issues regarding privacy and individual rights?
  - Which form should the regulation take?
  - Is there a need for a comprehensive public relation campaign?

# Challenges – cont.

- **Regulations/standards – cont.**
  - Some countries, including Japan, Italy, Korea, and the United States (at the individual state level) have proposed or are considering proposing specific guidelines or regulations on RFID;
  - Other countries, such as the Netherlands, have come to tentative conclusions that additional RFID specific legislation is not necessary at this stage of RFID development, as it may delay or prevent further development and application of RFID, while not necessarily contributing to better protection of privacy and individual freedom;
  - An alternative to government intervention is industry self-regulation. One example of a self-regulatory approach is the currently published (2005) EPC global guidelines.

# Sources:


- Wyld, D. C. (2005). RFID: The Rights Frequency for Government. E-Government Series. IBM Center for The Business of Government
- Strickland, L. S. and L. E. Hunt (2005). "Technology, Security and Individual Privacy: New Tools, New Treats, and New Public Perceptions." Journal of the American Society for Information Science and Technology **56**(3): 221-234
- OECD (2005) - The Radio-Frequency Identification (RFID): Drivers, Challenges and Public Policy Considerations (www.oecd.org)
- Radio Frequency Identification Technologies: A Workshop Summary (2004), Computer Science and Telecommunications Board, The National Academies Press at http://darwin.nap.edu/books/0309095433/html/15.html
- Press Releases, AIM Global (Association for Automatic identification and Mobility) at http://www.aimglobal.org/
- Dalbert, Tom (2003). IRIS City Centre Trial: Security Technology Is Finding a New Parking Application. ITS international 9(3): 50-54
- Heacock, P (2005). Improving Baggage Operations. Airports International 38(6): 26-28
- Farmer, M (2004). RFID - The Las Vegas Way. Airports International 37(4): 16-17
- Sutton, O (2005). A Tough Sell: RFID and The Airlines. Air Transport World 42(6): 46-47

# Sources – Cont.


- Hoffman, William (2005). Tagging's Bursting Bubble? Traffic World 269(32): 15-16
- ActiveWave. Applications and Solutions: Airports and High Security at http://www.activewaveinc.com/applications_airport_security.html
- Todd Weiss (2005).United Axes Troubled Baggage System at Denver Airport: The Complicated System Never Worked As Designed. Computerworld at http://www.computerworld.com/managementtopics/management/project/story/0,10801,102405,00.html
- **Terrence Nguyen (2006).** Port trucks get RFID'd. Fleet Owner 101(2)
- TransCore. Homeland Security Key Installations at http://www.transcore.com/markets/homeland_security/key_installations.htm
- Conference proceedings “2nd RFID Opportunities for Transport & Logistics Providers”, Las Vegas, October 4-5, 2005, survey at http://www.eyefortransport.com/rfid2005