Connected Vehicles in the U.S.: Opportunities and Challenges

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What Are Connected Vehicles?
The Opportunity
What is the Safety Pilot?

- Model for a national deployment of the technology
- Designed to determine the effectiveness of the safety applications at reducing crashes
- Designed to determine how real-world drivers will respond to the safety applications
- 1-year deployment began Aug 21, 2012
Largest pilot in the World

- More than 2,836 cars, commercial trucks, and transit vehicles
- A variety of different devices
  - Vehicle Awareness Devices
  - Aftermarket Safety Devices
  - Integrated Safety Systems
  - Retrofit Safety Devices
  - Roadside Equipment
- 73 lane-miles of roadway instrumented with 27 roadside-equipment installations
Roadside Infrastructure

• Several roadside infrastructure elements required:
  – DSRC Roadside Equipment (RSE)
  – SPaT-enabled traffic signal controllers
  – Backhaul communications network
  – Back-end data storage and processing
The Latest Challenge
Dedicated Short Range Communications (DSRC)
Short-to-medium range wireless communications protocol that permits very low latency data transfer critical in communications-based active safety applications
DSRC is the backbone of the connected vehicle program

- Basic Safety Message (BSM) sent 10 times per second (every 100 milliseconds)
- Message communicates vehicle position, trajectory and operational data
- Cars process information and warn driver as necessary
## DSRC Safety Applications

### Communications between Vehicle and Infrastructure
- Blind Merge Warning
- Curve Speed Warning
- Emergency Vehicle Signal Preemption
- Highway/Rail Collision Warning
- Intersection Collision Warning
- In–Vehicle Amber Alert
- In–Vehicle Signage
- Just–in–Time Repair Notification
- Left Turn Assistant
- Low Bridge Warning
- Low Parking Structure Warning
- Pedestrian Crossing Information at Intersection
- Road Condition Warning
- Safety Recall Notice
- SOS Services
- Stop Sign Movement Assistance
- Stop Sign Violation Warning
- Traffic Signal Violation Warning
- Work Zone Warning

### Communications between Vehicles
- Approaching Emergency Vehicle Warning
- Blind Spot Warning
- Cooperative Adaptive Cruise Control
- Cooperative Collision Warning
- Cooperative Forward Collision Warning
- Cooperative Vehicle–Highway Automation System
- Emergency Electronic Brake Lights
- Highway Merge Assistant
- Lane Change Warning
- Post–Crash Warning
- Pre–Crash Sensing
- Vehicle–Based Road Condition Warning
- Vehicle–to–Vehicle Road Feature Notification
- Visibility Enhancer
- Wrong Way Driver Warning
Relevant History

- 1997: ITS America petitioned FCC for allocation of the 5.85-5.925 (5.9 GHz band) to provide home for DSRC
- 1999: 5.9 GHz band was allocated
- 2003: DSRC Service and Technical Rules adopted
- 2008: Proposed DSRC/FSS spectrum sharing protocol was submitted
In 2004, the FCC stated that,

“vehicle–to–vehicle collision avoidance and mitigation applications are exceptionally time–sensitive and should not be conducted on potentially congested channels.”

The FCC further stated that,

“[a]lthough the Commission has long recognized that shared use of spectrum promotes spectrum efficiency, there are cases in which public safety concerns dictate exclusive use of frequencies,” and “such is the case here where the delay associated with shared use of a time–critical DSRC channel could be literally life–threatening in the context of collision avoidance.”
In 2012, the Middle Class Tax Relief and Job Creation Act required:

- **FCC Proceeding**: FCC to begin, within 12 months of enactment, a proceeding to modify the rules to all unlicensed U–NII (wireless) devices to operate in the 5350–5470 MHz (5.4 GHz) band

- **NTIA Study**: NTIA to study “known and proposed spectrum sharing technologies and the risk to Federal users if unlicensed U–NII devices were allowed to operate in the 5350–5470 MHz <5.4 GHz> band and the 5850–5925 MHz <5.9 GHz> band.”
  - 5.4 GHz Study required within 8 months of enactment (October 22, 2012)
  - 5.9 GHz Study required within 18 months of enactment (August 22, 2013)

- **FCC Pre–Announcement (Jan. 9, 2013)**: Consumer Electronics Show

- **Public Meeting (Feb. 20, 2013)**: Required proceeding with 5.4 GHz band initiated; proceeding also includes 5.9 GHz band

- **Proposal Published**: April 10, 2013 (78 Fed. Reg. 21320)
FCC 5 GHz Spectrum Sharing Proposal
- NTIA Study

• Required by Section 6406(b)(1) of the Middle Class Tax Relief and Job Creation Act of 2012 (Tax Relief Act)
• Presents the results of its initial study on the potential use of up to 195 megahertz of spectrum in the 5 GHz Band by Unlicensed–National Information Infrastructure (U–NII) devices
• Performed in consultation with the Department of Defense and other impacted agencies
• Assessed known and proposed spectrum–sharing technologies
• Evaluated the risk to federal users if the FCC allows U–NII devices to operate in the 5350 – 5470 MHz (5.4 GHz) and 5850 – 5925 MHz (5.9 GHz) bands
FCC 5 GHz Spectrum Sharing Proposal
- NTIA identified risk elements

• NTIA identified Risk Elements with U–NII Devices (wireless) operating in the 5.9 GHz Band:
  – Existing U–NII regulations were not developed to detect DSRC service signals
  – U–NII signal technologies may not be capable of detecting DSRC signals
  – Current U–NII regulations were not developed to protect transmitters and receivers in different locations
  – Changes to U–NII Dynamic Frequency Selection (DFS) detection parameters may not protect DSRC systems from serious performance degradation
FCC 5 GHz Spectrum Sharing Proposal - NTIA Initial Report findings

• “The report concludes that further analysis will be required to determine whether and how the identified risk factors can be mitigated through, for example, the promulgation of new safeguards in addition to the FCC’s existing requirements.”

• “Accordingly, NTIA, in collaboration with the federal and industry stakeholders and the FCC, will conduct quantitative analysis of potential mitigation requirements in connection with regulatory proceedings.”

• “In the next phase of its assessments, NTIA will lead detailed quantitative studies described more fully in this report, which will include additional analysis and measurements to evaluate the feasibility of existing, modified, proposed and new spectrum-sharing technologies and approaches.”
FCC 5 GHz Spectrum Sharing Proposal
- NTIA Initial Report findings

• “These studies will be supported by and involve direct interaction between federal and non-federal stakeholders, including representatives of the wireless industry and the intelligent transportation community.”

• “In addition, NTIA, the FCC, the State Department and the other affected federal agencies will continue to work cooperatively with industry representatives and international partners to fully assess various sharing scenarios.”
FCC 5 GHz Spectrum Sharing Proposal

**FCC Proposal**: Release up to 195 MHz of spectrum in 5 GHz band for unlicensed wireless device use

“Because the 5 GHz band is already used for other purposes by both federal and non-federal users, the effort will require significant consultation with stakeholders to enable non-interfering shared use of the spectrum. **But consultation can’t be an excuse for inaction or delay.**”

Julius Genachowski
FCC Chairman
FCC 5 GHz Spectrum Sharing Proposal
Overview of Final Action Timeline

• Comments Due to FCC: Tues., May 28, 2013
• Reply Comments Due to FCC: Mon., June 24, 2013
• NHTSA DSRC Rulemaking Decision: Q3 or Q4, 2013
• FCC Final Decision Anticipated: Q4–2013
• NTIA Review Completed: Q3 or Q4–2014
• World Radiocommunications Conference (WRC–15): November 2–27, 2015 (Geneva)
FCC 5 GHz Spectrum Sharing Proposal
Potential Implications for DSRC

• FCC Proposal allows unlicensed wireless devices to operate in spectrum currently reserved for DSRC
• Unlicensed wireless devices operating in DSRC spectrum may interfere/interrupt safety critical DSRC communications
• Requiring the sharing of DSRC spectrum to unlicensed wireless devices may invalidate all DSRC development and testing to date and delay implementation
• Strict priority protocols may need to be established to ensure no interference