The History and State of the Connected Vehicle

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Who We Are:
Connected Vehicle Trade Association

• CVTA is an international, non-profit trade association formed to advance the interests of industries and organizations involved in vehicle communications.

• Vision - A world where safe, efficient, effective travel is enabled through real-time vehicle connectivity.
A Brief History

• Automotive Multimedia Interface Collaboration (AMI-C) was formed by 12 automakers in 2001 and developed 3,500 pages of specifications for in-vehicle communications. At the completion of this work the automakers wanted to work on a common ex-vehicle communication system.

• The VII (Vehicle Infrastructure Integration) Consortium was formed in 2004 and signed a Cooperative Agreement with the USDOT for $50+ million to develop and test a generic DSRC communications solution.

• The automakers asked that a non-profit trade association be formed to bring together all the various industry sectors needed to build out a complete system. CVTA was incorporated in early 2005 with 12 founding companies from different industries.

• In 2006-2008, CVTA and the Center for Automotive Research developed the Connected Vehicle Proving Center, now a part of U of M Dearborn.

• In 2009, with the conclusion of the majority of the pre-competitive research by the VIIIC, and realizing the need to include cellular and WiFi communication protocols, the US DOT initiative was renamed IntelliDrive®. In 2011 the US DOT renamed IntelliDrive to the Connected Vehicle Initiatives.

• NHTSA will begin a deployment decision process in 2013 that could lead to a rulemaking that would require all vehicles to communicate via DSRC specific Vehicle to Vehicle safety messages. Commercial Vehicles will likely be mandated to communicate safety information in 2014-15 timeframe.
Evolution to Autonomous Vehicles

- Connected
  - Mobile Communications
  - Instant Asset Tracking
  - Real Time Traffic Info
  - Electronic Tolling

- Coordinated
  - Coordinated Routing
  - Optimized Traffic Flow

- Cooperative
  - Cooperative Collision Avoidance
  - Transit-aware Signal Preemption

Autonomous Vehicles
The Scope of the Connected Vehicle

• **Verticals**
  - Safety – the responsibility of the automakers
  - Mobility – the responsibility of the transportation agencies
  - Commercial Services – everything else

• **Communications Protocols**
  - Cellular – Diagnostics and Communications
  - WiFi – Information and Entertainment
  - DSRC – Safety Communications
  - Near Field, Bluetooth, Zigbee, etc.

• **Devices**
  - Embedded – built in to the car
  - Aftermarket – added after sale
  - Nomadic – carried in by driver/passenger
Conceptual Relationships of Connected Vehicle Applications

- Safety (DSRC)
- Mobility
- Commercial

Wireless Coverage Area

DSRC

WiFi

Cellular

- V-V - Hot Spots - Arterials - 50%

Telecommunications

- Local Services - Real Time Control

- Broadband Services

- Internet Services

- Equipment Connected Vehicle Population

- 2010 - 2015 - 2020 - 2025 - 2030

- 5% - 25% - 50% - 75% - 95%

Applications:

- Video/Audio Streaming
- Public Announcements
- Geo Fencing / Vehicle Recovery
- Voice Mail
- Fleet Management
- OEM Customer Relations
- Parking Locator
- Vehicle Maintenance
- Dynamic Traffic / Weather via Probe Data
- Tolls / Payments
- Active Highway Signage
- Traffic Signal Violation
- Dealer Processing
- File / Data Downloads
- Access Control
- Emergency Vehicles
- EE Brake Lights
- Merge Assist
- Traffic Management and Control
- Cooperative Collision Avoidance
- Detour Planning
- Traffic Management and Control
- Merger Assist
- Parking Locator
- Tolling / Payments
- Local Services - Real Time Control
- Broadband Services
- Internet Services

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European Initiatives

- The Primary EU Initiative is the Cooperative Vehicle Infrastructure Systems, whose objectives are:
  
  - to create a unified technical solution allowing all vehicles and infrastructure elements to communicate with each other in a continuous and transparent way using a variety of media and with enhanced localization;
  
  - to enable a wide range of potential cooperative services to run on an open application framework in the vehicle and roadside equipment;
  
  - to define and validate an open architecture and system concept for a number of cooperative system applications, and develop common core components to support cooperation models in real-life applications and services for drivers, operators, industry and other key stakeholders;
  
  - to address issues such as user acceptance, data privacy and security, system openness and interoperability, risk and liability, public policy needs, cost/benefit and business models, and roll-out plans for implementation.

- Their final deliverable reports are here: http://www.cvisproject.org/en/public_documents/deliverables/
EU Initiatives, continued

• Car2Car Communications Consortium (C2C-CC)
  – C2C-CC is a nonprofit, industry driven organization initiated by European vehicle manufacturers and supported by equipment suppliers, research organizations and other partners. See: www.car-to-car.org

• ISO, ETSI, CEN and ITU-T developing various standards

• US-EU Cooperations:
  – US DOT’s RITA established a partnership with the Society and Media Directorate-General (DG-INFSO)
Japan Initiatives

• Smartway is a next generation road system that incorporates existing services such as Vehicle Information and Communication System (VICS) and Electronic Toll Collection System (ETC), as well as various other services using advanced ITS technology.

• Dynamic route guidance: A service using new high-speed, large-capacity road-vehicle communications to distribute wide-area road traffic information exceeding prefectural boundaries (maximum about 1,000km in extended road length) in real time, enabling car navigation systems to choose the optimum route.

• Assisting safe driving: A service providing caution in emergencies, using ITS Spots that provide road traffic information in normal circumstances. The service can alert drivers by notifying them not only of fallen obstacles ahead but also traffic jams beyond curves, in other words, at blind spots on the road ahead, preventing them from being startled, causing accidents.
Korea/China Initiatives

• Korea
  – Arguably the most connected country for both broadband and vehicle communications.
  – Struggled with adoption beyond infotainment
  – Largely confined to cellular communications and WiBro (Broadband WiFi)

• China
  – First business league formed for vehicle communications (SVCTA)
  – Numerous Workshops and conferences country wide
  – Annual Telematics@China event will probably be largest in world in 2013
  – No major push internally except regional V2X
  – Highly desirous to sell technology globally, but costs are rising
USA Initiatives

• The 3,000 vehicle Safety Pilot will provide input for the decision on whether to pursue a Rulemaking Process for passenger vehicles.
• Interstate Commercial Vehicle rulemaking decision is expected early 2014.
• VII Consortium and CAMP doing a variety of technical research for V2X.
• Numerous State and industry vertical programs ongoing for transit, city, tour and school buses, taxis, and public utility vehicles.
Interstate Commercial Vehicles

• NHTSA’s broad enforcement authority, including recall authority, extends to vehicles in use, the agency regulates the safety of new vehicles and original equipment through its rulemaking authority, primarily mandatory Federal Motor Vehicle Safety Standards (FMVSS)
• FMCSA is authorized to prescribe commercial vehicle usage requirements, including vehicle operator requirements (e.g., hours of operation, substance abuse requirements, etc.).
• In 2014 NHTSA and FMCSA will consider the same vehicle safety message communication rulemaking for Interstate Commercial Vehicles.
• Unlike passenger vehicles, NHTSA has the ability to move this rulemaking on a substantially faster track (reference anti-texting ban last April, 2012).
• In addition, it could be required of all interstate commercial vehicles rather than just new production
A Watershed Opportunity

• Within a couple years, many vehicles could be outfitted with devices, software and communication capability to provide NHTSA and the auto industry with performance, robustness, security and viability data to support any passenger vehicle recommendation.

• In-vehicle real estate for device placement, and antenna shape and placement are not roadblocks.

• The additional cost to include vehicle diagnostics, driver behavior monitoring, trailer integrity, road condition, weather and traffic awareness is now a simpler business decision, and we should see a broad adoption of those capabilities.

• Suitable quid pro quo arrangements with commercial vehicle operators are then possible for USDOT, State and local agencies to harvest the mobility information very cheaply.

• The public awareness, technology refinement, value proposition and ability to address security issues are now accelerated in a controlled environment of long haul truckers.

• Utilizes the 5.9 GHz spectrum and tests the unlicensed devices
# Connected Vehicle Use Cases

## Primary
- Intersection Cooperation
- Lane/Road Departure
- Vehicle to Vehicle Cooperation

## Safety
- Intersection Collision Warning
- Highway / Rail Collision Warning
- Road Condition Warning
- Approaching Emergency Vehicle Warning
- Emergency Vehicle Signal Preemption
- Vehicle-to-vehicle Road Feature Notification
- Work Zone Warning
- Highway Merge Assistant
- Signalized intersection violation warning
- Traffic signal violation warning
- Stop sign movement assistance
- Stop sign violation warning
- In-vehicle highway signage
- Road condition warning
- Lane departure warning
- Curve speed warning / rollover warning
- Commercial vehicle electronic clearance
- Commercial vehicle safety data
- Approaching emergency vehicle warning
- Emergency vehicle ahead
- SOS services
- Crash data to Public Service Answering Point (PSAP)
- Post-crash warning

## Mobility
- Traffic Advisories (routing, re-routing assistance)
- Navigation Assistance
- In-Vehicle Signage
- Weather Alert Notifications
- Signal Phasing (traffic flow optimization)
- Incident observation and mitigation
- Roadway incident assistance
- Cooperative Adaptive Cruise Control
- Hazardous material path enforcement
- Cargo Management
- Traveler Information
- Highway Infrastructure Planning
- Vehicle-Highway Automation System
- Approach Speed to Signal
- Speed Limits
- Vehicles as traffic probes
- Incident information to vehicles
- Travel time data to vehicles
- Electronic payment
- Enhanced route guidance and navigation
- Crash data to Transportation Operations Center (TOC)
- Origin and Destination (OD) data to TOC

## Consumer Services
- Parking Location Assistance
- Parking Access
- Food Drive Through Payment
- Concierge Assistance
- Appointment Confirmation/Changes
- Download Data Files (MP3, etc...)
- Home Network Content

## Commercial Services
- Software Updates
- Remote Control
- Secure Access
- Just-In-Time Repair Notification
- Safety Recall Notification
- Remote Diagnostics
- Customer Relations Management
- Fleet Management

## Probe Applications
- Pothole Detection
- GPS Data
- Traction Control
- ABS (Braking)
- Moisture
- Darkness
- Fog
- Wet Pavement
- Abrupt Stop
- Skidding
- Road Surface Conditions
- Airbag
- Wipers
- Headlights
- Fog Lights
- Ambient
- Air Temp
- Location
- Snow
- Ice

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Green = Vehicle Only

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ITS Function versus Density of Connected Vehicles

- Traffic Info
- Roadway Situational Awareness
- Safety Warnings
- Traffic Management
- Crash Avoidance
- Active Controls
- Automated Highway Segments

Crashes

CV Equipped Population

Timeline

2010

2030

0% CV Equipped Vehicles 100%

0% Crash Reduction (reduction from 2006 baseline)

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Advanced Driver Assistance Systems

- Three levels of assistance:
  
  **Informational:**
  The vehicle informs the driver “The speed limit on this road is 45 miles per hour.”

  **Advisory / Warnings:**
  The vehicle warns the driver: “You are going too fast for the curve ahead,” OR “You are leaving your lane.”

  **Intervention:**
  The vehicle transitions the headlights in preparation for the curve ahead, OR applies the brakes as it approaches a stop sign or veers off road.
Rapid Evolution of Applications

Location Based Services
- Roadside Assistance
- Emergency Medical
- Off-Board POI look-up

Navigation
- Autonomous
- Turn by Turn Voice
- Guidance
- On-Board POI Look Up
- Map Display

ADAS
- Adapt. Cruise Control
- Headlight Aiming
- Curve Preview Warn.
- Transmission Control
- Fuel Management

- Auto Collision
- Notification
- Proximity Location

- Off-Board
- Full Voice
- Fleet Management

Increasingly sophisticated applications -- Broader Communications and Map Use
US DOT/FHWA Assessment of UBI*

• Cuts vehicle miles traveled
• Curtails crash claims in excess of driving reductions
• Relieves congestion at a rate greatly exceeding driving reductions
• Reduces air pollution and carbon emissions
• Lowers infrastructure costs
• Strengthens cities and reduces urban sprawl
• Provides substantial consumer savings
• Increases insurance company profits
• Improved utilization of vehicles

* Presentation by Allen Greenberg, USDOT before the Insurance Telematics Conference, Chicago, Ill, USA, September 2012
Insurance Telematics Program Value

• Ability to better manage fraud
• Improves claims handling
• Improved risk measurement and pricing accuracy
• Highly effective behavioral change models possible
• Knowledge to empower new risk engineering models
• Proactive data supporting improved business models
• Changes the overall value proposition with the insurer
• Indication that driving behavior may correlate with other non-auto risks
• Appeals to consumers as it is intuitive, controllable, and minimizes reliance on controversial proxies
• Attracts lower risk insurees via self-selection
• Allows customers to understand and eliminate risky behaviors, actually reducing accident frequency
• Differentiates product offering by offering additional services
Deployment Scenarios are Changing

• Federal Government Lead is unlikely due to lack of adequate funding
• State/Local Government Lead is hoped for in targeted areas (gateway Cities, Corridors, etc.)
• Private Sector Commercial Services
  – Business Applications
  – Public Private Partnerships
  – Mobile Internet
Where Are We Going?

- The US DOT’s Safety Pilot will test the real-world feasibility of V2V using DSRC.
- The US DOE’s Advanced Vehicle Technology Act will foster innovation and merge the energy and transportation efforts.
- WiFi, Cellular and other near-field communications for nomadic and aftermarket devices are proliferating.
- Federal Strategy and Policy for Safety, Security, Privacy and Liability is far behind the technical achievements.
- Electric and hybrid vehicles must have vehicle communications for reasons of range management and recharge scheduling, and will add to this ecosystem.
- Insurance, Finance, Security and other non-transportation functions will accelerate deployment.
- Gaps still exist in the standards, but until we know where we are going and what the non-differentiating elements are.
- Open Source initiatives have begun to show some promising results.
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Insurance Telematics

Addenda
UBI 2.0 Eco-system – The Evolution of Driver Intelligence

- Managed Services
- Integrated & Scalable
- Meaningful Data
- Personalized Experience

Program Mgmt & Support
- Training
- Adoption
- Support
- Retention

Logistics & Fulfillment Solutions
- BPL vendor selection
- Forward/Reverse logistics
- SIM provisioning
- Inventory management
- Personalization
- Enrolment models

System & Data Management
- Secure data warehousing
- System monitoring and scalability
- Data exports and analysis
- Administrative reports

Application
- UBI
- Young driver
- Mature driver
- Fleet
- Road charging

Business Intelligence
- Data Analytics
- Non-actuarial Scoring
- Driver identification
- Behavioral

Device Selection and Configuration
- Location tracking: GPS or non-GPS
- Port: OBD or Cigarette
- Voltage: 12V or 24V
- Accelerometer options
- Data collection and transmission intervals
- OTA upgradeability
- Antenna selection
- Multi-network device
- Panic button
- Feedback channels: web, mobile, email, SMS, 2-way radio, etc

Data Visualization
- Web or mobile based solutions
- Customized / Branded B2B / B2C portals
- Driving reports, coaching tips, scoring, account and vehicle management

Communication Protocols / Wireless Carrier
- GSM
- CDMA
- WCDMA
- WiFi
- BT
- RFID

Premium Services / VAS
- Auto vehicle locator (AVL)
- Roadside assistance
- Vehicle diagnostics
- Traffic alerts / routing
- Road charging
- Green reports
- Stolen vehicle recovery

Vehicle Supportability
- OBD-2 or non OBD-2 support
- Gas, diesel, hybrid, and electric support
- Cars, vans, trucks, heavy duty
- Device agnostic TSPs
Telematics Value Pyramid from Insurer Perspective

- Business Optimization
- Management Information and Decision Support
- Analytics – Knowledge Creation
- System Infrastructure – Data Management and Localization
- Telematics Services
- Devices or Sensors

Typical focal point

Graphic per Towers Watson
What are the Challenges?

- Most current telematics programs were developed to improve operational efficiencies – not specifically reduce claims
- Commercial telematics companies focused on claims reduction have had very limited access to claims data
- Crash reduction experiences are based on limited data sets and often lack control groups
- Data collection is based on thresholds which limits visibility to causal factors
- Behavioural based programs are highly dependent on a wide range of complex activities which can vary significantly
- Commercial vehicle operational characteristics vary widely

Assessment per Towers Watson
# Multiple level driver safety approach

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
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<tbody>
<tr>
<td>Extended services</td>
<td>Interface with risk and insurance solutions</td>
</tr>
<tr>
<td>Fleet /Safety mgr reflective</td>
<td>Interactive management dashboard compares drivers and trends and focus attention on problems</td>
</tr>
<tr>
<td>Fleet /Safety mgr immediate</td>
<td>Emails and reports on specific unsafe behaviour</td>
</tr>
<tr>
<td>Driver reflective</td>
<td>Driver scorecards regularly issued for training and reflection</td>
</tr>
<tr>
<td>Driver immediate</td>
<td>Immediate visual audible feedback to the driver in the cab of harsh and aggressive driving</td>
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Current and Future Business Models

• Insurance Telematics primarily is used to collect data for a period of time to allow insurer to assess the risk metrics of the driver.

• However, sampling data over longer periods, rather than continuous monitoring, has value.

• Vehicle telematics for an automaker is driven around providing data for diagnostics, routing & LBS, and other infotainment functions.

• Only Commercial fleets desire ongoing insurance telematics information for continual driver behavior monitoring, situational awareness and safety.