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Precise Positioning – Automated Driving & Safety Communications

GPS Technology Innovations & Networking Applications

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Industry Participation – T. Russell Shields

- Founding officer and director of the **Intelligent Transportation Society of America (ITS America)**
- Founder and current member of the **ITS World** Congress board of directors
- Chair of the first ITS World Congress in the U.S. in 1996
- First president of the **Automotive Multimedia Interface Collaboration (AMI-C)**
- Served two terms as chair of the Communications Committee of the **United States Transportation Research Board** (National Research Council)
- Past Convenor of **ISO/TC204/WG16,** the international working group that develops standards for V2V and V2I communications
- Co-Chair of the ITU-organized **Collaboration on ITS Communications Standards**
- Member and chair of many committees of the **Society of Automotive Engineers (SAE)**; named an **SAE Fellow** in 2007
- Recipient of the 1998 **SAE-Delco Electronics Intelligent Transportation Systems Award** for distinguished service to the ITS industry
- Inducted into the inaugural class of **ITS America's ITS Hall of Fame** in 2008
- Named the inaugural U.S. member of the **ITS World Congress Hall of Fame** in 2010

Vehicle-to-Vehicle (V2V) Communications – Current Efforts

V2V communications have been in development for more than a decade

- 5.9 GHz (700 MHz in Japan)
  - Proposed for V2V communications in the U.S., Europe, Japan, and many other locations
  - Can be used for a wide range of applications
    - Safety warnings (under testing in the Ann Arbor, Michigan Safety Pilot trial)
    - Collision avoidance (hope for the future)
    - Pedestrian-to-vehicle communications (possibly further in the future)
- U.S. NHTSA V2V Roadmap Status
  - Pending decision/final report for light vehicles, scheduled for Fourth Quarter 2013
  - Decision for heavy vehicles scheduled for 2014

Vehicle-to-Vehicle (V2V) Communications – Current Efforts

- University of Michigan Transportation Research Institute (UMTRI)/USDOT led Safety Pilot Model Deployment in Ann Arbor, Michigan
  - First phase completed in August 2013
  - See www.safetypilot.us
- International standards harmonization efforts by the U.S. DOT continue with the EU DG CONNECT (and starting to include DG MOVE) and the Japan MLIT

V2V Communications – Basic Requirements

V2V requirements for road transportation safety applications differ from those for land and water

- Each vehicle needs to send frequent updates of time, position, speed, and heading
  - Over 100 km per hour (27 meters per second) common
- A listening vehicle needs to determine if its path might intersect with another vehicle's path
- Transmitted V2V information for surface transportation need to be very accurate and reliable
  - Road vehicles often come very close to each other (*a key difference*)
- All vehicles should use a consistent data source for positioning and time
  - Mismatches could result in crashes

V2V Communications – Position Requirements

V2V for land transportation safety applications need completely reliable position information accurate to centimeters

- The automotive industry does not know how to get reliable, consistent, tamper-proof, highly accurate positioning
  - For hundreds of millions of vehicles of different ages and levels of repair
  - From dozens of vehicle manufacturers based in different countries
- How to help NHTSA with its V2V decision
  - Identify the level of vehicle safety warnings that are reliable using current GNSS technology
  - Provide clear information on the long-term evolution of possible future reliability of GNSS technology to understand if collision avoidance using vehicle safety communications will become practical

Automated Driving – Activities

Automated driving is gaining commitments from vehicle manufacturers and suppliers

- Automated driving testing has been evolving over the past decade in many places
  - Demos in the U.S., Germany, Japan, Korea, China, etc.
  - Some U.S. states have passed laws affecting versions of automated driving
  - The UK has passed a law permitting the testing of driverless vehicles on public roads
- In early September 2013, Nissan CEO Carlos Ghosn announced Nissan's intention to have automated driving in production vehicles in 2020
- Mercedes made a similar announcement at the 2013 Frankfort Motor Show two weeks later

Automated Driving – Key Issues

Automated driving is currently practical only on limited-access highways

- Vehicle manufacturers cannot afford mistakes
  - Lives are at stake
  - There could be potential damage to reputation and finances
- There is no good way to predict the behavior of pedestrians and bicyclists on the roadside
  - Even though vehicle sensors will increasingly be used to detect pedestrians and reduce accidents
  - Even though there will be pedestrian-to-vehicle communications in the future

Automated Driving – Next Steps

Progress will be step-by-step

- High-end vehicles already have some automated driving features
  - Brake assist
  - Stop-and-go adaptive cruise control (ACC) under 30 mph with ACC at higher speeds
  - Lane departure warning
- High-end vehicles will receive gradually improved and additional features
- Mass-market vehicles will receive mature technologies fairly quickly due to the reduced cost of cameras and IC chips

Automated Driving – Next Steps

Automated driving will initially occur on limited-access highways, possibly by 2020

- ACC will move to full automatic braking
- Lane departure warning will evolve into lane handling
- Expressway automated driving will
  - Rely on sensor probe data instead of GNSS and maps
  - Use broadcast information collected from authorities and probe data about road works and road hazards
  - Return to human control under complex conditions with advance notice from the system
  - Be unavailable under some bad weather conditions
- The approach will vary by vehicle manufacturer

Automated Driving – Challenges

- Collecting the detailed road information
  - Each vehicle manufacturer is likely to drive all qualified roads for testing and collecting sensor information
  - Driving both ways on all U.S. and Canadian limited-access highways is estimated to take about 2,000 hours
- Securing road construction and road hazard information reliably from authorities
- Gradual development of regulations and case law about automated driving
  - Mitigate some of vehicle manufacturers' concerns about liability
  - Provide predictable, clear legal environment

Automated Driving – Evolution

- Over the following decades, automated driving will move step by step to additional roads
- Precise, reliable vehicle positioning can help move forward the extension of automated driving beyond limited-access highways
- Vehicle manufacturers will extend automated driving without relying on GNSS until there is assurance of complete reliability

Thank You