Connected Vehicles & V2I
The Role of Infrastructure in Connected Vehicle Deployment

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Connected Vehicles
Vision of Connected Vehicles
What’s all the hype?

Buckle up: The connected-car revolution is almost here

- Tremendous Market Potential
  - Industry forecasts show 700M Connected Cars and 1.1B aftermarket devices by 2022
  - Machina Research predicts that 90% of all cars will be connected by 2020
  - Revenues will explode to $422B in 2022 from just $12B in 2012

MIT Technology Review
Top 10 Breakthrough Technology

Innovation for better mobility
What is Connected Vehicle?

- The use of wireless communications to share basic information about:
  - Vehicles
    - Position
    - Speed
    - Heading
  - Infrastructure
    - Signal phase
    - Roadway surface conditions
  - Vulnerable Road Users
    - Pedestrians
    - Bicyclists
CV Encompasses Many Elements

V2V - Vehicle to Vehicle
V2I - Vehicle to Infrastructure
V2P - Vehicle to Pedestrian
V2X - Vehicle to Anything
  – Bikes, Trains, TOC,

As a transportation professional:
  How do I make sure that the infrastructure is CV-ready?
  How do I take advantage of these existing systems?
Why should we be interested?

The annual societal cost of traffic crashes is $299.5 billion, more than three times the $97.7 billion cost of congestion.

NHTSA: connected vehicle technology could potentially address 80% of all unimpaired crash scenarios

Source: AAA’s “Crashes vs. Congestion – What’s the Cost to Society?”
Why Connected Vehicles?

According to a U.S. Department of Transportation (DOT) report, combined V2V and V2I systems potentially address:

- 81 percent of all-vehicle target crashes;
- 83 percent of all light-vehicle target crashes;
- 72 percent of all heavy-truck target crashes annually.

In the past, the U.S. DOT has focused on helping people *survive* crashes. Connected vehicle technology will change the paradigm by helping people *avoid* crashes.

http://www.its.dot.gov/connected_vehicle/connected_vehicle_research.htm
Benefits of Connected Vehicles

- The overall purpose of connected vehicle – **SAVE LIVES**
  - Reduce number of crashes and severity using vehicle to vehicle communications

- Onboard systems provide greater situational awareness:
  - Your vehicle can “see” nearby vehicles and knows roadway conditions you cannot see

- Reduce or even eliminate crashes through:
  - Driver advisories
  - Driver warnings
  - Vehicle control
Connected vs Autonomous Vehicles

- **Connected**
  - Wireless Communication
  - Driver

- **Autonomous**
  - Self-driving
  - Driverless

Innovation for better mobility
CV – It’s Not All About Cars

• In the Vehicle to Infrastructure world (V2I):
  – Sensors will continue to play a big role
  – Sensors may be in use more due to the need for data
  – Signal infrastructure cannot be discontinued until high penetration of connected vehicles
  – Infrastructure will be required to support bikes and pedestrians
Applications

Improve Transit Reliability
- Connection Protection
- Transit Signal Priority

Improve Pedestrian Safety
- Mobile Accessible Pedestrian Signal System
- Pedestrian in Signalized Crosswalk Warning
- Intersection Movement Movement Assist

Improve Air Quality
- Eco-Approach and Departure at Signalized Intersections
- Eco-Traffic Signal Timing

Innovation for better mobility
The Technology for Safety Applications

- Federal government has carved out a portion of the 5.9GHz wireless spectrum for Connected Vehicles
- The wireless protocol used to transfer the information is known as DSRC
  - Dedicated Short-Range Communication
- It’s unique quality is that it is written for low latency, to optimize speed of communication using many small messages
What Data Rides on the DSRC Signal?

- The “BSM”
  - Basic Safety Message
- Basic elements are in BSM part 1
- Says “Here I Am”

- Part 2 allows custom elements

BSM Part 1

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>Position</td>
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<tr>
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<tr>
<td>Steering angle</td>
</tr>
<tr>
<td>Acceleration</td>
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<td>Vehicle size</td>
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<td>Brake status</td>
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Broadcast 10x per second
The CV World Exists Today

- Current V2I Systems
  - GM OnStar
  - On board Wi-Fi systems
  - Bluetooth/Wi-Fi Travel Time Systems
  - EnLighten

*The Key is ALL depend on Communication with the infrastructure; the Intersection*
Around the Corner

- GM, Honda, Toyota, Ford, Mercedes, Audi
- AV Features – Super Cruise, Autopilot
- V2V and V2I communication
  - Ford Sync, Mercedes Mbrace, Audi signal recognition, etc.
New Challenges
Challenges in Developing the Technology

- Security
- Data ownership
- Liability
- Privacy
CV/AV Test Facilities Expanding

- **University of Michigan**, Mobility Transformation Center
- **GoMentum**, Contra Costa CA
- **Milford Proving Grounds** GM Facility Michigan
- **CTL** Centre for Transport and Logistics, University of Rome "La Sapienza"
- **AD:AM** Autonomous Drive: Advanced Mobility, Stuttgart Germany
CV/AV Test Scenarios

- Public road testing
- Virtual testing
- Simulation
- Traffic scenario testing
- Embedded software testing
- Reliability testing
- Safety and crash testing
- Fail-safe testing
- Cyber threat testing
- V2V and V2X testing
- Robotics
- Testing legislation
resources for more information

- FHWA
- RITA
- NHTSA
- UMTRI
- TTI
- VDOT
- CVTA
- U of M MTC
- CVRIA
Iteris Can Help

Check out the CVRIA: Connected Vehicle Reference Implementation Architecture

http://www.iteris.com/cvria/

Defines over 90 applications using CV technologies
Summary

- Before the world will see all Autonomous Vehicles, we will go through a period of Connected Technology
- Operating agencies will benefit from CV deployment – but they need to be selective
- Early deployments must show tangible benefits
  - Proven benefit to the community
- Applications taking advantage of mobile device to vehicle interaction will be in demand
- ITE is well positioned to drive this technology adoption
Thank You!

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