Future Directions in RFID Application and Research in Transportation

Max Donath
Intelligent Transportation Systems Institute
University of Minnesota

TRB Conference on Research Opportunities in RFID Transportation Applications
National Academies Keck Center
October 17-18, 2006

Alan Estevez, Asst Deputy Under Secretary, DoD Presentation on Oct. 17, 2006

- “It’s not about RFID.
- It’s about actionable information, delivered in real time enabling capabilities that have never existed before.”

- He quoted William Gibson
  - The future is here. It just isn’t widely distributed yet.

Role of Government

- First and foremost -> Improve safety and mobility
- How?
- By wirelessly communicating RFID derived position among vehicles (V2V), and between the vehicle and infrastructure (V2I and I2V), many applications requiring LANE LEVEL position are facilitated
  - As envisioned by the Vehicle Infrastructure Integration (VII) Program of the US DOT
- Consider applications.

Potential Applications Requiring Lane-level Accuracy in Urban Locations

- Collision avoidance
- Enhancement of driver's situation awareness
- Traffic signal priority for emergency and transit vehicles
- Traffic signal violation warning
- Lane change warning
- Stop sign movement assistant – Assessing which gaps are safe for driver
- Detection of approaching vehicles
- Congestion Mitigation -> Congestion pricing (High occupancy tolling lanes - HOT and TOT lanes. Price additional lane capacity)
- Incident and work zone management: Route vehicles off road or around incident LANE BY LANE
- Load balancing across lanes
- Alternative approach to the current loop detector
- **Wireless communication to/from vehicles based on lane-level position sensing: enabler of above apps**

Problems with Existing Vehicle Positioning Systems

- IN VII Program, US DOT developing the wireless infrastructure (DSRC), but is focused on GPS
- "Conventional" vehicle positioning systems are incapable of reliably and inexpensively providing lane level positioning ("which lane") in urban environments. For example, consider:
- Lane-level GPS
  - Differential GPS and a high accuracy digital map are required
  - Availability is poor in urban areas (where signals are either unavailable – e.g. skyscraper canyons – or degraded by multipath reflections off buildings)
- RFID enables real-time sensing of lane-level vehicle position

Consider RFID based Vehicle Lane-level Positioning System Concepts

- Attach RFID reader to vehicle front bumper as part of electronic “license plate” type device
- Lateral field of view = 1 lane width
- Place passive RFID tags down center of lane

  OR

- Embed RFID tags in tape that replaces standard lane marking tape

VPS Data in Tag

- Each RFID tag stores the following information
  - Road identifier
  - Lane identifier
  - Direction of travel identifier
  - Longitudinal distance from reference
  - Other relevant data (dependent on application)

- Can add vehicle length and speed to message set
  - Can now monitor the moving foot print of all vehicles, gaps between them in own lane and adjacent lanes
  - Can eliminate blind zones around vehicles

Research Issues

- What is RFID? Need better definition
  - V2V, V2I, I2V wireless communications is not necessarily RFID
  - RFID based vehicle positioning can be combined with V2V, V2I, I2V to enable VII applications
- Need to develop a science and taxonomy of RFID systems that is public domain
- Engineering and design issues: range, power, frequencies, environmental effects, robustness of tag and reader, noise immunity
- Applications have been dominated by supply chain logistics and asset/inventory management…. Focused on improved efficiency
- Need more focus by US DOT on transportation safety and congestion mitigation applications.
- Need to be careful about interoperability, … applications vary
- Consider another app - Tthe smart card CDL, TWIC.
  - Now add a RFID Plus biometric ID capability

Applications of RFID based Smart Card Driver Licenses

- Can transmit “age” range to Vehicle
  - Vehicle adapts to driver
- Can transmit age range to Traffic Control Device which adjusts “safe gap” to driver (CICAS – SSA)
- Can capture individual driver behavior characteristics/patterns and use to monitor driving under the influence, fatigue, driver vigilance

Standards

- Depends on application
- Need performance and functional standards
- Need Quality of Service (QoS) standard

Security and Privacy

- Security and integrity concerns
  - Many approaches, for example…
  - Check RFID “ID” against independent data base
- Privacy Concerns
  - Guidelines should be similar to other applications and depend on the application
  - For more, see “Limits of Privacy” by Amitai Etzioni
  - Must tackle issues early on
  - Must clearly prevent inadvertent “reads” by the wrong party, by the wrong device
  - However, there are other issues…

Privacy Considerations: Guidelines Should be Similar to other Apps

- Accountability
- Purpose identified at time of collection
- Informed consent for collection
- Limited use and disclosure
- Retention of data is limited
- Quality of data (accuracy, completeness, etc.)
- Security of data
- Openness about policies and practices
- Individual access to data and correction

Adapted from Collin Bennett and Charles Raab,
'The Governance of Privacy: Policy Instruments in Global Perspective', MIT Press, 2006

Questions re Privacy

- Admissibility as evidence in court?
- Release in “anonymized” form?
- Accessible to insurance companies?
- Transparency of process?
- Who owns the data?
- Can we trust the government?

Adapted from Collin Bennett and Charles Raab,

‘The Governance of Privacy: Policy Instruments in Global Perspective', MIT Press, 2006

Consider privacy and other technologies

- GPS
- Black boxes on vehicles
- Cell phones with locating capabilities (location based services)