Future Directions in RFID Application and Research in Transportation

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“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
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 footprint 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 - The 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

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?

Consider privacy and other technologies

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