ITS and Connectivity: A New Paradigm

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A Changing Paradigm for ITS

ITS is, once again, enabling a paradigm shift, driven by:
• Complexity of problems
• Innovative wireless technologies

Our challenge
• Embrace new approaches
• Leverage innovation and the market

Without
• Stopping progress, as we prepare for
• Emerging opportunities
ITS Enabled Operational Focus

**Successes:**
- FHWA created an Office of Operations
- AASHTO created an operations subcommittee
- State DOTs reorganized for operations
- Transit already had an operational focus
- Deployment of ITS progressed
  - 150 TMCs
  - 65% population covered by 511
  - 4700 DMS
  - 36 metro areas with real-time info on DMS
  - 1500 transit agencies using GPS
  - 45 States are part of CVISN
The Paradigm Shift for ITS

The first paradigm shift for ITS: Operations

ITS Program Headlines:

– Field operational tests
– Deployment
– Integration

The second paradigm shift for ITS:
The Paradigm Shift for ITS

Connectivity

- Safety technologies in all vehicles
- Multi-modal solutions
  - Seamless Service for
    - System management
    - Travel information
    - Pricing
Connectivity

Safety Technology for Situational Awareness Around the Vehicle

- Autonomous technology
- Vehicle to vehicle connectivity
- Vehicle to infrastructure connectivity

- Initially: inform driver
- Ultimately: not crash
Wireless Vehicle Communications

<table>
<thead>
<tr>
<th>Benefits</th>
<th>V2V</th>
<th>V2I</th>
<th>Nomadic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Apps</td>
<td>Tech</td>
<td>Apps</td>
</tr>
<tr>
<td>Mobility</td>
<td>Left-turn Asst Emergency Brake Warn Icy Condition Blind Spot Travel Info Platooning</td>
<td>DSRC</td>
<td>Curve Speed Warning Stop Sign Warning Signal Violation Traffic Mgmt Road Wx Alert Navigation</td>
</tr>
</tbody>
</table>
### Safety Benefits

<table>
<thead>
<tr>
<th>Crash Types</th>
<th>Frequency*</th>
<th>Severity**</th>
<th>V2V</th>
<th>V2I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Loss without Prior Vehicle Action</td>
<td>529</td>
<td>478</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road Edge Departure without Prior Vehicle Maneuver</td>
<td>334</td>
<td>270</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead Vehicle Stopped</td>
<td>975</td>
<td>240</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Vehicle(s) Not Making a Maneuver – Opposite Direction</td>
<td>124</td>
<td>206</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Straight Crossing Paths at Non-Signalized Junctions</td>
<td>264</td>
<td>174</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pedestrian Crash Without Prior Vehicle Maneuver</td>
<td>39</td>
<td>144</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle(s) Turning at Non-Signalized Junctions</td>
<td>435</td>
<td>138</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Running Red Light</td>
<td>254</td>
<td>135</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTAP/CD at Signalized Junctions</td>
<td>220</td>
<td>121</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>LTAP/CD at Non-Signalized Junctions</td>
<td>190</td>
<td>113</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Lead Vehicle Decelerating</td>
<td>428</td>
<td>100</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lead Vehicle Moving at Lower Constant Speed</td>
<td>210</td>
<td>78</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Vehicle(s), Changing Lanes – Same Direction</td>
<td>300</td>
<td>78</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Number of crashes (thousands)  **Functional Years Lost (thousands)
V2V Safety Research - Applications

- **Applications Development** (precompetitive)
  - Emergency Brake Lights
  - Forward Collision Warning
  - Lane Change Warning
  - Intersection Movement Assist
  - Do-Not-Pass Warning
  - Control Loss Warning

- **Next set crash types**
  - Head on
  - Intersection
  - Pedestrian & Motorcycles
V2V Safety Research - Applications

• **Applications Development** (precompetitive)
  – Message sets
  – Algorithms
  – Driver issues
    • Interface
    • Performance
  – Performance Evaluation
    • Performance Specs
    • Object test procedures
    • Effectiveness/benefits
V2V Safety Research - Interoperability

- Standards development & testing
  - Message sets
  - Communication protocols
- Certification
  - Performance requirements
  - Test procedures and testing verification
- Security and scalability
- Positioning
Weather and Environmental Applications

Applications

- NWS forecast
- Private forecast
- Road weather management
- Traveler info providers

Standard Message Format

Weather & Environmental Information

location
wipers
traction
emissions
brakes
Weather and Environmental Research

- Standards development and testing
- Research analysis and evaluation on
  - Data quality
  - Use for weather applications
- Applications – Road Weather Management
  - Advisory
  - Control
  - Treatment
Connectivity

Multi-modal Solutions for Situational Awareness of the Transportation System

• Modal choice
• Real-time information on all roads, all modes
  – Freeways and arterials
  – Transit
  – Parking
• Pricing
Nomadic Devices: Opportunities

Devices
- Cell phones
- GPS cell phone
- Aftermarket navigation
- Other

Applications
- Planning
- Performance Measures
- Traffic Management
- Transit Management
- Freight Management
- Rural Applications

- Curve Speed Warning
- Stop Sign Warning

- Mobility
- Safety
Nomadic Devices

• Standards development and testing
• Data quality and evaluation
• Applications development
• Procurement approaches
• Safety research and testing
Average trip speed was 18.5% faster than conventional navigation.

Comparison of average trip speed during Feb ‘07

Average trip speed [km/h]

<table>
<thead>
<tr>
<th></th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>conventional navigation</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fastest route</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nissan Motor Co.
Average Fuel Consumption was 10.5% less than conventional navigation.

Comparison of Fuel Consumption during Feb ‘07

Average Fuel Consumption [Litters]
Connectivity: Open Platform

Safety Technology
Multi-modal Solutions
Interoperability across
• Devices
  – DSRC
  – 3G, 4G, WiFi
  – Other
• Modes
Safety

- 41,059 fatalities/year
- 2.49 million injuries
- 6 million crashes/year
- $230 billion economic cost/year
- 1.37 fatality rate
Congestion

- Crashes are 25% of all congestion
- Congestion will increase by 50% in 10 years
- Congestion has grown 400% in 20 years in small cities
- Americans will spend a week stuck in traffic
- $78 billion/year
Environmental Concerns

- 25% of GHG emissions are from transportation sector
- 33% of all CO₂ emissions from fossil fuel were from transportation
- 60% of those resulted from gasoline consumption by personal vehicles
- 100 million people in the US live in counties that exceed air quality standards for ozone and particulates
Limited Public Resources

Cost to Maintain $50 Billion per year (through 2015)

Cost to Improve $107 Billion per year (through 2015)

Source: U.S. Chamber Funding Highway and Public Transportation Study (2005)
Complex Transportation Problems

Transportation Problems

- Safety
- Congestion
- Productivity
- Environment

System Performance

BUT
No sustainable Funding source
Navigation Device Sales Estimates: 2007 vs. 2015
Source: Telematics Research Group, Inc. (TRG)
### Automotive Adoption of Real-Time Traffic

**Number of OEM Models with available factory-installed XM NavTraffic**

<table>
<thead>
<tr>
<th>OEM</th>
<th>Traffic Intro</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honda/Acura</td>
<td>MY 2005</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GM/Cadillac</td>
<td>MY 2005</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Toyota/Lexus</td>
<td>MY 2007</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nissan/Infiniti</td>
<td>MY 2007</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ferrari</td>
<td>MY 2008</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>19</td>
<td>40+</td>
<td>50+</td>
</tr>
</tbody>
</table>

**OEM NavTraffic Annual Production**

Source: Vehicle Traffic Information Coalition
Information Technology Explosion

- Expectations for information
- Ubiquitous Connectivity
- Hand-held devices
- Person-to-person Networking

A Wireless World
Observations: Public Sector

- General but slow acceptance of technology in transportation
  - ITS use has grown: TIM, signals, freeway mgt, transit mgt, toll collection, CVISN
  - ITS investment is slow; constrained resources
  - Data limitations (extent and quality) limit value
  - Slow to innovate
  - Cautious contracting
  - Low risk
Wireless Technology Revolution

Observations: Technology Private Sector

- Fast technology evolution
  - Growing use of navigation systems (on 69% of all models)
  - Growing desire to deliver real-time traffic information
  - Data quality and extent is limited
  - Many technologies are vying to be the data solution
  - OEMs are looking to technology for vehicular safety
  - Adept at innovation
  - Risk taking is rewarded
  - Quick to market
The Paradigm Shift for ITS

Wireless World

Safety & System Performance

Leverage the market
The Paradigm Shift for ITS

How do we use the unique attributes of public sector agencies to create incentives to achieve the desired outcome?

- NCAP (Stars on Cars)
- Right of Way
- Funding
- Standards
- Regulation
- Other?
The Paradigm Shift for ITS: Leverage the Market

Connectivity: Open Platform

• Safety technologies in all vehicles
• Multi-modal solutions
A Changing Paradigm for ITS: Connectivity

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