CONNECTED AUTOMATION

IMPROVING SAFETY THROUGH CONNECTED VEHICLE TECHNOLOGY

INDUSTRY TECHNICAL WORKSHOP – NORTHWESTERN UNIVERSITY TRANSPORTATION CENTER

Roger Berg - Vice President
North America Research and Development
DENSO Corporation
Global Supplier of Advanced Automotive Technology, Systems and Components with $39.8 billion in sales.

For FY ending March 31, 2014

More than 200 Subsidiaries & Affiliates

In 36 Countries & Regions

Employing more than 130,000 People Worldwide
DENSO’s Global Product and R&D Focus

DENSO Thinks Systems

1. **Powertrain Control System**
   - Engine management system, Gasoline direct injection, Hybrid components, Starter, Alternator, etc.

2. **Thermal Systems**
   - Heating Ventilation Air Conditioning (HVAC), Compressor, Heat exchangers, Battery thermal management, etc.

3. **Information & Communication Systems**
   - Instrument Cluster, Head-up Display, Human Machine Interface technology, Horn, Keyless entry, Wireless phone charger, etc.

4. **Driving Control & Safety Systems**
   - Passive safety technologies, Airbag sensing system, Active safety technologies, Traction control system, Antilock braking system, etc.
Connected Vehicle Vision for Today
What Can Connected Vehicle Technology Do?
What is Connected Vehicle Technology?
How does it improve vehicle safety?

Sample Safety Applications

- Blind Intersection Warning
  - Blocked Field of View

- Forward Collision Warning
  - Stopped Vehicles in Roadway

- Emergency Vehicle Advisor
  - Locate First Responders

- Intersection Collision Avoidance
  - Red Light Violation

- Blind Spot / Lane Change Warning
  - Blocked Field of View

- Electronic Brake Lights
  - Hard Brake
V2V Safety Application - Intersection
V2V Safety Application – Stopped Car Ahead
V2V Safety Application – Emer. Vehicle Alert
A V2X Service Deployment Scenario

1) Use V2X safety messages and content to provide day one benefits
   • Focus on information and warning functions as new and retrofit devices deploy
   • Cooperate with infrastructure systems providers for integrated V2V/I2V approach

2) Expand to more advanced (safety) services as deployment penetration increases
   • Building on a mature system, use of effective safety features can proliferate
   • Achieve improved functional integration to lower system cost
SAFETY PILOT Model Deployment

- To determine the effectiveness of the safety applications
- More than 2800 cars, commercial trucks and transit vehicle
- 29 roadside equipment installations
- Variety of different devices
- $25M, 2.5yrs program

DENSO Supports with

- 8 Retrofit Trucks
- 3 Integrated Trucks
- 3 Transit Vehicles
- 50 Aftermarket Safety Device
- 64 Integrated devices for all of 8 LV OEMs
“NHTSA will [then] begin working on a regulatory proposal that would require V2V devices in new vehicles in a future year, consistent with applicable legal requirements, Executive Orders, and guidance. DOT believes that the signal this announcement sends to the market will significantly enhance development of this technology and pave the way for market penetration of V2V safety applications.”

U.S. Department of Transportation Feb 3, 2014
Vision for the Future
Vehicle with radar and V2V approaches intersection

Gray car slows to let truck pass intersection

Truck moves at constant speed (example)

Blue car slows because gray one did

Blue car accelerates back to original speed
Vehicle with radar and V2V approaches intersection

- Gray car slows to let truck pass intersection

- Truck moves at constant speed (example)

- Blue car slows because gray one did

- Blue car accelerates back to original speed
Connected Automation Example

Vehicle with radar and V2V approaches intersection

- Gray car slows to let truck pass intersection
- Truck moves at constant speed (example)

- Blue car slows because gray one did
- Blue car accelerates back to original speed
Vision for the Future

HMI System  Components of In-car Technology

- Rear View Camera (for parking assist, road recognition)
- Side View Camera
- Ultrasonic Sonar (driving assist at low speed)
- Vision Sensor (lanes, classification and attribute of object)
- Short Distance Millimeter Wave Radar (for pre-crash)
- Rear Radar (for parking assist)
- Laser Sensor (position, relative velocity and width of object)
- Long Distance Millimeter Wave Radar (position and relative velocity of object)
- Haptic Device
How Do We Get there

- Sensors
- HMI
- Lab
- Driver Monitor
- V2X

- Color HUD
- Haptic
- Center Display

Driver Workload Indicator

- Workload Meter
  - Driving Workload
  - Accident Prevention
  - Task Workload
One Idea - Connected Automation City

- Less restrictive operational constraints
- May coexist with pedestrians & bikes
- Safety is absolute must

© DENSO International America, Inc. All rights reserved.
Summary

- V2X is effective at cooperative crash avoidance
- Connected Automation provides advantages
- Road to automation includes connectivity to driver
- Future flows to alternative transport vehicles and must include technology for pedestrian environment operation