

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)
)
)
Revision of Part 15 of the Commission's) ET Docket No. 13-49
Rules to Permit Unlicensed National)
Information Infrastructure (U-NII) Devices)
in the 5 GHz Band)

**COMMENTS OF THE ALLIANCE OF AUTOMOBILE MANUFACTURERS,
ASSOCIATION OF GLOBAL AUTOMAKERS,
INTELLIGENT TRANSPORTATION SOCIETY OF AMERICA, AND
DENSO INTERNATIONAL AMERICA, INC.**

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EXECUTIVE SUMMARY

In 1999, the Federal Communications Commission (“FCC” or “Commission”) allocated 75 MHz of spectrum in the 5.850-5.925 GHz (“5.9 GHz”) band for improving road safety and efficiency through a variety of Dedicated Short Range Communications (“DSRC”) applications.¹ In allocating this spectrum and adopting detailed rules for its use, the FCC aimed to “encourage the private sector to develop operational standards facilitating nationwide compatibility and interoperability of [safety] applications.”²

In its 2004 Order promulgating rules for DSRC equipment and applications, the Commission emphatically stressed the importance of DSRC’s safety-of-life features and the concomitant requirement that DSRC operations be reliable across the nation if we are to reap its greatest safety benefits.³ Indeed, the FCC noted that “the importance” of DSRC safety applications “cannot be underestimated” and that “[t]imeliness and reliability are essential components in this service.”⁴

The Alliance of Automobile Manufacturers (“Alliance”), Association of Global Automakers (“Global Automakers”), Intelligent Transportation Society of America (“ITSA”), and DENSO International America, Inc. (“DENSO”), and others have relied on the FCC’s commitment to keep the 5.9 GHz band free from harmful interference. We have also relied on

¹ *Amendment of Parts 2 and 90 of the Commission’s Rules to Allocate the 5.850-5925 GHz Band to the Mobile Service for Dedicated Short Range Communications of Intelligent Transportation Services*, Report and Order, 14 FCC Rcd 18221 (1999).

² *Amendment of Parts 2 and 90 of the Commission’s Rules to Allocate the 5.850-5925 GHz Band to the Mobile Service for Dedicated Short Range Communications of Intelligent Transportation Services*, Notice of Proposed Rulemaking, 13 FCC Rcd 14321 ¶ 7 (1998).

³ *Amendment of the Commission’s Rules Regarding Dedicated Short-Range Communication Services in the 5.850-5.925 GHz Band (5.9 GHz Band) et al.*, Report and Order, 19 FCC Rcd 2458 ¶¶ 5, 11-15 (2004) (“5.9 GHz Report and Order”).

⁴ *Id.* ¶ 14.

the FCC's DSRC channelization, channel size, and use restriction rules in developing and testing DSRC equipment and applications. The magnitude of this program cannot be ignored, and the challenges faced by the private and public sectors in reaching this point should not be trivialized to suit the short-term interests of providers of non-safety-related services.

It is axiomatic that, given the multiplicity of public and private stakeholders involved, uniform standards pertaining to road safety communications are difficult to push forward. Despite this fact, we are on the verge of a new generation of safety communications applications that holds great promise to save thousands of lives each year and increase the efficiency of our traffic management system. Given this occasion to refresh the record, we welcome the opportunity to remind the Commission that maintaining interference protection for the entire 5.9 GHz DSRC band was always the intention of Congress and should remain the focus of the Commission in this proceeding, particularly in light of the years of significant investment, research, and development.

As discussed more fully below, we respectfully submit that sharing of the 5.9 GHz DSRC band with unlicensed devices should be permitted only if it can be shown that such sharing will not interfere with DSRC's ability to provide timely and reliable safety communications. As of the date of this submission, it has not been definitively shown that any of the proposed sharing methods described in the *Public Notice* – “detect and avoid,” “re-channelization,” some combination or hybrid of the two, or some other method – is technically capable of preventing interference to DSRC if the 5.9 GHz band is opened up to unlicensed devices. However, of the sharing approaches being considered, the one that holds the most promise is the “detect and avoid” approach.

The “detect and avoid” method is the superior choice for preventing interference to DSRC. It is also the least disruptive to DSRC and the legitimate investment-backed expectations of its public and private sector proponents, while at the same time providing meaningful 5.9 GHz band access for unlicensed devices. As explained more fully below, this is because “detect and avoid” aims to prevent interference to DSRC operations by avoiding use of the 5.9 GHz band when DSRC operations are present in a way that requires no changes to the FCC’s rules, past orders, and statements regarding the incumbent and primary DSRC service.

Were the Commission to adopt the “re-channelization” approach, the United States Department of Transportation automakers would have to discard decades of costly research and go back to the drawing board to redesign DSRC to be compatible with a re-channelized band, thereby delaying the deployment of applications and equipment that have great potential to improve road safety and provide other important benefits. Indeed, based on current evidence, “re-channelization” would likely require a redesign of DSRC equipment and applications, additional significant, expensive and time-consuming testing, as well as modifications of widely accepted industry standards – all of which would come at significant cost and unreasonably delay the roll-out of DSRC. Moreover, if all DSRC safety-related applications are forced into the upper three DSRC-exclusive channels, as the “re-channelization approach” envisions, many potentially life-saving applications could be lost or greatly reduced.

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I. INTRODUCTION.

The Alliance of Automobile Manufacturers (“Alliance”),¹ Association of Global Automakers (“Global Automakers”),² Intelligent Transportation Society of America (“ITSA”),³ and DENSO International America, Inc. (“DENSO”) respectfully submit these comments in response to the *Public Notice* issued by the Federal Communications Commission (“FCC” or

¹ The Alliance is an association of twelve of the world’s leading car and light truck manufacturers, including BMW Group, Chrysler Group LLC, Ford Motor Company, General Motors Company, Jaguar, Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche, Toyota, Volkswagen Group of America, and Volvo Cars. *See* Alliance of Automobile Manufacturers, Members, <http://www.autoalliance.org/about-the-alliance/overview>.

² Global Automakers’ automobile manufacturer members include: American Honda Motor Co., Aston Martin Lagonda of North America, Inc., Ferrari North America, Inc., Hyundai Motor America, Isuzu Motors America, Inc., Kia Motors America, Inc., Maserati North America, Inc., McLaren Automotive Ltd., Nissan North America, Inc., Suzuki Motor of America, Inc., and Toyota Motor North America, Inc. Its supplier members include: Delphi Corporation, Denso International America, Inc., Robert Bosch GmbH, NXP Semiconductors USA, Inc., and Sirius XM. *See* Global Automakers, Members, <http://www.globalautomakers.org/members>.

³ Established in 1991, ITSA is the leading advocate for the development and deployment of communications and other advanced technologies that improve the safety, security and efficiency of the nation’s surface transportation system – collectively termed “Intelligent Transportation Systems.” Its members include private corporations, public agencies, and academic institutions involved in the research, design, development and deployment of ITS.

“Commission”) in the above-captioned proceeding.⁴ In the *Public Notice*, the FCC seeks to refresh the record on the status of potential solutions to allow Unlicensed National Information Infrastructure (“U-NII”) devices to share the 5850-5925 MHz (“5.9 GHz”) band with incumbent Dedicated Short Range Communications (“DSRC”) without causing harmful interference to DSRC operations.⁵ The FCC also solicits comment on its proposed test plan to evaluate the electromagnetic compatibility of DSRC and U-NII devices.⁶

As explained below, DSRC is ready for widespread deployment and poised to make driving safer and transportation more efficient. However, DSRC devices and applications have been developed in reliance on the FCC’s existing DSRC rules, which were designed specifically to ensure the reliability of DSRC communications by preventing interference, and reflect a sophisticated understanding of both DSRC’s radiofrequency (“RF”) environment and its “safety-of-life” reliability requirements. Consequently, of the sharing methods under consideration, the “detect and avoid” approach, if proven to be technically feasible, is far superior to the “re-channelization” approach. “Detect and avoid” would be far less disruptive to DSRC while allowing unlicensed devices meaningful access to spectrum. “Detect and avoid” is also far more likely to protect DSRC from harmful interference, is more consistent with Congress’s directives and other countries’ DSRC efforts, and, unlike “re-channelization,” would not require years of expensive redesign and re-testing. Moreover, regardless of the sharing approach the FCC ultimately chooses, it should indicate with sufficient specificity the interference avoidance mechanism that will protect DSRC rather than leaving this issue to industry standards bodies.

⁴ *The Commission Seeks to Update and Refresh the Record in the “Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band” Proceeding*, Public Notice, FCC 16-68 (2016) (“*Public Notice*”).

⁵ *See id.* at 1-2.

⁶ *See id.*

Finally, the FCC’s proposed test plan does not provide enough information to determine if its tests will be able to appropriately assess the sharing methods. We recommend below tests that should be included in Phase I, such as a test to determine the impact of U-NII interference on the aggregate throughput of DSRC safety communications. We also recommend tests that should be included in Phase II, such as tests in controlled environments that allow for longer device separation ranges. When it is released, the Phase III Test Plan should specify a meaningful set of scenarios on which parties can comment. As the FCC continues to develop these plans, it should remain mindful that the metrics involved with crash-imminent safety applications are more important at the applications-level than the lower-level communications protocols, which seem to be the focus of the proposed tests. Above all, an ongoing FCC test plan to examine sharing should not impede the deployment of DSRC.

II. DSRC HOLDS GREAT PROMISE TO MAKE DRIVING AND TRANSPORTATION SAFER AND MORE EFFICIENT.

DSRC holds great promise for improving the safety of United States (“U.S.”) roadways and substantially enhancing the efficiency of our national highway transportation system – as Congress, the FCC, the U.S. Department of Transportation (“USDOT”), and others have consistently recognized.⁷ In fact, DSRC is already being deployed in many parts of the country and will soon become a central component of the nation’s highway transportation system. By allowing vehicles to communicate with each other, with infrastructure, and with nearby individuals, DSRC will provide public safety, traffic management, environmental, and other benefits to motorists, pedestrians, and others who use or live near the nation’s roadways.

⁷ See, e.g. USDOT, *Fact Sheet: Improving Safety and Mobility Through Connected Vehicle Technology*, <http://bit.ly/29xE5va> (last visited July 7, 2016); *infra* Section V.A.

A. DSRC Holds Great Promise to Reduce the Number of and Damage Caused by Automobile Crashes and Save Lives.

In 2015 alone, 35,200 people were killed on U.S. roads.⁸ DSRC will enable drivers to avoid potential crashes and significantly reduce the number of lives lost and injuries caused on U.S. roads each year. In fact, the National Highway Transportation Safety Administration (“NHTSA”) estimates that DSRC can potentially address 81 percent of all vehicle crashes involving unimpaired drivers.⁹

The *Public Notice* seeks comment on existing and anticipated uses of the 5.9 GHz DSRC band.¹⁰ DSRC will include vehicle-to-vehicle (“V2V”), vehicle-to-infrastructure (“V2I”), and vehicle-to-pedestrian (“V2P”) communications, collectively referred to as “V2X,” that will improve overall vehicular and road safety. V2V communications enable vehicles to exchange data regarding heading, speed, and location (at a minimum) so that the vehicles can sense threats and hazards with a 360 degree awareness of the position of other vehicles and the threat or hazard they present; calculate risk; issue driver advisories or warnings; or assist in taking pre-emptive actions to avoid and mitigate the damage caused by crashes.¹¹

V2I communications enable vehicles to communicate with roadway infrastructure and mobile devices, and are “designed to avoid or mitigate vehicle crashes, particularly those crash scenarios not addressed by V2V alone, as well as provide mobility and environmental

⁸ NHTSA, DOT HS 812 269, Early estimate of motor vehicle traffic fatalities for 2015 (Jul. 2016), <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812269>.

⁹ NHTSA, DOT HS 811 381, Frequency of Target Crashes for IntelliDrive Safety Systems, at 15 (Oct. 2010), <http://www.nhtsa.gov/DOT/NHTSA/NVS/Crash%20Avoidance/Technical%20Publications/2010/811381.pdf>.

¹⁰ See *Public Notice* at 8.

¹¹ National Highway Traffic Safety Administration, DOT HS 811 753, Traffic Safety Facts: 2011 Data (2013), <http://www-nrd.nhtsa.dot.gov/Pubs/811753.pdf>.

benefits.”¹² For example, V2I allows traffic signals to be better sequenced. By dynamically adjusting signal phase and timing, road operators can reduce the potential for a collision when a vehicle runs a red light. Road operators can also sequence traffic signals to provide more green lights when pedestrians are not nearby and to create a more efficient flow of commercial vehicles through traffic corridors. Most of these applications are place-limited, and all leverage the characteristics of short-range communications offered in the 5.9 GHz DSRC band.

V2P communications are designed to enable vehicles on the road and nearby pedestrians to communicate with each other and warn both vehicles and pedestrians of impending harm. V2P is designed to warn drivers of potential collisions with pedestrians, and allow anyone with a DSRC-equipped smartphone to receive alerts about the dangers about nearby vehicles on the road, by generating data that can be used to determine the presence, speed, and direction of both pedestrian and vehicle, as well as the likelihood that the pedestrian is in a distracted state.¹³

DSRC safety applications, defined as both safety-of-life-and-property and public safety applications,¹⁴ have been designed to be deployed throughout all seven 10 MHz channels in the DSRC band.¹⁵ If all these applications are pushed to the top three DSRC channels, as the “re-channelization approach” envisions, the benefits of these potentially life-saving applications

¹² See U.S. Government Accountability Office, *Intelligent Transportation Systems: Vehicle-to-Infrastructure Technologies Expected to Offer Benefits, but Deployment Challenges Exist*, GAO-15-775, at 5 (Sept. 2015), <http://www.gao.gov/assets/680/672548.pdf> (“GAO 2015 Report”).

¹³ See, e.g., Kami Buchholz, *Honda Works to Prevent Vehicle-to-Pedestrian Accidents*, SAE INTERNATIONAL (Sept. 30, 2013), <http://articles.sae.org/12408/>; Andrew Handley, *How Honda’s V2V and V2P Technology Uses Smartphones to Save Lives*, QUARTSOFT.COM (Sept. 26, 2013), <http://bit.ly/29j89Zd>.

¹⁴ *Amendment of the Commission’s Rules Regarding Dedicated Short-Range Communication Services in the 5.850-5.925 GHz Band (5.9 GHz Band) et al.*, Report and Order, 19 FCC Rcd 2458 ¶¶ 32-34 (2004) (“5.9 GHz Report and Order”) (recognizing three classes of DSRC service, the first two of which directly impact the safety of the traveling public).

¹⁵ See, e.g., Letter from Ari Q. Fitzgerald, Counsel, the Alliance, et al., to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 2-3 (Apr. 14, 2016) (“April 14 Letter”).

could be lost or greatly reduced. The following graphic provides an illustration of how safety applications may use the various DSRC channels.¹⁶ Actual channel use will vary with time and location with many applications.

Critical DSRC Traffic

Illustrative DSRC Application-Channel Usage Map

	5.850	5.855	5.865	5.875	5.885	5.895	5.905	5915	5.925					
Guard Band	<u>172</u> SCH		<u>174</u> SCH		<u>176</u> SCH		<u>178</u> Control Channel		<u>180</u> SCH		<u>182</u> SCH		<u>184</u> SCH	
	Exclusively for vehicle-to-vehicle safety communications for accident avoidance and mitigation, and safety of life and property applications		Curve speed warning, Queue warning, Left turn assist, stop sign assist, Intersection violation, Disabled vehicle		Vulnerable road user safety, Automated driving, Certificate Revocation List, Coop. merge, Real-time communication services				Pre-crash mitigation, Distribution of remote sensor data, Platoon control, Cooperative adaptive cruise control, Advanced crash notification,		Work zone, Incident zone, Speed advisory, Heavy Vehicle inspection, Dangerous road conditions, GPS corrections		Exclusively for high-power, longer-distance communications to be used for public safety apps involving safety of life & property, including road intersection collision mitigation	

This is illustrative. Actual channel use will vary with time and location for many applications. A given application may be offered on more than one channel.

Furthermore, the DSRC application channel usage plan is being finalized at the Society of Automotive Engineers (“SAE”) for deployment use as follows:

- CH 172: Primarily V2V safety.
- CH 174: Primarily V2I safety and mobility.

¹⁶ See John Kenney *et al.*, *A response to the re-channelization proposal*, doc. IEEE 802.11-14/1101r1, at 10 (Sept. 5, 2014), <http://bit.ly/29CE75u>.

- CH 176: Primarily V2P and security information, such as certificate revocation list (“CRL”) distribution and update.
- CH 178: Control channel.
- CH 180: Primarily V2V safety, such as cooperative adaptive cruise control (“CACC”) and platooning.
- CH 182: Primarily V2I safety, such as work zone speed and road condition advisories.
- CH 184: Primarily for high-power, longer-distance public safety.

Combined, V2V and V2I hold great promise to enable the next generation of smart infrastructure and connected cars that can communicate and exchange data in real time to recognize high-risk situations before they occur and provide alerts and warnings to drivers.

While some of these applications might be labeled as “non-safety,” they cannot be easily separated from safety-of-life-and-property applications. For example, some V2I non-safety applications that depend on sensing vehicles at particular locations on the roadway are likely to depend on latency-sensitive basic safety messages (“BSMs”) and additional messages from vehicles to eliminate congestion and provide other benefits that enhance public safety. As another example, a “congestion ahead” warning could be considered a public benefit application because it enhances mobility; however, this application also has potential safety-of-life-and-property and public safety benefits because it is likely to help prevent rear-end collisions.

Examples of other band uses include the deployed and soon-to-be deployed connected vehicle sites that are currently using or will be using multiple DSRC channels. For example, the New York City Connected Vehicle Pilot deployment will use Channels 172, 174, 176, and 178 for the traditional V2X safety applications in addition to security-related critical safety information updates.

B. DSRC Services Hold Great Promise to Provide Significant Traffic Management Benefits.

According to the Texas A&M Transportation Institute, U.S. highway users wasted 6.9 billion hours stuck in traffic in 2014, costing \$160 billion.¹⁷ Certain DSRC applications will help reduce traffic congestion by allowing drivers to navigate the roads more efficiently, decreasing travel time, reducing congestion and increasing mobility. Real-time communications between and among vehicles and roadside infrastructure using V2V, V2I, and other DSRC technologies can shorten travel times, improve traffic flow, and improve traffic signal timing.¹⁸ In turn, DSRC technologies will provide substantial benefits to the U.S. economy by helping to reduce expenditures on gasoline and increase worker productivity by reducing commuting times, among other factors.¹⁹

C. DSRC Services Hold Great Promise to Provide Significant Environmental Benefits.

DSRC will also help mitigate the significant environmental damage caused by air pollution. Drivers used an additional 3.1 billion gallons of gasoline in 2014 due to traffic congestion.²⁰ The Environmental Protection Agency (“EPA”) estimates that transportation accounted for 26 percent of the 6,870 million metric tons of carbon dioxide (“CO₂”) that the U.S. emitted in 2014.²¹ Most of these emissions resulted from the operation of cars and light-duty trucks.²² DSRC traffic congestion mitigation applications have the potential to cause significant

¹⁷ David Schrank, *et al.*, *2015 Urban Mobility Scorecard*, Texas A&M Transp. Inst. (Aug. 2015), <http://bit.ly/1JHc4xM> (“*Urban Mobility Scorecard*”).

¹⁸ USDOT, *Beyond Traffic: Trends and Choices*, at 100-01 (2015), <http://bit.ly/29r2s14>.

¹⁹ *Urban Mobility Scorecard* at 5.

²⁰ *Id.*

²¹ EPA, *Sources of Greenhouse Gas Emissions*, <http://bit.ly/1N4r25f> (last visited July 3, 2016).

²² *Id.*

reductions in both CO₂ and conventional pollutants.²³ Because DSRC will help to prevent crashes, improve traffic flow, and reduce the time drivers spend in stop-and-go traffic, it will also provide corresponding benefits for the environment.

III. DSRC DEVICES AND APPLICATIONS HAVE BEEN DEVELOPED IN RELIANCE ON THE FCC’S EXISTING DSRC RULES, WHICH WERE CAREFULLY CRAFTED AND REFLECT A SOPHISTICATED UNDERSTANDING OF THE RF ENVIRONMENT AND DSRC’S RELIABILITY REQUIREMENTS.

A. The FCC Designed the Current 5.9 GHz Band Rules to Minimize Interference to DSRC.

The FCC carefully and deliberately structured the current 5.9 GHz DSRC rules to minimize interference to DSRC. The current DSRC channel plan illustrates this:

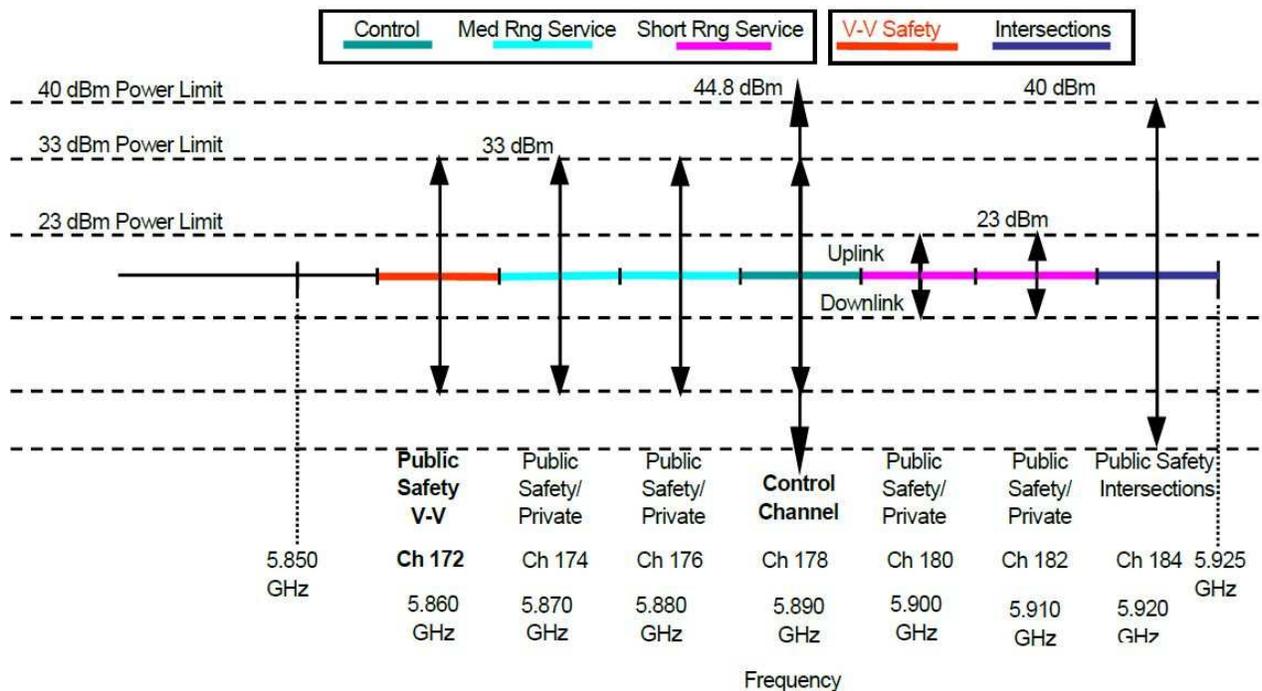


Figure 1: Band Plan for DSRC Channel Spectrum

²³ See, e.g., USDOT, *Transit Connected Vehicle Research Program*, <http://bit.ly/29r05ed> (last visited July 3, 2016).

All seven 10 MHz DSRC channels are available for safety-related communications. The FCC purposely set the lower-powered V2V safety-of-life channel at Channel 172 (5855-5865 MHz) so that it could be as far away as possible from the high powered DSRC public safety Channel 184 (5915-5925 MHz) to avoid inter-service interference.²⁴ The FCC also created a virtual guard band of 5 MHz between transmissions in the frequency band immediately below 5850 MHz to minimize interference to the critical V2V crash-avoidance applications on Channel 172.²⁵ Similarly, the DSRC control channel, Channel 178 (5885-5895 MHz), with higher power limits, and expected higher levels of data traffic, was purposely segregated from both of the designated safety-of-life-and-property channels (Channels 172 and 184) to minimize adjacent channel interference.²⁶ In addition, Channel 184 was placed at the upper end of the DSRC band, next to the fixed-satellite service (“FSS”) uplink spectrum beginning at 5925 MHz.²⁷ This placement was chosen because Channel 184 has a high maximum power allowance and because Channel 184 applications will be implemented at fixed locations, which can be planned to avoid interference from adjacent channel FSS uplink operations.²⁸ Safety applications that were not expected to require the high power of Channel 184, nor support heavy data usage over large geographic areas, were expected to use Channels 174, 176, 180 and 182.²⁹ These are not private service channels, carrying only non-safety communications, but rather first and foremost

²⁴ See *Amendment of the Commission's Rules Regarding Dedicated Short-Range Communication Services in the 5.850-5.925 GHz Band (5.9 GHz Band), Amendment of parts 2 and 90 of the Commission's Rules to allocate the 5.850-5.925 GHz Band to the Mobile Service*, Memorandum Opinion & Order, 21 FCC Rcd 8961 ¶ 13-17 (2006) (“2006 DSRC Order”) (explaining that “there are cases in which public safety concerns dictate exclusive use of frequencies.”).

²⁵ See NHTSA, *Vehicle-to-Vehicle Communications: Readiness of V2V Technology for Application*, DOT HS 812 014, at 93 (Aug. 2014), <http://bit.ly/1BtNawA> (“V2V Readiness”).

²⁶ See *id.* at 110.

²⁷ See *id.*

²⁸ See *id.*

²⁹ See *id.* at 115.

“safety” channels, which can be used for non-safety applications only when such uses will not interfere with the safety applications.³⁰

The FCC similarly found that the other 5.9 GHz DSRC band technical requirements would “serve an interference management purpose,” “facilitate effective and robust public safety communications,” and “help ensure that an adequate market develops for equipment that will meet the needs of [DSRC].”³¹ For example, channel sizes of 10 MHz “were developed to support DSRC in a mobile, high multi-path environment.”³² The FCC rejected requests to use a less restrictive mask formula in the DSRC band, explaining that it is “safer and in the public interest” to use the limit in the ASTM-DSRC Standard given the density of microwave links in the DSRC band because roadside unit (“RSU”) transceivers will be placed in close proximity to one another.³³ The FCC observed an “overwhelming majority of commenters supported” these requirements, which were grounded in the ASTM-DSRC Standard.³⁴ The FCC also observed the band plan itself was “supported by all commenters”³⁵ that “no commenter recommends changing the size of the channels.”³⁶

³⁰ The FCC determined that communications by certain entities, including state and local governments, should be presumed to be “public safety” priority communications. *See 5.9 GHz Report and Order* ¶ 33.

³¹ *See id.* ¶ 18.

³² *See id.* ¶ 26.

³³ *See id.* ¶ 37.

³⁴ *See id.* ¶ 35.

³⁵ *Id.* ¶ 26.

³⁶ *Id.*

B. Public and Private Stakeholders Have Engaged in Comprehensive Research and Testing in Reliance on the FCC’s Current DSRC Rules.

Today’s DSRC systems are the products of more than a decade of research and years of real-world testing – all of which relied on the FCC’s current DSRC channelization, channel bandwidth, and use restriction rules, and which have resulted in substantial capital investments.

For example, DSRC is the key communications technology that has been implemented at the Maricopa County Department of Transportation (“MCDOT”) SMARTDrive Testbed in Anthem, Arizona. MCDOT considers DSRC an essential and unique technology for safety of life V2I, V2V, and V2P communications. It chose to invest in DSRC technology once the FCC allocated the spectrum assigned for transportation applications in reliance on the FCC’s efforts in this area. The transportation industry has spent hundreds of millions of dollars on research and development in reliance on the FCC’s channel plan that has seven 10 MHz wide channels which accommodates the requirement for very low latency, stability, and reliability. MCDOT’s Multi-Modal Intelligent Traffic Signal System applications use channels 172, 178, and 182 according to the current channel plan.

In addition, comprehensive testing of DSRC under real-world conditions began four years ago in Ann Arbor, Michigan.³⁷ Sponsored by NHTSA and four other federal entities,³⁸ this testing included approximately 3,000 DSRC-equipped vehicles and 30 roadside infrastructure units, covered more than 73 lane-miles, and was designed to demonstrate DSRC performance in a real-world, multimodal environment.³⁹ Vehicles used DSRC to communicate information such

³⁷ See USDOT, *Research Data Exchange Release 2.3: Safety Pilot Model Deployment Data*, <http://www.its.dot.gov/factsheets/pdf/SafetyPilotModelDeployment.pdf> (last visited Jun. 28, 2016).

³⁸ The other sponsors were: the Intelligent Transportation Systems Joint Program Office, Federal Highway Administration, Federal Motor Carrier Safety Administration, and Federal Transit Administration. *See id.*

³⁹ *See id.*

as speed, location, and direction, at a frequency of 10 messages per second.⁴⁰ That program also evaluated Signal Phase and Timing (“SPaT”) technology and the performance of V2I applications, such as curve speed warning and warnings that alert transit bus drivers to the presence of pedestrians.”⁴¹ The information gained from this testing has been invaluable in validating the viability of DSRC.⁴²

Existing research has also led to significant advancements in V2I. For example, the Connected Vehicle Pooled Fund Study was created by state transportation agencies and “funds projects that facilitate the field demonstration, deployment, and evaluation” of V2I applications.⁴³ Its projects include the University of California at Berkeley and University of Arizona’s efforts “to develop and test an intelligent traffic-signal system that could, among other things, provide traffic signal priority for emergency and transit vehicles.”⁴⁴ State and local agencies have also created test beds to develop and test V2I applications, such as the one established by the Virginia Department of Transportation (“DoT”) and the University Transportation Center.⁴⁵

The significant research and testing activities conducted during the past 15 years by public and private partnerships that include car manufactures, the USDOT, universities, and others include the following and are partially depicted in Appendixes A and B:

⁴⁰ *See id.*

⁴¹ GAO 2015 Report at 12.

⁴² As the USDOT has explained, the testing has “significant research value” and generated data that could be used to improve transportation in the area in a number of ways – for example, by uncovering safety hot spots, developing algorithms to estimate travel times, and evaluating vehicle performance with lane-level precision. *See id.*

⁴³ *See id.* at 12-13.

⁴⁴ *See id.* at 13.

⁴⁵ *See id.* at 13-14.

- 2002-2004 – Determined initial communication requirements and standards for supporting DSRC-based safety applications.
- 2005-2006 – Developed and evaluated the Emergency Electronic Brake Light application and the first V2V cooperative active safety application.
- 2006 – 2009 – Developed and field tested an intersection safety application using DSRC V2I communications and developed a common vehicle safety communication architecture, protocols, and messaging framework to achieve interoperability among different vehicle manufacturers' applications. Began scalability testing of DSRC.
- 2010-2012 – Conducted research to address the technical issues related to interoperability, scalability, security, and data integrity of DSRC.
- 2011-2012 – Conducted driver clinics using prototype V2V safety applications.
- 2012-2014 – Conducted the Safety Pilot Model Deployment, a real-world operational environment with 3,000 DSRC equipped vehicles exercising V2V and V2I safety applications.
- 2014-2016 – NHTSA issued the Advanced Notice of Proposed Rulemaking (“ANPRM”) and prepared to release a Notice of Proposed Rulemaking that is expected to propose that all new light duty vehicles be required to include DSRC equipment.
- 2016 – As a product of the above, revised revisions of the Institute of Electronics Engineers (“IEEE”) 1609.2 (Security Services for Applications and Management Messages), IEEE 1609.3 (Networking Services), IEEE 1609.4 (Multi-channel Operation), and SAE J2735 (DSRC Message Set Dictionary) Standards were published and a new SAE J2945/1 (On-Board System Requirements for V2V Safety Communications) Standard was published.

In summary, fundamental development and testing of vehicle onboard units employing 5.9 GHz DSRC, based upon commercially-available IEEE 802.11a radio chipsets tuned to DSRC channel 172 and adjusted through device driver software to the 10 MHz bandwidth and particular modulation characteristics required for DSRC, was conducted in the mid-2000s. Thousands of

these prototype onboard units were built, and large-scale test track testing was conducted between 2009 and 2013, as shown in the following NHTSA research chart:⁴⁶

NHTSA V2V Research....

	2009	2010	2011	2012	2013
Track 1 Crash Scenario Framework	Analyze crash data and define target crash scenarios addressable by V2V. Develop high level performance requirements.				
Track 2 Interoperability and Security	Standards development for messages, data elements and protocols; Security system design, development and testing.				
Track 3 Benefits Assessment	Prototype characterization testing; performance measures; prior studies and field tests of crash avoidance systems; simulation and modeling				
Track 4 Applications Development	Build and test prototype applications; develop objective test procedures.				
Track 5 Human Factors	Driver-vehicle interface evaluations; Driver workload; Driver acceptance studies.				
Track 6 Policy Issues	Privacy impacts and studies; Security system governance; Business models; Retrofit and Aftermarket device considerations;				
Tracks 7, 8 Commercial & Transit	Specialized technical requirements (articulated vehicles); applications adaptation; participation in Safety Pilot.				

Foundational research sponsored by USDOT included standards development and proof of concept testing –and began in early 2000's

Of course, investment in DSRC technologies is not limited just to government entities or large companies with limitless sources of revenue. For example, Savari, Inc. (“Savari”) is a 55-person operation that has dedicated all of its resources since its inception in 2008 to supporting the development, validation, and deployment of DSRC for V2X safety.⁴⁷ After three years of

⁴⁶ Tim Johnson & Patrick Son, *If These Cars Could Talk: Connected Vehicles & Safety Technology* (Mar. 18, 2015) at 14, <http://bit.ly/29j4wqS> (“If These Cars Could Talk”).

⁴⁷ See, e.g., Savari, *Company*, <http://www.savari.net/company/> (last visited July 7, 2016).

grass roots funding efforts, Savari was able to begin developing its roadside unit.⁴⁸ Now, eight years later, and Savari has spent \$7 million, 100,000 hours, and millions of miles designing, testing, and validating the performance of the RSU.⁴⁹

The result of this substantial expenditure of time and resources is that DSRC technologies and applications based on the FCC's existing DSRC rules have "reached a level of stability that now support deployment,"⁵⁰ including:

- Large-scale testing and model deployments that have helped evolve the hardware and applications from pre-competitive prototypes into products that are being qualified to support a set of planned connected vehicle pilot sites – of which a first set was awarded in 2015 and second set will be awarded in 2017;
- Standards that have evolved to assure device interoperability;
- An initial security solution that has been tested under real-world conditions;
- A certification program that is under development and will result in test procedures that reflect DSRC performance requirements; and
- NHTSA's current rulemaking, as discussed above, is expected to require DSRC in all new light vehicles.⁵¹

NHTSA has recognized the importance of this collaborative research, development, and testing among regulators and stakeholders, observing that it has significantly advanced deployment of DSRC V2V technology.⁵² In 2013, it concluded that it had completed enough research and gathered enough positive evidence to proceed with a rulemaking to require 5.9 GHz

⁴⁸ See Savari, *Road-Side-Unit*, <http://www.savari.net/technology/road-side-unit/> (last visited July 7, 2016).

⁴⁹ Press Release, Savari, Inc., Savari Launches Next-Gen V2X Solutions to Accelerate Adoption of Safety Apps in Connected and Self-driving Cars (June 13, 2016), <http://bit.ly/29iV3ef>.

⁵⁰ See *If These Cars Could Talk* at 29.

⁵¹ See *id.*

⁵² NHTSA, *Vehicle-to-Vehicle Communications*, <http://bit.ly/29qGbiB> (last visited July 7, 2016).

DSRC capabilities in new vehicles.⁵³ As noted above, NHTSA released an ANPRM in 2014, and its Notice of Proposed Rulemaking (“NHTSA NPRM”) is currently under review by the Office of Management and Budget.

All of the testing discussed above, including the testing which undergirds NHTSA’s expected NPRM, was based on the FCC’s current DSRC rules, including Section 95.1511(a), which sets out DSRC’s channelization and how those channels are to be used.⁵⁴ If the FCC changes its rules at this late date in an effort to accommodate the business plans of parties who support a “re-channelization” approach, it would almost certainly undermine NHTSA’s and the private sector’s efforts, as discussed below in Section IV.

C. DSRC Deployments and Planned Deployments.

Deployments. The FCC seeks comment on the projected timeframe for introduction of DSRC applications under the current channel plan.⁵⁵ In fact, DSRC is now poised for widespread deployment after years of development and testing, and pilot deployments have occurred or are planned to occur in many areas. These deployments include at least 35 public sector applications that are related to public safety.⁵⁶

For example, General Motors (“GM”), an Alliance member, will deploy DSRC devices based on the FCC’s existing DSRC rules – including the existing channelization requirements – in its Model Year 2017 Cadillac CTS.⁵⁷ These vehicles will be equipped with FCC-compliant

⁵³ NHTSA, *Overview of NHTSA Priority Plan for Vehicle Safety and Fuel Economy, 2015 to 2017*, at 4, www.nhtsa.gov/staticfiles/nvs/pdf/NVS_priority-plan-June2015_final.pdf (last visited Jun. 22, 2016).

⁵⁴ See 47 C.F.R. § 95.1511(a).

⁵⁵ See *Public Notice* at 2.

⁵⁶ See, e.g., USDOT, *Connected Vehicle Pilot Deployment Program*, <http://bit.ly/1wg2Kbq> (last visited July 3, 2016) (providing the most recent reports from the New York City, Wyoming, and Tampa, Florida deployments).

⁵⁷ See Press Release, GM, Cadillac to Introduce Advanced ‘Intelligent and Connected’ Vehicle Technologies on Select 2017 Models (Sept. 7, 2014), <http://bit.ly/1SO5UMR>.

DSRC radios and will be available for purchase during calendar year 2016.⁵⁸ Meanwhile, during the next few months, there will be several safety-related DSRC V2I deployments in the U.S. that use DSRC channels other than Channel 172. According to a USDOT press release, New York City, Wyoming, and Tampa, Florida “will receive up to \$42 million to pilot next-generation technology in infrastructure and in vehicles to share and communicate anonymous information with each other and their surroundings in real time, reducing congestion and greenhouse gas emissions, and cutting the unimpaired vehicle crash rate by 80 percent.”⁵⁹ As part of the USDOT’s Connected Vehicle Pilot Deployments, planning has begun in New York City, along Interstate 80 in Wyoming, and in and around reversible freeway lanes in Tampa.⁶⁰

New York City will deploy 10,000 DSRC-equipped vehicles and 380 RSUs at signalized intersections in Manhattan and Brooklyn corridors.⁶¹ Planned applications for deployment in New York City include: Forward Crash Warning; Emergency Electronic Brake Lights; Blind Spot Warning; Lane Change Warning; Intersection Movement Assist; Red Light Violation Warning; Vehicle Turning Right in Front of Bus Warning; Curve Speed Compliance Warning; Speed Compliance/Work Zone/School Zone Warning; and Pedestrian in Signalized Crosswalk Warning.⁶² In addition, RSUs will be installed at other locations, including vehicle fleet terminals, river crossings, and airports, for communicating with DSRC-equipped aftermarket

⁵⁸ *See id.*

⁵⁹ *See* Press Release, USDOT, U.S. Department of Transportation Announces up to \$42 Million in Next Generation Connected Vehicle Technologies, http://www.its.dot.gov/press/2015/ngv_tech_announcement.htm (“USDOT Announces \$42 Million”).

⁶⁰ *See* USDOT, *Connected Vehicle Pilot Deployment Program*, <http://bit.ly/1wg2Kbq> (last visited July 3, 2016).

⁶¹ *See, e.g.*, USDOT Announces \$42 Million.

⁶² *See* Connected Vehicle Pilot Deployment Program Phase 1 *et al.*, *Concept of Operations (ConOps) – New York City*, at 17-18 (Apr. 8, 2016), <http://bit.ly/29tMvUG>.

safety devices.⁶³ These other locations will transfer performance data, provide security credentials, and fulfill other administrative functions.⁶⁴

The Wyoming Pilot will involve applications that use V2I and V2V connectivity to support a flexible range of services that improve safety and mobility.⁶⁵ The applications that will be deployed include: Road Weather Advisories and Warnings for Motorists and Freight Carriers; Weather-Responsive Variable Speed Limit System; Freight-Specific Dynamic Travel Planning; Spot Weather Impact Warning; Situational Awareness; and others to be determined by needs of truck drivers and fleet managers in the corridor.⁶⁶

The Tampa Pilot will deploy a variety of connected vehicle technologies on and within the vicinity of the Lee Roy Selmon Expressway reversible express lanes in downtown Tampa.⁶⁷ In addition to the Expressway, the deployment area includes bus and trolley services, high pedestrian densities, special event trip generators and highly variable traffic demand over the course of a typical day.⁶⁸ A primary objective of this deployment is to alleviate congestion on the roadway during morning commuting hours.⁶⁹ It will deploy a variety of V2V and V2I safety, mobility, and agency data applications to create reinforcing benefits for motorists, pedestrians, and transit operators.⁷⁰ The applications that will be deployed include: Curve Speed Warning;

⁶³ *See id.* at 4.

⁶⁴ *See id.*

⁶⁵ *See* Connected Vehicle Pilot Deployment Program Phase 1 *et al.*, *Security Management Operational Concept – ICF/Wyoming*, at 8 (Mar. 14, 2016), <http://bit.ly/29e8uRz>.

⁶⁶ *See id.* at 54-59.

⁶⁷ *See* Connected Vehicle Pilot Deployment Program Phase 1 *et al.*, *Security Management Operational Concept – Tampa (THEA)*, at 26 (May 2016), <http://bit.ly/29tP2hM>.

⁶⁸ *See id.* at 19.

⁶⁹ *See id.* at iii, 87.

⁷⁰ *See id.* at iii, 73-97.

Intelligent Traffic Signal System; Intersection Movement Assist; Mobile Accessible Pedestrian Signal; and Transit Signal Priority.⁷¹

Additional DSRC-enabled V2X deployments are being finalized for other parts of the country.⁷² For example, in New York, approximately 40 RSUs have been installed for urban application and traffic management around the Jacob Javits Center in Manhattan and along the Long Island Expressway.⁷³ The Virginia DoT installed more than 48 RSUs on I-495 and I-66 — major highways in Fairfax County, VA.⁷⁴ In Orlando, the Florida DoT has deployed 29 RSUs around the Orange County Convention Center for the purposes of interfacing with onboard equipment and connecting with Florida DoT's District Five SunGuide® advanced transportation management system.⁷⁵ Also in Florida, Kapsch TrafficCom has worked closely with Lee County's electronic toll collection system “to develop and host North America's first fully integrated 5.9 GHz DSRC open road tolling system with vehicle enforcement,” which includes “a high-performance automatic license plate recognition system using both infrared and white light cameras for each lane, as well as a laser vehicle classification system based on FHWA's axle estimation Scheme F.”⁷⁶ In Novi, Michigan, as many as 50 RSUs have been deployed “specifically designed to support DSRC testing in the 5.9 GHz Band” covering 45 square miles

⁷¹ *See id.* at 75, 87, 93.

⁷² *See, e.g.*, Press Release, Colorado Dept. Transp., HERE and Colorado Department of Transportation Announce First of its Kind Connected Vehicle Project in North America (Jan. 11, 2016), <http://bit.ly/1ZAxXbO>.

⁷³ Comments of Omniair Consortium, ET Docket No. 13-49, at 3 (May 28, 2013) (“Omniair Comments”).

⁷⁴ Kimley-Horn and Associates, Inc. & ch2m, I-66 Corridor Improvements Project: Transit/TDM Technical Report Draft, at 1-12 (May 12, 2105), *available at* <http://bit.ly/29oWRan>; Robert J. Sheehan, USDOT Connected Vehicle Research Program at 11 (2014), *available at* <http://bit.ly/29obtW6>.

⁷⁵ Florida DoT, *FDOT ITS Program Annual Report FY 2013-14*, at 16 (2014), *available at* <http://bit.ly/29zV68A>; Omniair Comments at 4.

⁷⁶ Ominair Comments at 4.

and covering signalized and un-signalized intersections.⁷⁷ Finally, for the PrePass Pilot I-70 Corridor project, “Kapsch, in collaboration with Help Inc., and Xerox, built an escreening Pilot Corridor with the objective of demonstrating the power of automated escreening utilizing 5.9 GHz DSRC [with] six inspection stations equipped with RSE in the I-70 corridor” to facilitate more accurate weighing of trucks traveling across the interstate.⁷⁸ Licensees run the gamut from government entities such as the Honolulu Board of Water Supply,⁷⁹ to private companies, such as Veniam, Inc.⁸⁰

Some of these deployments may be supported by federal transportation funding provided through the Fixing America’s Surface Transportation (“FAST”) Act,⁸¹ while others will be supported by state transportation funding.⁸² At the same time, the SAE International standards-setting process for V2P operations on Channel 176 is well underway and close to completion, and a DSRC pedestrian protection deployment will be launched in Lower Manhattan, New York

⁷⁷ *Id.* at 4-5; Fran Perry, Leidos CV Projects: Michigan CAV working Group Meeting, at 4 (May 28, 2016), <http://bit.ly/29n9Aq2>.

⁷⁸ Letter from Suzanna Murtha, Executive Director, OmniAir, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at Attach. (Apr. 9, 2014).

⁷⁹ Honolulu County created the Joint Traffic Management Center, an agency intended to coordinate six other state agencies and oversee the implementation and management of ITS programs for “reduc[ing] traffic congestion on the island of Oahu through the application of current technology in the operations of the county’s traffic signal and CCTV systems.” See Hoku Paa, *Joint Traffic Management Center*, <http://www.honolulu.gov/jtmc.html> (last visited July 5, 2016); Am. Council of Engineering Companies of Hawaii, *Workshop Registration Form*, <http://bit.ly/29p4htf> (last visited July 5, 2016).

⁸⁰ See, e.g., FCC, *Universal Licensing System*, Call Sign WQXP441, <http://bit.ly/29j8s6C> (last searched July 6, 2016)

⁸¹ See Pub. Law No. 114-94 (signed Dec. 4, 2015).

⁸² For example, the Colorado Department of Transportation committed \$20 million for 2016 to kick-start its RoadX program, which includes V2I deployment. See Colorado Dept. Transp., *Colorado’s Vision: RoadX*, at 7, <https://www.codot.gov/programs/roadx/roadx-vision> (last visited July 1, 2016).

City next year as part of the connected vehicle pilot activity.⁸³ These developments are in addition to NHTSA’s anticipated mandate.⁸⁴

In June 2016, the USDOT selected the city of Columbus, Ohio as the winner of its inaugural Smart City Challenge (“SCC”), a designation that brings with it \$40 million in USDOT funding – as well as up to \$100 million in private sector funding – to aid Columbus in “[reshaping] its transportation system to become part of a fully-integrated city that harnesses the power and potential of data, technology, and creativity to reimagine how people and goods move throughout their city.”⁸⁵ DSRC will play a central role in modernizing the city’s transportation system. The city plans to equip 175 intersections throughout 50 miles of roadways with DSRC RSUs.⁸⁶ These “smart” intersections will be able to communicate with at least 3,000 DSRC-equipped vehicles, including transit buses, city vehicles, trucks, school buses, and privately-owned vehicles.⁸⁷ Numerous V2X safety applications will be deployed, including Stopped Vehicle Ahead Warning, Emergency Electronic Brake Lights, Emergency Vehicle Signal Preemption, School Zone Safety Warning, and Pedestrian Safety Warning.⁸⁸ From a security standpoint, both the back-end and the in-vehicle systems will be fully operational to ensure the authenticity and integrity of the data exchange, as well as the overall security and privacy protections of the system.

⁸³ See Letter from David Schwietert, Executive Vice President, the Alliance, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49 at 2 (Jun. 2, 2016).

⁸⁴ See NHTSA, *Federal Motor Vehicle Safety Standards: Vehicle-to-Vehicle (V2V) Communications*, Advance Notice of Proposed Rulemaking, 79 Fed. Reg. 49270 (Aug. 20, 2014) (“ANPRM”).

⁸⁵ See Press Release, USDOT, U.S. Department of Transportation Announces Columbus as Winner of Unprecedented \$40 Million Smart City Challenge (June 23, 2016), <http://bit.ly/28QqhKz>.

⁸⁶ See City of Columbus, Solicitation No. DTFH6116RA00002, *Beyond Traffic: The Smart City Challenge Phase 2*, at 8 (May 24, 2016), available at <http://bit.ly/29A1fnH>.

⁸⁷ See *id.* at 15.

⁸⁸ See *id.* at 8, 9, 17.

Heavy-duty trucks equipped with DSRC, combined with adjustable SPaT information gleaned from DSRC-equipped RSUs, will demonstrate the potential safety and efficiency gains to be had through platooning. The Columbus SCC plan involves truck platooning and freight signal priority (“FSP”) for trucks in platoon, with both applications using DSRC.⁸⁹ DSRC-assisted truck platooning will allow for much closer headway between vehicles and stability of the formation, which translates into greater fuel efficiency and cost savings.

A number of pilot and research initiatives currently focus on DSRC-assisted truck platooning. For example, Peloton Technology, Inc. (“Peloton”) has logged more than 15,000 platooning miles and been showcased in on-highway demonstrations, government, private and fleet tests in Nevada, Utah, Texas, Ohio, Florida, Alabama and Michigan.⁹⁰ Demonstrations and fleet pilot deployments in additional states will be held later this year.⁹¹ In addition, Auburn University and the California Partners for Advanced Transportation Technology (“PATH”) are leading federally-funded research projects that focus on the potential reductions in fuel consumption, and the effects on safety, system robustness, and transportation.⁹² The American Trucking Association has indicated that Driver Assist Truck Platooning (Level 1) will occur in

⁸⁹ Press Release, The White House, *Fact Sheet: Obama Administration Announces Columbus, OH Winner of the \$40 Million Smart City Challenge to Pioneer the Future of Transportation*, (June 23, 2016), <http://bit.ly/28OLVji>.

⁹⁰ See Press Release, Peloton, Lockheed Martin Invests in Peloton Technology and Commercializing Truck Platooning (Aug. 31, 2015), <http://bit.ly/29IE1gD>.

⁹¹ Neil Abt, *Platoon Use to Begin in '16: Fleet to Implement System, Peloton CEO Says*, TRANSPORT TOPICS (Aug. 17, 2015), <http://bit.ly/29IEkI8>. Peloton is also participating in the California Energy Commission Freight Transportation Projects at California Seaports, featuring truck platooning and FSP, led by the Ports of San Diego and Los Angeles in two separate projects. See, e.g., California Energy Commission, *Solicitations for Transportation Area Programs*, <http://www.energy.ca.gov/contracts/transportation.html> (last visited July 3, 2016).

⁹² See, e.g., Auburn University, *Control: Evaluation, Testing, and Stakeholder Engagement for Near Term Deployment: Phase One Final Report* (Apr. 2015), <http://bit.ly/29dSPD7>; California PATH, *Truck Platooning*, <http://bit.ly/1NrNF2Z> (last visited July 2, 2016).

the 2016-2018 timeframe.⁹³ Benefits include: improved freight efficiency, fleet efficiency, safety, and highway mobility, along with reduced emissions.⁹⁴

Market Penetration. The Commission seeks comment on what market penetration is needed for DSRC to reliably provide safety-of-life functions or prevent collisions. V2V crash-imminent safety applications do not require ubiquitous fleet penetration to yield significant public benefits. Researchers estimate that most of these applications can achieve significant safety benefits at 30 to 40 percent fleet penetration.⁹⁵ Some of these applications, such as emergency electronic brake lights, are projected to achieve significant safety benefits at penetration rates of as little as 20 percent.⁹⁶

IV. OF THE SHARING APPROACHES UNDER CONSIDERATION, “DETECT AND AVOID” IS FAR SUPERIOR TO “RE-CHANNELIZATION.”

The FCC poses several questions regarding the merits of the “detect and avoid” sharing approach versus the “re-channelization” approach, as well as the impact that each may have on the timely deployment of DSRC.⁹⁷ For example, the FCC asks parties to identify “the benefits and drawbacks of each approach” and whether “one approach [is] better than the other.”⁹⁸ The “detect and avoid” is superior on the merits to “re-channelization” because, among other things, it would minimize the risk of harmful interference to “safety-of-life” DSRC, would not require

⁹³ See Am. Trucking Assoc. Tech.& Maint. Council, *Automated Driving & Platooning Issues & Opportunities*, Information Report TMC 2015-2, at 18-19 (Dec. 2015), available at <http://bit.ly/29oa02b>.

⁹⁴ See *id.*

⁹⁵ *V2V Readiness* at 296-97.

⁹⁶ See Michele Segata *et al.*, *Emergency Braking: A Study of Network and Application Performance* (Nov. 30, 2011), <http://bit.ly/29jXZZo>.

⁹⁷ See, e.g., *Public Notice* at 6-7.

⁹⁸ *Id.* at 7.

lengthy re-testing of DSRC equipment and applications, and would allow DSRC deployment to continue as scheduled.

A. In Contrast to the “Re-channelization” Approach, the “Detect and Avoid” Approach Would Minimize the Risk of Interference to “Safety-of-Life” DSRC While Making Significant 5.9 GHz Spectrum Available for Unlicensed (Including Wi-Fi) Use.

“Detect and avoid” is the most promising sharing solution because it is designed to work around DSRC operations and allow the spectrum to be used for U-NII operations only when and where DSRC devices are not operating. This would allow W-Fi operations in the band without setting back, limiting, or delaying DSRC deployment. Specifically, the “detect and avoid” approach should not require any redesign of any DSRC system, which in turn will allow the anticipated NHTSA rulemaking to proceed in a timely fashion. Further, currently deployed DSRC applications, vehicles, and RSUs would not need to be reconfigured or abandoned.

As noted above, a great deal of testing and analysis has been conducted to arrive at the current DSRC system design under the FCC’s existing spectrum allocation and rules. The complexities of developing and approving vehicle safety applications in a highly-regulated environment, and the variations in vehicle crash scenarios, demanded this rigorous testing and development. Of the potential sharing concepts discussed in the *Public Notice*, only the “detect and avoid” concept allows for use of the current DSRC system design. As described in more detail below, requiring a system redesign for incumbent DSRC, as envisioned by the “re-channelization” concept, would seriously delay the realization of DSRC’s safety benefits and likely prevent the implementation of many of its planned safety applications.

The “re-channelization” approach would at best delay DSRC deployment. At worst, it would dramatically limit the functionality of DSRC applications. At its heart, the “re-channelization” concept favors the expansion of commercial Wi-Fi to the detriment of safety-of-

life DSRC. Forcing applications previously planned for DSRC onto Wi-Fi protocols, while likely advantageous for commercial Wi-Fi proponents, is not the equivalent of allowing unlicensed users to share licensed spectrum with incumbent users without causing harmful interference. Moreover, “re-channelization” could eliminate or crowd out important V2I, V2P, and V2X uses from the remaining three DSRC-exclusive “safety channels.” There also would not be a guard band between the DSRC-exclusive “safety channels” and the remaining 40 MHz shared by DSRC and Wi-Fi under the “re-channelization” approach.⁹⁹

If the “re-channelization” concept required any DSRC spectrum users on the lower four channels to only use Wi-Fi technology that has not been optimized for the high-mobility transportation environment (*i.e.*, vehicles traveling at highway speeds) and has not been proven through testing to meet the communications requirements of these applications, then test plans and appropriate equipment will need to be developed to determine the basic feasibility of these types of communications for the affected applications. Testing at that level would require the development of onboard and roadside units with integrated commercially-available Wi-Fi radio links in order to complete appropriate testing for feasibility.

It is also not clear whether V2I, V2P, or V2X applications can be accommodated in the lower channels at the same time that Wi-Fi is operating there. Once the “re-channelization” proposal is defined in sufficient detail, determining the feasibility of shared use would require significant additional testing in the presence of expected levels of unlicensed transmissions on that portion of the DSRC band.

⁹⁹ See *Public Notice* at 7.

Parties would be able to better assess the “re-channelization” approach if they had more information regarding a number of key issues. These include:

- 1) The proposed re-channelization for DSRC in the lower, shared, 40 MHz of the 5.9 GHz band (*i.e.*, 5855-5895 MHz). For example, would DSRC continue to operate in four 10 MHz channels, as under the current channelization, or two 20 MHz channels? The *Public Notice* suggests that the four lower 10 MHz channels would become two 20 MHz channels,¹⁰⁰ and previous presentations by “re-channelization” advocates have not been clear on this issue.¹⁰¹
- 2) How U-NII and DSRC operations would share the U-NII-4 band under the “re-channelization” approach. What specific priority mechanism would be used and how would it ensure no interference to DSRC operations in the shared channels? As late as June 16, 2016, “re-channelization” proponents seemed to still be discussing proposals.¹⁰²
- 3) Whether and how the designations currently assigned to DSRC channels (*e.g.*, Channels 172 and 178) would need to change if the operations that are currently designated for these channels need to occur in the upper 30 MHz of the 5.9 GHz DSRC band (*i.e.*, Channels 180, 182, and 184).
- 4) Moving all safety-of-life DSRC operations to the upper 30 MHz of the 5.9 GHz DSRC band. Have “re-channelization” proponents quantified or modeled the U-NII-4 adjacent channel operation to better understand the impact to DSRC safety services in the upper 30 MHz DSRC channels from a channel availability and/or interference perspective? Can this analysis be provided?

Although many important details regarding the “re-channelization” concept have not been revealed, it seems to propose that those other “non-safety” ITS, and possibly even some public safety applications (V2I, V2P, V2X), just use current Wi-Fi communications protocols on 20 MHz channels in the lower portions of the current DSRC band that would be shared with unlicensed Wi-Fi users. It is not clear from any known documentation of the “re-channelization” concept, however, exactly what is being proposed for DSRC and Wi-Fi sharing of the lower four DSRC channels. Proponents of the “re-channelization” concept should clarify their proposal in order to allow a more thorough analysis. At the current level of documentation, the re-channelization concept is not a defined technical approach. Such a concept is not able to be tested, even at the proof-of-concept level, without further definition. Clarification of the re-channelization proposal must be provided before any detailed test plans can be constructed.

¹⁰⁰ See *Public Notice* at 7.

¹⁰¹ See, *e.g.*, Qualcomm, *Proposal for DSRC Band Coexistence* (Oct. 11, 2013), <http://bit.ly/1NbSXuy> (“*Qualcomm Proposal*”).

¹⁰² See, *e.g.*, *id.*

B. The “Detect and Avoid” Approach Would Not Require a Redesign of the FCC’s Existing DSRC Rules (e.g., Band Plan, Channelization, and Channel Use Designations) and, as a Result, Would Not Slow DSRC Deployment.

The FCC seeks comment on whether and by how much “re-channelization” would affect the timeframes for DSRC deployments.¹⁰³ As discussed above, “re-channelization” would significantly slow DSRC deployments because it would disrupt and possibly scrap the many years of research and development that was based on the FCC’s existing DSRC rules.

Although the FCC’s DSRC rules channelize DSRC into seven 10 MHz-wide channels,¹⁰⁴ the “re-channelization” concept calls for changing the channelization for the lower 40 MHz of the DSRC band from 10 MHz to 20 MHz channels.¹⁰⁵ This would require new efficacy testing and run counter to the current body of DSRC research, which has established the superiority of 10 MHz channels for latency-sensitive DSRC applications.¹⁰⁶

C. The “Detect and Avoid” approach Would Not Require a New Round of RF Compatibility and DSRC Viability Testing.

The FCC seeks comment on whether changing the DSRC channel plan would require re-testing of DSRC equipment or applications.¹⁰⁷ If the “re-channelization” approach is adopted, most of the DSRC research and testing that has already been completed will need to be redone. This would come at great expense to stakeholders as well as the American public, who would be deprived of the significant benefits of DSRC during this lengthy period. Although it is difficult

¹⁰³ See *Public Notice* at 8.

¹⁰⁴ See 47 C.F.R. § 90.377; *5.9 GHz Report and Order* ¶¶ 25-29.

¹⁰⁵ See, e.g., *Qualcomm Proposal* at 12.

¹⁰⁶ See, e.g., Lijian Xu et al., *Communication Information Structures and Contents for Enhanced Safety of Highway Vehicle Platoons*, at 11-12, <http://bit.ly/29Edrnh> (last visited July 7, 2016) (explaining that using 10 MHz channels for DSRC “brings better wireless channel propagation with respect to multi-path delay spread and Doppler effects caused by high mobility and roadway environments”).

¹⁰⁷ See *Public Notice* at 7.

to predict the precise length of this period, the Commission should expect it to be comparable to the amount of time it took to develop DSRC in the first place.

For example, significant testing would need to be conducted to determine whether the currently planned V2I, V2P, and V2X safety applications would cause harmful interference to the V2V crash-imminent safety applications when compressed onto adjacent channels. Moreover, there is an expectation that many new V2I, V2P, and V2X safety applications will be developed, and these would need to be accommodated in the three designated “safety channels” in the proposed “re-channelization” approach. Testing using only planned applications, therefore, would not assess the impact of these future applications.

Further, as implied in the Commission’s test plan discussion,¹⁰⁸ V2V crash-imminent safety testing would have to be repeated to validate that the applications work reliably and consistently in the new channel structure. Changing the dedicated DSRC channel assignments and related characteristics would require re-testing the DSRC communications reliability for crash-imminent V2V safety applications in the context of heavily-used, high-powered, adjacent DSRC channels, unlicensed radio communications on lower adjacent channels, unknown out-of-band interference from upper adjacent band usage, and same-channel interference at the upper end of the DSRC spectrum from other incumbent 5.9 GHz users. Such re-testing would be necessary within congested vehicle traffic environments incorporating the new channel assignments with the presence of representative interferers (both other DSRC in-band interferers and expected out-of-band interferers) in order to re-establish the data required for NHTSA to impose through rulemaking a requirement for DSRC capabilities in light and heavy vehicles.

¹⁰⁸ *See id.* at 11.

Depending upon the results of fundamental lab testing related to the in-band interference levels caused by compressing all DSRC safety-of-life-and-property and public safety applications into just 30 MHz of DSRC-exclusive spectrum, rather than the current 75 MHz, a redesign of DSRC channel maximum power limits, physical layer standards and compliant radio hardware may be necessary in order to meet the communications requirements of crash imminent V2V safety applications. NHTSA would be expected to require positive results from such testing and redevelopment before proceeding with a result to require DSRC capabilities in new vehicles. In addition, V2I public safety and other ITS uses of the DSRC spectrum for the public good, other than for crash- imminent safety applications, may need to be eliminated or moved to other spectrum bands.

Examples of the types of testing that was conducted and that would need to be redone include both laboratory and test track testing. The laboratory testing that would need to be completed would include, for example:¹⁰⁹

- 1) Receiver Tests – typical tests:
 - a. Reference sensitivity;
 - b. Dynamic range;
 - c. Blocking characteristics;
 - d. In channel sensitivity;
 - e. Fading impacts; and
 - f. Adjacent channel rejection (“ACR”).
- 2) Receiver Tests under Fading Conditions
 - a. Repeatable real time fading simulation with Rice, Doppler, etc.
- 3) Receiver Tests with Interference – performance with:
 - a. In-band interference;
 - b. Adjacent channel interference; and

¹⁰⁹ See Rhode & Schwarz, Intelligent Transportation Systems Using IEEE 802.11p, Application Note, http://www.rohde-schwarz.de/file_12631/1MA152_2e.pdf (last visited July 7, 2016).

- c. Spurious interference.
- 4) Transmitter Tests – typical tests:
- a. Transmit power;
 - i. Transmit signal quality, such as modulation and error vector magnitude (“EVM”);
 - b. Output spectrum such as occupied bandwidth; and
 - c. Out-of-band measurements such as adjacent channel leakage ratio (“ACLR”) or spurious.

If laboratory tests, such as the examples described above, identify any significant differences in transmitter or receiver performance as a result of compressing DSRC safety-of-life and public safety communications into only three 10 MHz channels at the higher end of the DSRC band, then new chipsets will likely need to be developed and integrated into onboard and roadside DSRC equipment and then re-tested to ensure equivalent performance levels.

Depending upon the results of the re-tests, the fundamental DSRC physical layer standards in the IEEE 802.11 standards may need to become more restrictive, particularly with regard to spectrum mask requirements for transmitters and adjacent channel interference rejection requirements for DSRC receivers. Current spectral masks in the relevant IEEE 802.11 standards are illustrated in the following diagram:¹¹⁰

¹¹⁰ See *id.* at 9.

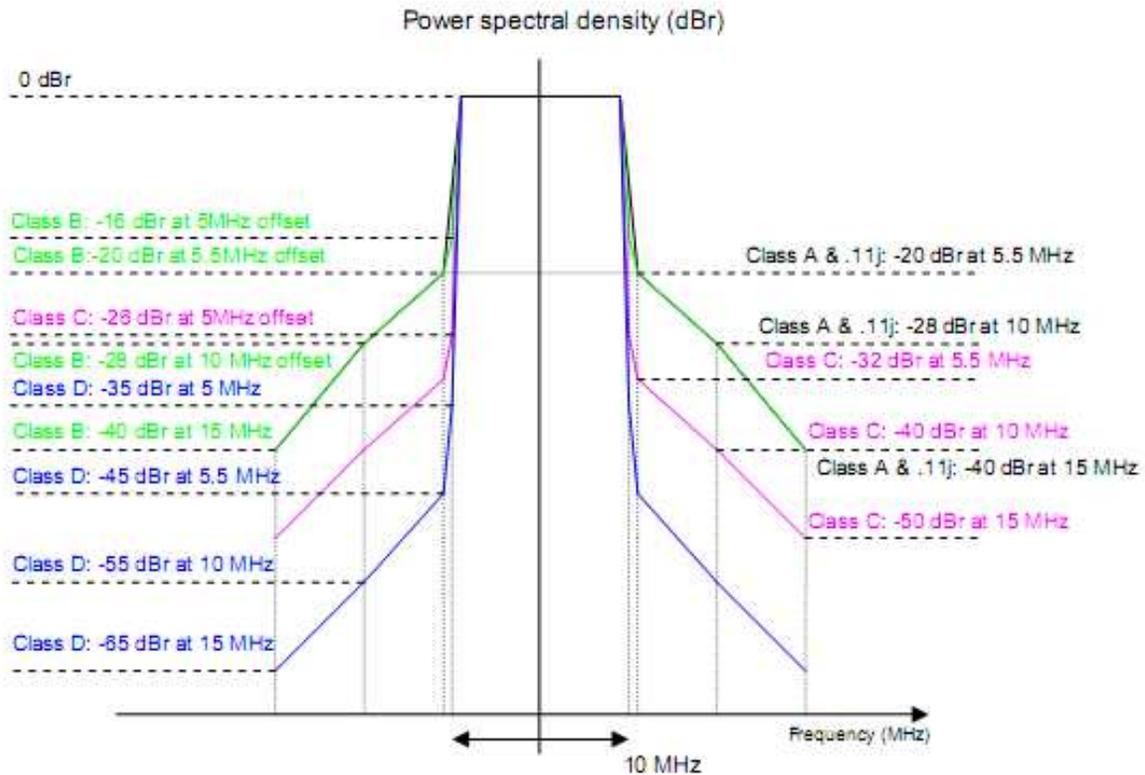
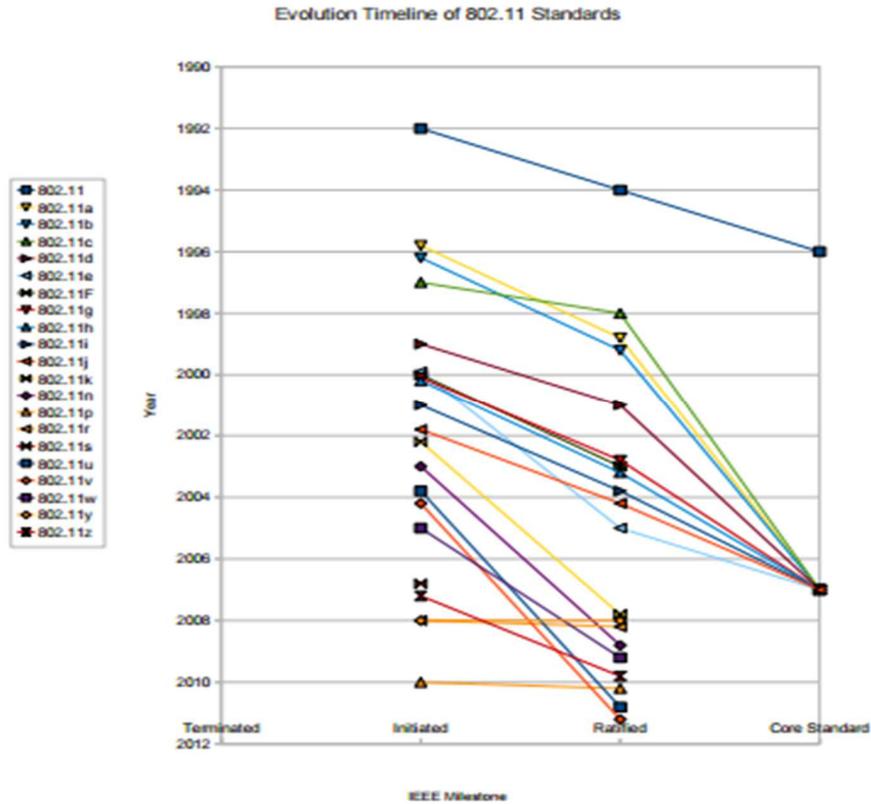


Figure 7: – IEEE 802.11p spectrum masks (10 MHz channel spacing)

Changing the 802.11 standard to make it more restrictive will take a significant amount of time. The entire IEEE 802.11 standard spans over 1,200 pages. First adopted in the early 1990's, its history shows that each change or addition to the standard takes a significant amount of time. The following is a timeline of the evolution of the 802.11 standard:¹¹¹

¹¹¹ Justin Berg, *The IEEE 802.11 Standardization, Its History, Specifications, Implementations, and Future*, Technical Report GMU-TCOM-TR-8, at 5-6, <http://bit.ly/29t1pvq> (last visited July 7, 2016).



Therefore, revising or adding to the 802.11 standard will likely take multiple years.¹¹²

Spectrum mask changes in the standards would most likely require the development of dedicated DSRC radio chipsets, rather than allowing use of existing, commercially-available IEEE 802.11 Wi-Fi chipsets. This would be a costly and time-consuming process. Moreover, given that the current DSRC spectral mask requirements (which are discussed below) are already very difficult to satisfy, more stringent requirements would be even more difficult and expensive to meet.¹¹³

¹¹² See *id.*, at 4 (“In July 2000, the 802.11 Task Force G was assigned the task of overlaying the OFDM waveform on the 2.4 GHz spectrum, producing a new standard that was fully backward-compatible with the 802.11b standard. *This was no easy feat, but after 3 years the new standard was ratified.*”) (emphasis added).

¹¹³ See Think Pham, *et al.*, *Shaping Spectral Leakage for IEEE 802.11p Vehicular Communications*, VEHICULAR TECHNOLOGY CONFERENCE (VTC SPRING), May 2014, at 18, <https://kar.kent.ac.uk/51748/> (“Four Spectrum

Subsequently, new field tests would need to be conducted with different characteristics at the new channel settings to determine if crash-imminent safety applications could be effectively supported under the various expected field conditions. Examples of the types of field testing that would need to be repeated with new hardware (chipsets) and different performance values are:

- 1) Baseline Scalability Tests
 - a. Packet error rate (“PER”) vs. Range for Vehicle Pairs;
 - b. PER vs. Received Signal Strength (“RSS”) and PER vs. Range for Multiple Remote Vehicles (“RVs”); and
 - c. Inter Packet Gap IPG Distribution.

- 2) Non-Baseline Static Scalability Tests
 - a. PER vs. Message Size;
 - b. PER vs. Message Transmit Rate;
 - c. PER vs. Data Transmit Rate;
 - d. PER vs. Data Transmit Rate vs. Range; and
 - e. PER vs. Data Transmit Rate vs. RSS.

- 3) Moving Scalability Test Results
 - a. Interpreting the Charts;
 - b. PER Comparison for Channel Configuration C2 vs. C3;
 - c. Cumulative PER for Moving Host Vehicle (“HV”) with Moving Blocking RV;
 - d. Cumulative PER for Moving HV w/ Moving Semi-Blocking RV;
 - e. Cumulative PER for Stationary HV; and
 - f. PER Comparison for Stationary vs. Moving Vehicle Tests.¹¹⁴

This type of field testing culminates with large-scale test track testing, using many vehicles to create a “congested traffic” environment. This testing would need to be repeated to

Emissions Masks (SEMs) specified in IEEE 802.11p are much more stringent than those for current 802.11 systems. In addition, the guard interval in 802.11p has been lengthened by reducing the bandwidth to support vehicular communications (VC) channels, and thus results in a narrowing of the frequency guard. This raises a significant challenge for filtering the spectrum of 802.11p signals to meet the specifications of the SEMs.”); ARNIC Corp., Comments on Petition for Reconsideration, WT Docket No. 01-90, ET Docket No. 98-95 (Oct. 27, 2004).

¹¹⁴ NHTSA, *Vehicle Safety Communications– Applications Final Report: Appendix 2 Communications and Positioning*, at I-1–I-23 (Sept. 2011), <http://bit.ly/29h33jR>.

determine how the communications perform under the “re-channelization” approach in realistic scenarios. The following picture and diagram demonstrate the scale and complexity of such test track testing:¹¹⁵

PHASE 1 SCALABILITY TESTING

100 and 200 vehicle tests



¹¹⁵ USDOT, *V2V Interoperability Project*, USDOT ITS Connected Vehicle Workshop at 9-10 (Sept. 25, 2012), <http://bit.ly/29lhy7j>.



Moreover, the SAE DSRC Technical Committee would need time to develop new technical requirements under the “re-channelization” approach. The committee required nine years to develop performance requirements for the on-board equipment’s (“OBE”) BSM transmission function, which are based on the assumption of a dedicated channel (Channel 172) without interference. The committee’s standards are built on a deep understanding of the proven technology and the results of hundreds of vehicle hours of dynamic testing on radio signal reception and application-level performance. If the 5.9 GHz DSRC band is “re-channelized” and BSM transmissions are moved to one of the upper three DSRC-only channels, that would introduce interference concerns that would need to be further researched before safety applications could be allowed to operate in the new, presumably more congested, RF environment. Channel 180 would be adjacent to a re-banded 20 MHz Wi-Fi channel with likely high data traffic; Channel 182 would be adjacent to high-power Public Safety Channel 184. None of these channels’ characteristics resembles current Channel 172. The re-channelized BSM transmission radio reception and application performance would need to be re-examined, and the resulting data would need to be analyzed and considered by the SAE DSRC Technical

Committee before a revision and balloting process could begin. This process would likely take at least two to three years to complete.

D. Existing DSRC OBU and RSU Equipment Would Not Have to be Altered in Any Way Under the “Detect and Avoid” Approach, While Changes Would Be Necessary Under the “Re-channelization” Approach.

The FCC seeks comment on whether the “re-channelization” approach would “require any change in the design of DSRC electronic components contained in DSRC prototypes or just require a change in the processing of the data.”¹¹⁶ Re-channelization would likely require a redesign of the overall DSRC system, including redesign of the DSRC electronic components. For example, such a redesign would likely require specialized chipsets, rather than the readily-available, generic Wi-Fi chipsets currently used in production DSRC devices.

One of the main concerns we have with “re-channelization” involves the congestion that would occur if only three channels were dedicated to DSRC applications rather than the seven channels that are currently provided. This is particularly troublesome because safety-of-life-and-property applications and public safety applications have been planned for all seven DSRC channels. This compression of safety-of-life-and-property applications and public safety applications will increase the same-channel interference levels, as well as create additional data traffic on adjacent DSRC channels, thereby increasing adjacent channel interference within the proposed three dedicated DSRC channels.

In fact, researchers continue to emphasize that “the major source of interference in vehicular communications systems is the cross-channel interference, generated by nodes

¹¹⁶ See *Public Notice* at 7.

communicating in the adjacent channels.”¹¹⁷ Such adjacent channel interference can “severely compromise the integrity of the messages received by a [DSRC] radio unit.”¹¹⁸ Therefore, the increased in-band DSRC interference caused by compressing all the DSRC safety and potentially other V2I mobility and environmental applications requiring DSRC-level performance into 30 MHz rather than 75 MHz would need to be estimated, simulated, and tested.

To illustrate this, members of the Crash Avoidance Metrics Partnership (“CAMP”) Vehicle Safety Communications 2 (“VSC2”) Consortium tested prototype DSRC radios to see how cross-channel interference (“CCI”) affects packet reception probability.¹¹⁹ In each test, a target transmitter sent BSMs to a receiver in the target channel while an interferer sent signals in a different channel.¹²⁰ The primary metric for analyzing the CCI effects was PER.¹²¹ Two of the factors investigated were: (1) the spectral distance between the channel on which the BSM is transmitted and the channel on which the interfering signal is transmitted; and (2) the ratio of the BSM transmitter-to-receiver distance to the interferer-to-receiver distance.¹²²

As explained in NHTSA’s report, the tests showed that adjacent channel interference can create a substantial PER when the transmitter-to-receiver distance is an order of magnitude or more than the interferer-to-receiver distance.¹²³ This can be seen in the table below, where the

¹¹⁷ See João Almeida *et al.*, *Mitigating Adjacent Channel Interference in Vehicular Communications Systems*, DIGITAL COMMUNICATIONS AND NETWORKS, at 58 (May 2016), <http://bit.ly/29k8teO>.

¹¹⁸ See *id.*

¹¹⁹ See NHTSA, *Vehicle Safety Communications – Applications (VSC-A) Final Report: Appendix Volume 2 Communications and Positioning* (2011), <http://bit.ly/29h33jR> (“CAMP VSC2 Report App. Vol. 2”).

¹²⁰ See *id.* at D-2-5.

¹²¹ See *id.* at D-1-7.

¹²² See *id.* at D-2-9.

¹²³ See *id.*

transmitter (“TX”) and the receiver (“RX”) were in the target Channel 172 and the interferer was in the adjacent Channel 174.¹²⁴

RX - Interferer Distance (meters)	60						0%
	40					0%	10%
	30				0%	1%	80%
	25				0.5%	80%	99%
	20				40%	90%	100%
	15	0%	1%	40%	92%	95%	100%
	12.5	0.10%	1.50%	70%	98%	100%	100%
	10	0.90%	35%	99%	100%	100%	100%
	7.5	15%	95%	100%	100%	100%	100%
	5	55%	98%	100%	100%	100%	100%
2.5	95%	100%	100%	100%	100%	100%	
Legend:	15	25	50	100	150	200	
PER >10%	RX-TX Distance (meters)						

Non-adjacent channel interference is usually less of an issue, but it is still a factor in some environments, such as where a power asymmetry condition exists. The following table describes the results when the transmitter (“TX”) and receiver (“RX”) were operating on Channel 172 at different distances and with different transmit powers. The interferer (“Int”) was placed on non-adjacent Channels 176 and 178 at a fixed distance from the receiver and had a fixed power.¹²⁵

¹²⁴ See Vinuth Rai *et al.*, *Cross-Channel Interference Test Results: A report from the VSC-A project*, doc.: IEEE 802.11 11-07-2133-00-000p, (July 2007), <http://bit.ly/29vu0R7>.

¹²⁵ See *id.*

TxRx Dist	Int CH	Tx Power	Int Power	RxInt Dist	Rx PER
25m	176	20dBm	20dBm	2.5m	0%
25m	176	15dBm	20dBm	2.5m	0%
25m	176	10dBm	20dBm	2.5m	0%
50m	176	20dBm	20dBm	2.5m	0%
50m	176	15dBm	20dBm	2.5m	0%
100m	176	20dBm	20dBm	2.5m	0%
100m	176	15dBm	20dBm	2.5m	20%
100m	176	10dBm	20dBm	2.5m	100%
100m	178	20dBm	20dBm	2.5m	0%
100m	178	15dBm	20dBm	2.5m	22%
200m	176	20dBm	20dBm	2.5m	0%
200m	176	15dBm	20dBm	2.5m	0%
200m	176	10dBm	20dBm	2.5m	100%
200m	178	20dBm	20dBm	2.5m	0%
200m	178	15dBm	20dBm	2.5m	0%
200m	178	10dBm	20dBm	2.5m	100%

The FCC’s current seven-channel DSRC environment allows technical rules for channels that are adjacent to safety-critical high-availability and low-latency channels to be tailored to minimize the CCI effects. For example, to protect BSM reception on Channel 172, usage of adjacent Channel 174 could be targeted for applications in which most transmissions originate at roadside units at some distance from BSM receive antennas. A power restriction on Channel 174 could also be considered. However, if all DSRC safety applications are compressed into just 30 MHz of DSRC-exclusive spectrum, the volume of DSRC traffic on in this spectrum will likely lead to severe CCI issues among DSRC safety operations.

The data above also suggest that re-channelization, which envisions simultaneous U-NII transmissions and DSRC safety transmissions in the 5.9 GHz band, would create a high risk of interference from U-NII to DSRC safety communication. This risk is heightened by two considerations. First, DSRC transmitters are subject to a very strict transmit spectral mask. By contrast, U-NII transmitters are only regulated with respect to out-of-band emissions. If the U-

NII-4 out-of-band emissions (“OOBE”) limits proposed in the 2013 NPRM were in place,¹²⁶ U-NII interference limits into Channels 180, 182 and 184 would be higher than DSRC CCI resulting from transmissions in Channels 172-178 (assuming transmissions at or below 20 dBm that conform to the Class C transmit spectral mask). Second, the Commission’s rules consider interference between licensed devices on a different basis compared to interference from a Part 15 device to a licensed device. Interference between licensed devices (*e.g.*, DSRC CCI) is to be reduced through cooperation,¹²⁷ whereas operation of a Part 15 device is subject to the constraint that “no harmful interference is caused.”¹²⁸

E. Existing Mitigation Testing Demonstrates the Viability of the “Detect and Avoid” Approach.

The Commission seeks comment on research, testing, or analyses of the potential methods for allowing incumbent DSRC to share the 5.9 GHz band with U-NII devices.¹²⁹ The DSRC Coexistence Tiger Team (“Tiger Team”) process provided a key forum for engaging all of the relevant stakeholders on the 5.9 GHz sharing issue. Over a twenty-month period, a broad cross-section of interested parties from the wireless local area network (“WLAN”) and automotive industries analyzed, discussed, and debated various sharing proposals.¹³⁰

As observed in the *Public Notice*, the Tiger Team did not reach a consensus on either of the proposed sharing methods.¹³¹ However, as the Alliance and Global Automakers explained to

¹²⁶ See *Revision of Part 15 of the Commission’s Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 1769 (2013).

¹²⁷ 47 C.F.R. § 95.1511.

¹²⁸ 47 C.F.R. § 15.5.

¹²⁹ See *Public Notice* at 8.

¹³⁰ See, *e.g.*, Letter from Ari Q. Fitzgerald, Counsel, the Alliance, *et al.*, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 2 (Mar. 25, 2015) (“Alliance *et al.* Tiger Team Letter”).

¹³¹ See *Public Notice* at 6.

the FCC last year, the Tiger Team’s final report reveals two key conclusions.¹³² First, there was a clear preference among all stakeholders for the “detect and avoid” concept.¹³³ Second, even the WLAN community was divided as to whether to support the “re-channelization” concept.¹³⁴

Additionally, the Alliance, Global Automakers, DENSO, and Cisco Systems, Inc. (“Cisco”) recently completed initial feasibility testing of the “detect and avoid” approach.¹³⁵ Cisco developed the V2X detector portion of its mitigation equipment.¹³⁶ It then obtained three software defined radios, each of which could be operated as DSRC 802.11 detectors on channels 172, 174, 176, and 178.¹³⁷ Cisco calibrated the equipment by measuring between two radios (one operating as a DSRC transmitter and one as a DSRC detector) and a third-party DSRC radio to verify that the detector was performing as expected.¹³⁸ DENSO then logged the packet detection activity on DSRC channels while a programmable signal generator provided a V2X-compliance packet stream in a shield box.¹³⁹

The results were extremely promising. The testing demonstrated reliable detection of V2X signals at DSRC signal levels down to -95 dBm on DSRC channels 172, 174, 176, and 178 using the “detect and avoid” approach.¹⁴⁰ It also demonstrated a detection response time of about 8 microseconds.¹⁴¹

¹³² See Alliance *et al.* Tiger Team Letter at 2-6.

¹³³ See *id.*

¹³⁴ See *id.*

¹³⁵ See Letter from Ari Q. Fitzgerald, Counsel, the Alliance, *et al.*, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49 (Dec. 22, 2015).

¹³⁶ See *id.* at 2.

¹³⁷ See *id.*

¹³⁸ See *id.*

¹³⁹ See *id.*

¹⁴⁰ See *id.*

¹⁴¹ See *id.*

F. The “Detect and avoid” Approach Might Not Allow Outdoor Wi-Fi Use in the 5.9 GHz Band in Some Places, but 95 Percent of Wi-Fi Use is Indoors.

The FCC asks whether certain sharing techniques permit more or less indoor or outdoor unlicensed use.¹⁴² The “detect and avoid” approach could conceivably allow for both indoor and outdoor unlicensed use in the 5.9 GHz band where DSRC operations are not present. Even if the “detect and avoid” approach does not allow outdoor Wi-Fi use in some areas, this would have a marginal impact on Wi-Fi use of the 5.9 GHz band. According to industry estimates, 95 percent of all Wi-Fi activity occurs indoors.¹⁴³

The “re-channelization” approach has not been adequately defined yet to allow detailed analysis, but high-powered outdoor U-NII units would likely cause harmful interference to lower-powered DSRC operations on shared channels using common Wi-Fi priority technologies – if that is the intent of the “re-channelization” concept.

One suggestion might be to test low-powered indoor units. If these units are successful in not bleeding through building perimeters, then further safeguards would have to be put into place to ensure that they would not be operated outdoors (or even close to windows). The logical conclusion of this line of thought is that “detect and avoid” would be necessary, and indoor units would be more likely to be able to make use of the 5.9 GHz band because they would not detect (or interfere with) DSRC transmissions if adequately shielded by building walls.

¹⁴² See *Public Notice* at 9.

¹⁴³ See Peter B. de Selding, *Europe Mounts Defense of Radar Satellite Spectrum Against Wireless Broadband Incursion*, SPACENEWS (Jan. 24, 2014), <http://bit.ly/29k8BaH>.

G. The FCC’s Suggested Hybrid Approach is Unworkable.

The FCC asks whether a hybrid approach that takes elements from both the “detect and avoid” and “re-channelization” proposals could create benefits for DSRC and U-NII users.¹⁴⁴ This question is not very clear. Under the approach the FCC describes, unlicensed users would need to detect 10 MHz DSRC transmissions and vacate upon detection under the approach it describes.¹⁴⁵ However, this would not represent a hybrid re-channelization approach. Rather, it is essentially the “detect and avoid” approach. For example, the “hybrid chip” the FCC suggests would be expected to be developed if “detect and avoid” proves to be feasible with prototype equipment using field-programmable gate arrays (“FPGAs”).¹⁴⁶

A database system may be able to control access to spectrum near licensed DSRC roadside units. However, vehicle units are too dynamically mobile to be included individually in locational databases. It would be necessary, for example, to map exclusion zones for 300 meters around all roadways in order to account for vehicles that potentially could be located there. As a mitigation technique, it might be possible to state that even with exclusion zones around all U.S. roadways, only a limited portion of the U.S. would be off-limits to U-NII devices. However, areas that would remain available for unlicensed use would likely not be of interest to unlicensed Wi-Fi proponents.

¹⁴⁴ See *Public Notice* at 9.

¹⁴⁵ See *id.*

¹⁴⁶ See *id.*

V. THE “DETECT AND AVOID” APPROACH IS MOST CONSISTENT WITH CONGRESS’S DIRECTIVES AND OTHER COUNTRIES’ DSRC EFFORTS.

A. The “Detect and avoid” Approach to Sharing the Spectrum is Most Consistent with Congress’s Directions and Expectations.

When deciding between the “detect and avoid” and the “re-channelization” approaches, the FCC should also consider and harmonize all statutory provisions enacted by Congress, and take actions consistent with Congress’s expectations and directions. If the FCC does this, it would decline to select the “re-channelization” approach because it would effectively reallocate most of the spectrum that had been previously allocated for DSRC.

i. Congress has spent 25 years developing the current framework for DSRC, which is poised to bear fruit with several large scale deployments.

The development of DSRC can be traced back to 1991, when Congress passed the Intermodal Surface Transportation Efficiency Act (“ISTEA”). During that year, Senator Frank Lautenberg, Chairman of the Senate Appropriations Committee’s Transportation Subcommittee, introduced the Intelligent Transportation Systems (“ITS”)¹⁴⁷ bill, creating a comprehensive program to promote the development and use of technology that improves highway safety.¹⁴⁸ Senator Lautenberg envisioned that this technology would “allow individual automobiles to communicate with external systems,” and would be “an integral part of the highways of today, and the future.”¹⁴⁹ In passing ISTEA, Congress envisioned specific technologies such as: sensors on vehicles that could warn drivers of impending collisions; “smart cars”; and

¹⁴⁷ Originally titled “Intelligent Vehicle Highway Systems.” See Federal Highway Administration, *Detection Technology for IVHS* (1996), <http://1.usa.gov/1WFCUxY>.

¹⁴⁸ 102 Cong. Rec. S5407-02 (daily ed. May 7, 1991) (statement of Sen. Lautenberg).

¹⁴⁹ *Id.*

“intelligent vehicles.”¹⁵⁰ ISTEA tasked the Secretary of the USDOT with developing standards, protocols, and deadlines to promote the widespread use of ISTEA technologies.¹⁵¹ To work towards ISTEA’s goals, the USDOT selected ITSA as its Federal Advisory Committee on ITS matters.¹⁵²

In 1997, ITSA petitioned the FCC to allocate 75 MHz of spectrum in the 5.9 GHz band for DSRC, noting that DSRC would be “essential to the accomplishment of Congress’s objectives in ISTEA.”¹⁵³ However, before the FCC could act on the ITSA petition, Congress intervened in 1998 and directed the FCC to complete a rulemaking on the operation of a “dedicated short-range vehicle-to-wayside wireless standard.”¹⁵⁴

In so doing, Congress noted that ISTEA’s six-year research efforts had advanced ITS technologies beyond research and into deployment,¹⁵⁵ but that institutional and financial challenges continued to constrain the widespread use of ITS.¹⁵⁶ Therefore, Congress found that

¹⁵⁰ *Id.*; 102 Cong. Rec. S5419 (daily ed. May 7, 1991) (statement of Sen. Lautenberg); Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, 105 Stat. 1914, 1915 (1991).

¹⁵¹ Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, § 6053, 105 Stat. 1914 (1991). Within a year of the enactment of ISTEA, the Secretary was required to submit a plan to Congress, specifying goals, objectives, milestones, and a course of action that would meet ISTEA’s specific technological mandates. *See* Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, § 6054(a), 105 Stat. 1914 (1991). After submitting this plan, the Secretary was also required to submit implementation reports to Congress. *See* Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, § 6054(c), 105 Stat. 1914 (1991).

¹⁵² *Intelligent Vehicle Highway Systems: Hearing Before the Subcomm. on Investigations & Oversight of the H. Comm. on Science, Space, & Technology*, 103d Cong. (1993) (statement of Lester P. Lamm, President, IVHS AMERICA). From 1993 to 1995, ITSA and the USDOT developed a National Program Plan delineating the specific tasks that must be completed in order to realize the goals of the strategic plan submitted to Congress. *See* ITSA Petition for Rulemaking, ET Docket No. 98-95 at 3 (filed May 19, 1997) (“*ITSA Petition*”). From 1995 to 1996, the USDOT commissioned three studies in order to investigate the spectrum requirements for DSRC use. The agency selected 75 MHz of the 5.850 GHz to 5.925 GHz band, and included this spectrum band in its National Program Plan submitted to Congress. *See* USDOT, *Spectrum Requirements for Dedicated Short Range Communications (DSRC)* 80 (Jul. 1996); USDOT, ITSA., National ITS Program Plan 57 (Mar. 1995).

¹⁵³ *ITSA Petition* at 1.

¹⁵⁴ Transportation Equity Act for the 21st Century, Pub. L. No. 105-178, § 5206(f), 112 Stat. 107, 457 (1998).

¹⁵⁵ S. Rep. No. 105-95, at 60 (1997).

¹⁵⁶ *Id.*

continued investment in standards development, research, and systems integration was necessary for the widespread incorporation of ITS into the national surface transportation network.¹⁵⁷

Since then, Congress has continued to devote significant time and resources to developing the current DSRC framework.¹⁵⁸

Congress recently emphasized the importance of DSRC by passing legislation that encourages state transportation authorities and entities that receive federal funding to deploy DSRC. On December 4, 2015, Congress passed the FAST Act, which included provisions for federal funding of DSRC applications and deployments. For example, the FAST Act created a \$60 million-per-year program to provide competitive grants for the development of model deployment sites for large scale installation, as well as the operation of advanced transportation technologies to improve safety.¹⁵⁹ Under this program, USDOT will award grants to support advanced safety systems such as V2V and V2I communication, and technologies associated with autonomous vehicles and collision avoidance.¹⁶⁰ Congress has chosen to invest millions of the

¹⁵⁷ Transportation Equity Act for the 21st Century, Pub. L. No. 105-178, § 5202(2), 23 U.S.C. § 101 (1998). Furthermore, similar to ISTEA, TEA-21 also tasked the Secretary of Transportation with managing a transportation system program to research, develop, and operationally test intelligent transportation systems. *See id.* § 5204(a), 112 Stat. at 453. However, compared to ISTEA, TEA-21 increased the Secretary of Transportation's ITS program management responsibilities. Specifically, TEA-21 required the Secretary of Transportation to maintain and update the National ITS Program Plan (a plan established by the Department of Transportation and ITSA) and required the Secretary to develop a national architecture to promote the widespread use and evaluation of ITS. *See id.* § 5205(a), 5206(a)(1), 112 Stat. at 455-56.

¹⁵⁸ Major transportation acts passed by Congress, such as the Moving Ahead for Progress in the 21st Century Act (passed in 2012) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (passed in 2005), encourage state transportation authorities and entities that receive federal funding to deploy DSRC, emphasizing the importance of DSRC. *See e.g.*, Moving Ahead for Progress in the 21st Century Act, Pub. L. No. 112-141 § 602(1)(5), 126 Stat. 405, 612 (2012); Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, Pub. L. No. 119-59, § 1943(a), 119 Stat. 1290, 1512 (2005); Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, Pub. L. No. 119-59, § 5101(a)(5), 119 Stat. 1290, 1779 (2005).

¹⁵⁹ Fixing America's Surface Transportation Act, Pub. L. No. 114-94, § 6004(A), 129 Stat. 1312, 1562 (2015) (creating the Advanced Transportation and Congestion Management Technologies Deployment Program).

¹⁶⁰ *Id.* Furthermore, the FAST Act provides explicit funding eligibility of V2I communication equipment within all major highway formula programs (such as the National Highway Performance Program (NHPP), Surface Transportation Block Grant Program (STP), Highway Safety Improvement Program (HSIP), and Congestion

public's dollars in order to deploy DSRC operations, and the FCC should not undermine these efforts by selecting the "re-channelization" approach.¹⁶¹

- ii. **Consistent with Chairman Wheeler's recent letter to Congress, the FCC should take the lead in testing and modeling sharing proposals to ensure that DSRC remains intact and protected from harmful interference.**

On September 9, 2015, Senator John Thune, Chairman of the Senate Commerce Committee, wrote a letter to the Commission, USDOT, and the Commerce Department, urging all three agencies to work together to study the possibility of allowing unlicensed operations in the 5.9 GHz band.¹⁶² In his response to Chairman Thune, Chairman Wheeler described a collaborative test plan (among all three agencies) that would be implemented in three phases.¹⁶³ The first phase (Phase I) involves testing to determine the technical characteristics of prototype unlicensed devices and how they are designed, in order to avoid causing harmful interference to DSRC operations.¹⁶⁴ The second phase (Phase II) involves field tests with a few vehicles to

Mitigation and Air Quality (CMAQ) Improvement program). *See* § 1113-14, 1407, 129 Stat. at 1347-48, 1410 (2015).

¹⁶¹ We note that the FCC misinterpreted Congress's intent when it sought comment in 2013 on making spectrum in the 5.85-5.925 GHz band available for U-NII device use. *Revision of Part 15 of The Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, ET Docket No. 13-49, 28 FCC Rcd 1769 (2013). Rather, the Spectrum Act directed the Assistant Secretary of Commerce, in consultation with the Department of Defense (and other impacted agencies), to conduct a study evaluating spectrum sharing technologies and the risk to incumbent users if unlicensed U-NII devices are allowed to operate in the 5.35-5.47 GHz band and in the 5.85-5.925 GHz band. Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, § 6406(b)(1), 112 Stat. 156, 231 (2012). Importantly, Congress did not require the FCC to allow (or even consider allowing) U-NII devices to operate the 5.85-5.925 GHz band. It only required a Commerce Department study evaluating spectrum sharing in the band, and *did not even mention that the FCC specifically should conduct this study. See id.*

Further, in another provision of the Spectrum Act, Congress expressly stated that the Commission should only begin a proceeding to modify its rules to allow U-NII devices to operate in the 5.35-5.47 GHz. *See id.* This provision does not reference the 5.85-5.925 GHz band, demonstrating that Congress had considered which bands it wanted to require the FCC to explore for device sharing and had decided against including the 5.85-5.925 GHz band.

¹⁶² Letter from Senators John Thune, Cory A. Booker, and Marco Rubio to Anthony Foxx, Secretary, USDOT, Penny Pritzker, Secretary, U.S. Department of Commerce, and Tom Wheeler, Chairman, FCC (September 9, 2015).

¹⁶³ Letter from Tom Wheeler, Chairman, FCC, to Senator John Thune (January 12, 2016).

¹⁶⁴ *Id.*

determine whether the techniques to avoid interference (evaluated in Phase I) are effective. The third phase involves tests with more vehicles, test devices, and real-world scenarios.¹⁶⁵

Chairman Wheeler’s letter specifically states that all three phases of the test plan are interdependent and notes that it is “imperative to ensure the future automotive safety and efficiency of the traveling public” that all phases are completed before the entities conclude that unlicensed devices can operate in the 5.9 GHz band.¹⁶⁶ The *Public Notice* appears to have triggered a process that is consistent with the testing process outlined by Chairman Wheeler in his response to Chairman Thune because it plans to consider the technical characteristics of prototype unlicensed devices to determine how they are designed to avoid and cause interference to DSRC operations. A decision to re-channelize the DSRC band would be outside the scope of that process.

B. The “Detect and avoid” Approach Would Not Pose Problems for Harmonization of the U.S. and non-U.S. Band Plans for DSRC.

The FCC asks how its current DSRC band plan and the proposed sharing approaches match up with international efforts for safety-related DSRC.¹⁶⁷ The current U.S. DSRC band plan is consistent with existing and emerging international ITS norms. As in the U.S., 5 GHz V2V and V2I applications being developed in Europe and Asia require extremely low-latency, high availability communications. These applications include pre-crash safety communications, speed warnings, adaptive cruise control, lane departure prevention, traffic and infrastructure communication, as well as many others.¹⁶⁸

¹⁶⁵ *Id.*

¹⁶⁶ *Id.*

¹⁶⁷ See *Public Notice* at 8.

¹⁶⁸ See, e.g., *supra* Section II; *V2V Readiness* at 116-18.

The U.S. DSRC spectrum allocation is consistent with those in Europe, Japan, South Korea, China, Australia, and New Zealand, which have either already allocated or are in discussions to allocate ITS operations in the 5.9 GHz range.¹⁶⁹ Maintaining this consistency is especially important given that the U.S. has made several public commitments to international harmonization of connected vehicle standards. In 1999, the U.S. signed a joint declaration with Europe pledging to use global ITS standards whenever possible. Between 2010 and 2012, the U.S. signed similar agreements with Canada, Japan, and South Korea.¹⁷⁰ The USDOT has indicated that standardization of connected vehicle systems is a core objective of EU-U.S. cooperation on ITS.¹⁷¹

Harmonization of ITS standards also plays an important role in encouraging widespread adoption and deployment of connected vehicle technologies.¹⁷² Common standards help ensure interoperability between infrastructure and vehicle equipment, ensuring V2I technologies can function most effectively.¹⁷³ Also, as USDOT officials have noted, maximizing similarities between connected vehicle standards increases the likelihood that consumers and original equipment manufacturers will be able to deploy common hardware and software across markets, which will reduce costs and accelerate DSRC deployment.¹⁷⁴ Moreover, harmonization of international ITS standards enables stakeholders to leverage economies of scale for research,

¹⁶⁹ See, e.g., The Netherlands Organization for Applied Scientific Research, *Spectrum Allocation for ITS: The World ITS playing field*, at 2 (Jan 28, 2015), <http://bit.ly/29jResp>.

¹⁷⁰ See Michigan Department of Transportation and Center for Automotive Research, *Global Harmonization of Connected Vehicle Communication Standards* (Jan. 12, 2016) at 24, <http://bit.ly/29j14O9> (“*Global Harmonization of Connected Vehicle Communication Standards*”).

¹⁷¹ GAO 2015 Report at 27.

¹⁷² See, e.g., *V2V Readiness* at 28 (“[T]he overall potential of V2V and the number of rashes prevented and lives saved is highly dependent on the number of safety applications deployed, the penetration of those applications in the fleet and the way in which the applications operate.”)

¹⁷³ *Global Harmonization of Connected Vehicle Communication Standards* at 1.

¹⁷⁴ See GAO 2015 Report at 27.

development, and manufacturing activities, thereby expediting international deployment of ITS systems.¹⁷⁵

Europe. The United States' current DSRC framework closely matches the European Union's ("E.U.") framework. Both are based on seven 10 MHz-wide channels in the 5855-5925 MHz band and use 802.11p-based technologies.¹⁷⁶ The E.U. has dedicated 50 MHz of spectrum for ITS (5855-5905 MHz), with three 10 MHz bands (5875-5905 MHz) dedicated to safety-related applications and reserves the possibility of granting two additional 10 MHz channels (5855-5875 MHz) in the future.¹⁷⁷ Under the FCC's current rules, including its channelization rules, DSRC hardware will likely be able to comply with both U.S. and E.U. standards.¹⁷⁸ The International Telecommunication Union ("ITU") Constitution recognizes that "safety-of-life" communications must be given "absolute priority,"¹⁷⁹ and both the U.S. and E.U. allocate specific spectrum for crash-critical V2V safety applications.¹⁸⁰ In fact, both the U.S. and the E.U. reserve channels 176, 178 and 180 for safety use.¹⁸¹

The "re-channelization" concept would represent a departure from this close U.S.-E.U. alignment. Whereas the "detect and avoid" approach should allow DSRC hardware and software to continue to work in both regions, the "re-channelization" approach would likely reduce this

¹⁷⁵ *See id.*

¹⁷⁶ Toyota InfoTechnology Center, U.S.A., Inc., *DSRC: Deployment and Beyond (WINLAB Research Review)*, (May 2015), <http://www.winlab.rutgers.edu/iab/2015-01/Slides/06.pdf>. The E.U. plan does not, like the U.S. plan, reserve the 5850-5855 MHz band. *See id.*

¹⁷⁷ *Global Harmonization of Connected Vehicle Communication Standards* at 23.

¹⁷⁸ *Id.*

¹⁷⁹ ITU, *ITU Constitution Article 40 – Priority of Telecommunications Concerning Safety of Life*, available at <http://bit.ly/29lubwl> (last visited July 5, 2016).

¹⁸⁰ USDOT, *Report to Congress: Status of the Dedicated Short-Range Communications Technology and Applications*, at 167 (July 2015), <http://ntl.bts.gov/lib/56000/56800/56889/FHWA-JPO-15-218.pdf>.

¹⁸¹ Christoph Sommer & Falko Dressler, *Vehicular Networking* 122 (2014).

interoperability, increasing equipment costs and reducing the speed of deployment. As a result, other countries considering V2V implementation, such as Australia (which imports more than 85 percent of its new vehicles¹⁸²), may have to choose between the two standards for its own roads, further fragmenting the DSRC ecosystem and potentially reducing future trade and research collaboration. If the U.S. were to adopt a “re-channelization” concept, other countries would be unlikely to follow suit – leaving the U.S. unique in its approach to DSRC.

Asia. Japan has allocated 80 MHz in the 5 GHz band (5770-5850 MHz) and 10 MHz in the 700 MHz band (715-725 MHz) for a wide range of connected vehicle applications consistent with the DSRC standard.¹⁸³ Of this 5 GHz spectrum, Japan uses 20 MHz for electronic toll collection and 60 MHz for advanced safety services and road traffic information.¹⁸⁴ Like the U.S., Japan uses 10 MHz-wide channels.¹⁸⁵ Japan installed 1,600 “ITS Spot” services across its roadways in 2011, using DSRC across the 5 GHz spectrum to deliver services such as safety warnings, vehicle data, route guidance, traffic conditions, and emergency information.¹⁸⁶ The Japanese government tested the possibility of sharing spectrum on its V2I bands, but ultimately decided against allowing sharing in the band, due to concerns that it could cause latency problems and harmful interference.¹⁸⁷

¹⁸² Main Roads Western Australia, *Connected Vehicles: Are we ready?* (June 2015) at 2, <http://bit.ly/1MEJWKV> (“Are we ready?”).

¹⁸³ *Global Harmonization of Connected Vehicle Communication Standards* at 8.

¹⁸⁴ See Ministry of Land, Infrastructure, Transport, and Tourism, *ITS (Intelligent Transport System) Spot Services*, http://www.mlit.go.jp/kokusai/itf/kokusai_itf_000006.html (last visited Jun. 30, 2016).

¹⁸⁵ Kengo Kishimoto, et al., *Cooperative Inter-Infrastructure Communication System Using 700 MHz Band*, SEI TECHNICAL REVIEW, Number 78, at 19 (Apr. 2014), <http://bit.ly/29hDBYF>.

¹⁸⁶ *Are we Ready?* at 17.

¹⁸⁷ GAO 2015 Report at 19-20.

Additionally, China's transportation authority, automotive industry, and ITS industry have started their V2X standards effort and deployment planning, and are relying on the U.S.'s current model. The first draft of China's V2X message and application performance standards is already being circulated for comments, largely based on U.S. and European DSRC work.¹⁸⁸ A large-scale V2X testing facility was opened on June 6, 2016 in Shanghai.¹⁸⁹ It is well-equipped with U.S.-compatible 5.9 GHz RSUs, and automotive manufacturers and other industry and research institutes have already started to test their V2X applications using the same DSRC technology, leveraging the U.S.'s decades of research and test results. If the channel character, performance, or standards change in the U.S., it would negatively impact China's V2X progress as well. Most, if not all, of the U.S. automobile manufacturers have Chinese footprints, so the international impact of the FCC's decision should not be overlooked.

C. Other Anticipated Communications Technologies Will Not Bypass DSRC.

The Commission asks whether autonomous vehicle and other technologies could bypass DSRC safety-of-life capabilities prior to DSRC reaching sufficient penetration to be effective.¹⁹⁰ The answer is "no." NHTSA's research demonstrates DSRC's inherent advantages over other technologies. Other than DSRC, no wireless technology – including LTE and modern Wi-Fi – has demonstrated that it is capable of supporting low-latency V2V crash imminent safety applications. Moreover, the standards for low-latency communications applicable to 5G have

¹⁸⁸ See Anna Lu, *Autonomous connected cars on their way*, SHANGHAIDAILY.COM (Jun. 8 2016), <http://www.shanghaidaily.com/business/biz-special/Autonomous-connected-cars-on-their-way/shdaily.shtml>.

¹⁸⁹ See *id.*

¹⁹⁰ See *Public Notice* at 8.

not been developed, and the physical characteristics of millimeter wave spectrum being considered for 5G are not optimal for the range of communications envisioned.¹⁹¹

After years of thorough testing, NHTSA found that, although “vehicle-resident” crash avoidance technologies such as on-board sensors, cameras, and radar applications “can be highly beneficial, V2V communications represent an additional step in helping to warn drivers about impending danger.”¹⁹² V2V communications use on-board DSRC devices to transmit messages about a vehicle’s speed, heading, brake status, and other information to other vehicles and receive the same information from the messages, with range and “line-of-sight” capabilities that greatly exceed current and near-term “vehicle-resident” systems.¹⁹³ As NHTSA explained, “this longer detection distance and ability to ‘see’ around corners or ‘through’ other vehicles helps V2V-equipped vehicles perceive some threats sooner than sensors, cameras, or radar can, and warn their drivers accordingly.”¹⁹⁴

To illustrate this, in an effort to study the benefits of DSRC+Positioning in overcoming some of the limitations of autonomous safety systems, the CAMP VSC2 Consortium evaluated the performance of DSRC+Positioning alongside a production-representative Forward-Looking Radar (“FLR”) autonomous sensor in driving environments that highlight the limitations of these sensors.¹⁹⁵ As an illustration of the analysis and results, the following shows the side-by-side

¹⁹¹ See, e.g., Larry Greenemeier, *Will Millimeter Waves Maximize 5G Wireless?*, SCIENTIFIC AMERICAN (June 23, 2015), <http://bit.ly/1HhuAfc>.

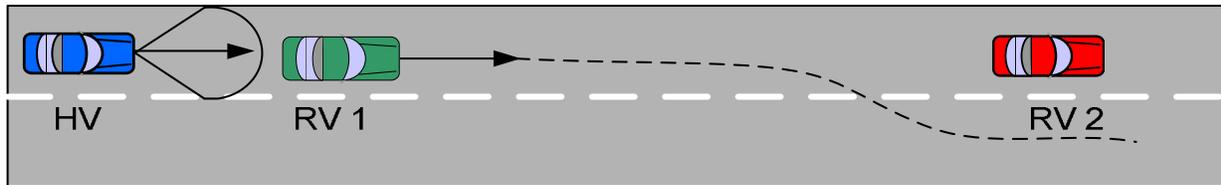
¹⁹² *V2V Readiness* at xiv.

¹⁹³ See *id.*

¹⁹⁴ *Id.* V2V technology can also be “fused with those vehicle-resident technologies to provide even greater benefits than either approach alone.” *Id.*

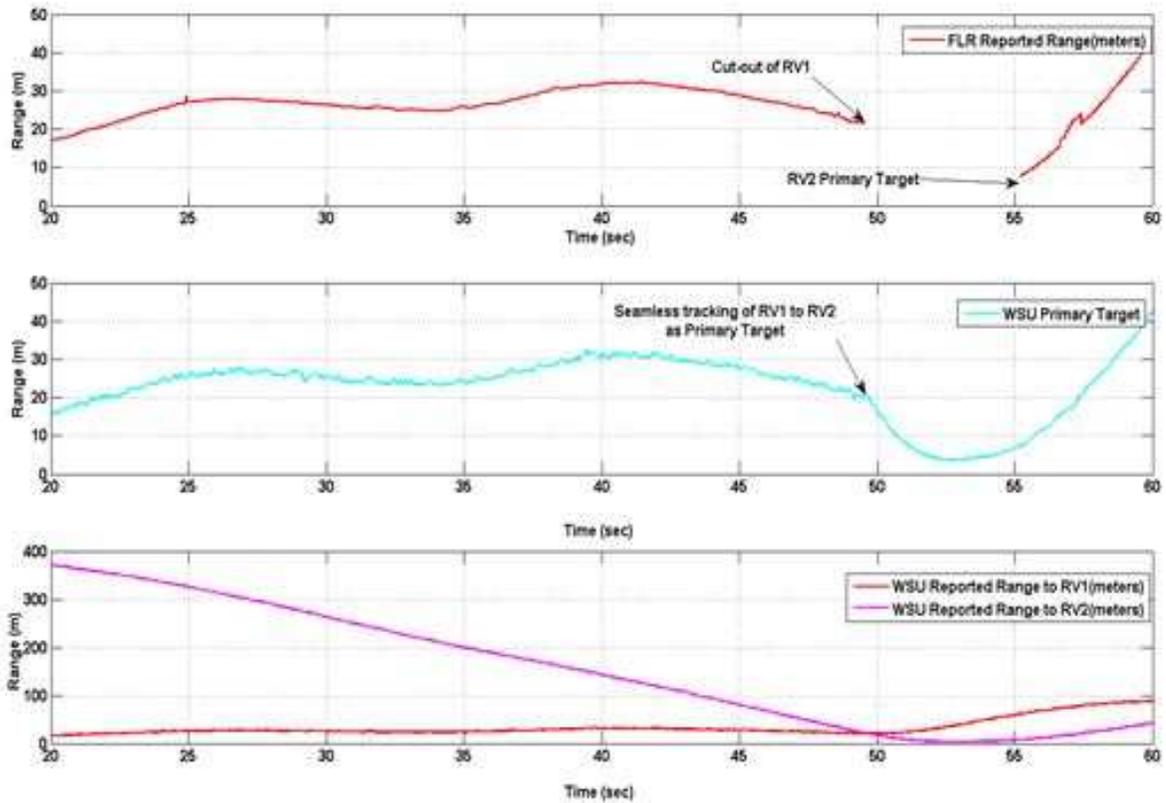
¹⁹⁵ See *CAMP VSC2 Report App. Vol. 2* at 7-13

performance of the FLR-autonomous sensor and the DSRC+Positioning system during a sudden cut-out of a previously tracked vehicle to reveal a stationary vehicle within the lane of travel:



For this scenario, as can be seen in the following diagram, the in-path target confirmation was only possible with the FLR after the stopped vehicle is within the radar field-of-view.¹⁹⁶ When the initial primary target vehicle (“RV1”) cuts-out of the test vehicle (“HV,” which is equipped with the FLR and DSRC+Positioning system) lane of travel, revealing the stationary vehicle (“RV2”), it takes approximately 5 seconds before RV2 is acquired by the FLR sensor. In contrast, the DSRC+Positioning system on the HV received positional information from RV2 several hundred meters away. After the RV1 cut-out, it can be seen that the DSRC+Positioning system provides continuous ranging information to the stationary vehicle, thereby, greatly enhancing the ability for a Collision Avoidance System (*e.g.*, forward collision warning) to provide an alert to the driver of the HV, if deemed necessary.

¹⁹⁶ See NHTSA, *Vehicle Safety Communications – Applications (VSC-A) Final Report* (2011), <http://bit.ly/29oRKVS> (“CAMP VSC2 Final Report”).



In fact, NHTSA even considers DSRC-based V2V to be an important component in the development of advanced driver-assist technologies. “The Department wants to speed the nation toward an era when vehicle safety isn’t just about surviving crashes; it’s about avoiding them,” USDOT Secretary Foxx has explained.¹⁹⁷ Accordingly, “[c]onnected, automated vehicles that can sense the environment around them and communicate with other vehicles and with infrastructure have the potential to revolutionize road safety and save thousands of lives.”¹⁹⁸

¹⁹⁷ Press Release, USDOT, Transportation Sec. Foxx Announces Steps to Accelerate Road Safety Innovation (May 13, 2015), <http://www.nhtsa.gov/About+NHTSA/Press+Releases/2015/nhtsa-will-accelerate-v2v-efforts>.

¹⁹⁸ *See id.*

DSRC's benefits relative to other technologies can be traced back to its inception. When the FCC allocated the 5.9 GHz band for DSRC use,¹⁹⁹ no available wireless technology could support low-latency V2V crash-imminent safety applications. The most advanced basic wireless technology then available – Orthogonal Frequency Division Multiplexing (“OFDM”) – was used to develop a technology (DSRC) that could meet these low-latency requirements and remain consistent with the chipsets used for high-volume wireless communications.²⁰⁰ Meanwhile, DSRC's development since has cemented this superiority. The other technologies that have brought about improvements in the basic OFDM technology have generally done so in ways that are optimized for commercial point-to-point communications involving centralized network control over mobile units, such as modern cellular networks and Wi-Fi access points. In contrast, DSRC has continued to improve the basic OFDM technology in ways that are optimized for low-latency, peer-to-peer communications on a point-to-multipoint basis, and that meet the requirements for V2V imminent crash avoidance applications.

¹⁹⁹ See *Amendment of Parts 2 and 90 of the Commission's Rules to Allocate the 5.850-5.925 GHz Band to the Mobile Service for Dedicated Short Range Communications of Intelligent Transportation Services*, Report and Order, 14 FCC Rcd 18221 (1999).

²⁰⁰ OFDM is a modulation format that is being used for many of the latest wireless and telecommunications standards. OFDM has been adopted in the Wi-Fi arena where the standards like 802.11a, 802.11n, 802.11ac and more. It has also been chosen for the cellular telecommunications standard LTE / LTE-A, and in addition to this it has been adopted by other standards such as WiMAX and many more. See Ian Poole, *OFDM Orthogonal Frequency Division Multiplexing Tutorial*, Radio-Electronics.com, <http://bit.ly/29rj47e> (last visited Jun. 30, 2016).

VI. THE FCC SHOULD INDICATE WITH SPECIFICITY THE INTERFERENCE AVOIDANCE MECHANISM THAT WILL PROTECT DSRC – NOT LEAVE THE ISSUE TO INDUSTRY-STANDARDS BODIES.

A. Technical Requirements.

The FCC asks whether it is necessary for it to specify the details of the interference avoidance mechanism in its rules or if this can be addressed by relying primarily on industry standards to develop the specific sharing methods.²⁰¹

The FCC, in collaboration with the USDOT, should specify sharing requirements in sufficient detail to protect the public while considering private sector business interests. Given the public's interest in preventing harmful interference to DSRC operations, the FCC should not rely on voluntary industry standards to develop the specific sharing method. The FCC's rules carry the full weight of the law and would apply to everyone operating in the 5.9 GHz DSRC band.

Specifically, the FCC should adopt rules that require the interference avoidance mechanism to adhere to the metrics specified in the SAE J2945/1 Standard. The SAE J2945/1 Standard sets minimum system requirements for on-board V2V safety communications systems in light vehicles, including functional and performance requirements.²⁰² For example, the SAE J2945/1 Standard requires a PER of less than 10 percent at a receive sensitivity level of at least -92 dBm for BSMs.²⁰³ In addition, the SAE J2945/1 Standard's congestion control algorithm determines the interval and power level at which BSMs are transmitted depending on, among

²⁰¹ See *Public Notice* at 7.

²⁰² See SAE, *On-Board System Requirements for V2V Safety Communications* (Mar. 30, 2016), http://standards.sae.org/j2945/1_201603/.

²⁰³ PER is defined as the ratio of the number of missed BSMs from a particular transmitting remote vehicle during a time interval to the total number of expected BSMs from that remote vehicle within the same time interval. See *id.* Comparisons of PER to receive signal strength ("RSS") for prototype OBEs at this level of performance were shared with the IEEE Tiger Team in 2013.

other factors, the number of neighboring vehicles, the PER of neighboring vehicles, vehicle dynamics, and channel busy percentage.²⁰⁴

Two of the metrics used to develop the SAE J2945/1 Standard's congestion control algorithm are especially important to safety application performance and could be reflected in the FCC's rules: Information Age ("IA") and Communications Induced Tracking Error ("CITE").²⁰⁵ The maximum allowable values for IA and CITE were 650 milliseconds and 0.5 meters, respectively.²⁰⁶ These values remain fixed at all levels of vehicle density, but the range at which the metrics apply can vary.²⁰⁷ For example, CITE can range from 150 meters at low-vehicle densities to 50 meters at high-vehicle densities.²⁰⁸

B. Certification Processes.

The FCC also asks whether there is a certification process to hold products to these performance levels.²⁰⁹ The USDOT is currently working with industry to develop a connected vehicle certification process to ensure compliance with the SAE J2945/1 Standard.²¹⁰ It is an open question whether individual companies could meet such an obligation on their own, or

²⁰⁴ *See id.*

²⁰⁵ IA is the time measured at a receiving host vehicle ("HV"), expressed in milliseconds, between the timestamp corresponding to the data contained in the most recently received information from a given transmitting RV and the current time at a receiving HV. *See* CAMP VSC3 Consortium, *Phase 2 Final Report Volume 2 – Communications Scalability for V2V Safety Analysis* at 2 (Feb. 24, 2015), <http://bit.ly/29iFG7S> ("CAMP VSC3 Final Report"). CITE is the difference, in meters, between where a receiving RV thinks a transmitting HV is, using older GPS information contained in the last received BSM from the HV, and where the transmitting HV estimates it is, using the latest GPS information from its GPS receiver. *See id.* at 38.

²⁰⁶ *Id.* at 40.

²⁰⁷ *Id.*

²⁰⁸ These metrics helped lead to the following "base set" of boundaries: maximum inter-transmit time: 100 ms – 600 ms; estimated tracking error: 0.2 m - 0.5 m; and transmit power level: 10 dBm – 20 dBm. *Id.*

²⁰⁹ *See Public Notice* at 7.

²¹⁰ *See, e.g.,* USDOT, *ITS Research Fact Sheets – Connected Vehicle Certification Process*, http://www.its.dot.gov/factsheets/certification_factsheet.htm (last visited June 23, 2016).

whether independent testing facilities might be needed.²¹¹ In its pending rulemaking, NHTSA stated that any standard requiring DSRC devices in new vehicles would likely specify “exactly what specifications all related devices would have to meet.”²¹² NHTSA also sought comment on making a self-certification process available to automobile manufacturers.²¹³ Of course, the FCC’s equipment certification process would apply to any U-NII device that sought to operate in the 5.9 GHz DSRC band. However, that process would only be as thorough as the FCC’s rules. Therefore, it is essential that the FCC set sharing requirements with specificity to ensure that DSRC operations are protected.

VII. THE FCC’S PROPOSED TESTING AND PROTOTYPE SUBMISSION PROCESSES WOULD BENEFIT FROM KEY ADJUSTMENTS.

The FCC seeks comment on its decision to require prototype unlicensed, interference-avoiding devices for testing by July 30, 2016.²¹⁴ The FCC also seeks comment on what constitutes an acceptable prototype and on whether it would have sufficient time to test prototypes if it concluded its testing no later than January 15, 2017.²¹⁵ As discussed below, however, the FCC’s proposed test processes would benefit from key adjustments.

A. Prototype Submission Process.

5.9 GHz DSRC equipment is in production, and units are commercially available from vendors such as Savari, Lear, Arada, Cohda, Delphi, Kapsch, and DENSO. Given the

²¹¹ *V2V Readiness* at xvii.

²¹² *See id.* at 131.

²¹³ *See id.* at 49-50, 130-32; *ANPRM*, 79 Fed Reg. at 49274.

²¹⁴ *See Public Notice* at 1-2.

²¹⁵ *See id.* at 10-11.

Commission's relative inexperience with testing connected vehicle equipment and applications, it may find the CAMP's efforts to be a helpful resource.²¹⁶

B. The FCC's Test Plan.

The *Public Notice* does not provide enough information to determine whether the FCC's planned tests will be able to appropriately assess the proposed sharing methods. Some initial feedback follows, although the FCC should provide an additional opportunity to submit feedback if it revises these plans. It is particularly important that the proponents of "re-channelization" be required to provide additional information because the concept cannot be properly tested as presently framed, as discussed *supra* in Part IV.A.

Phase I. The Phase I Test Plan attached to the *Public Notice* is vague or ambiguous in a number of important areas. For example:

- 1) Regarding the second point in Section 2.1,²¹⁷ it is important to recognize that an elevated potential for corruption of received data packets will be caused not only by the direct presence of U-NII traffic, but also from changing the way DSRC uses the band. Under the "re-channelization" approach, there may be higher levels of high priority safety communication in Channels 180, 182 and 184, leading to elevated DSRC packet collision probabilities. This is particularly concerning because the elevated corruption potential will exist everywhere that DSRC operates, including where U-NII traffic levels are low or zero (including where the U-NII community chooses never to introduce products into the 5.9 GHz DSRC band).
- 2) With respect to the test of "unwanted emission levels,"²¹⁸ unwanted emissions measurements are important. However, since U-NII-4 will not include U-NII channelization, what constitutes "unwanted?" Under the "detect and avoid" approach, all 75 MHz is part of U-NII-4, so there are no OOBES. Under "re-channelization," at least 45 MHz is in the U-NII-4 band. So, some in-band energy measurements are needed. The U-NII device should be placed in each 802.11-defined channel it intends to occupy, and the power of that U-NII signal should then be measured in each DSRC channel, including those that have overlap with the declared "occupied bandwidth" and those that do not.

²¹⁶ See, e.g., *CAMP VSC2 Final Report*; *CAMP VSC2 Final Report App. Vol. 2*; *CAMP VSC3 Final Report*.

²¹⁷ See *id.* at 15.

²¹⁸ See *id.* at 16.

- For Wi-Fi U-NII devices, the occupied channel will presumably include 20 MHz channels 169, 173, and 177, 40 MHz channels 167 and 175, 80 MHz channel 171, and 160 MHz channel 163.
 - The DSRC channels include the 5 MHz reserved channel, the seven 10 MHz channels, and the two 20 MHz channels that would be required under the “re-channelization” approach.
 - The U-NII device should be configured for maximum power, including antenna gain or emulated antenna gain if conducted with cables.
 - The FCC should also recognize that no matter what behavior the offered prototypes exhibit, there remains a problem of regulating U-NII emissions within the U-NII-4 band because there will be no channelization of U-NII devices in regulations. So, absent any additional regulation, any U-NII-4 device is permitted to place all of its maximum permitted power in one (or even a fraction of one) DSRC channel. Will the U-NII-4 minimum occupancy bandwidth be 500 KHz as in U-NII-3? Will test devices (using signal generator) be configured with that minimum bandwidth, or with other bandwidths? How can non-tested bandwidths be permitted? Will a signal generator be configured to emit -17 dBm/MHz in Channel 180 and -27 dBm/MHz in Channels 182 and 184, as per proposed maximum OOB under re-channelization?
- 3) Would a U-NII device that fails to conform to some Wi-Fi specification be disqualified?²¹⁹ Do industry specifications substitute for FCC regulatory limits?
 - 4) The Phase I Test Plan does not clearly define “network delay.”²²⁰ Additionally, PER and channel access delay depend heavily on the traffic generation models which are not specified.
 - 5) The “worst-case” interference interaction test description does not specify the strength of the desired DSRC signal at the DSRC receiver, which will make a big difference in how much U-NII energy is needed to cause a DSRC packet loss.²²¹ We recommend considering the test where the strength of received desired DSRC signal is close to the minimum sensitivity.

²¹⁹ *See id.* at 16.

²²⁰ *See id.*

²²¹ *See id.*

- 6) It is unclear whether the observation from FCC's experience with developing and instituting compliance measurement of U-NII transmissions will hold if the U-NII technology changes fundamentally (*e.g.*, to LTE-U).²²²
- 7) With respect to tuning U-NII transmit signal to evaluate adjacent-channel rejection capability of a DSRC receiver,²²³ U-NII devices have no regulated concept of channel. The entire notion of channel rejection when the interferer has no defined channels does not really make sense. Results of such a test depend not only on the receive filtering in the DSRC device, but also on the transmit mask and occupied channel in the U-NII device which is not defined. In addition, 802.11 channel rejection is only defined when the interferer and the desired signal are of the same protocol (including same bandwidth). Therefore, DSRC channel rejection with a second DSRC device as interferer can produce meaningful channel rejection according to the 802.11 specification. DSRC device channel rejection when the interferer is not DSRC is not defined in standards.
- 8) Regarding the "network loading" test,²²⁴ the minimum number of U-NII devices should be specified. If prototype U-NII devices are not available in sufficient quantities, the Commission should use signal generators to create equivalent interference so the impact of multiple U-NII devices can be properly assessed.
- 9) Because the test procedures for different protocols are under development,²²⁵ the right of commenting should be reserved for the public. We observe that many details of "re-channelization" devices have not yet been provided. The "re-channelization" approach also requires changes to DSRC devices, and many of those details are also not specified.²²⁶
- 10) Interference to DSRC under the "re-channelization" approach could come from many directions. Only interference directly coming from U-NII emissions is considered in this test plan. Other factors directly caused by re-channelization should also be considered and tested as possible. One such factor is increased loss and delay suffered by DSRC safety communication in 5895-5925 compared to loss and delay of such traffic under the current band plan. For example, DSRC safety communication is currently planned to be distributed across all seven 10 MHz channels, and within each channel such traffic will have channel access priority compared to non-safety traffic. Under the "re-channelization" approach, all of the safety traffic is compressed onto two or three channels (it is not clear if the proponents of re-channelization consider Channel 180 as viable for safety communication). In those channels, safety

²²² *See id.*

²²³ *See id.*

²²⁴ *See id.* at 17.

²²⁵ *See id.*

²²⁶ *See April 14 Letter* at 3-5.

traffic will mostly compete with itself on an equal channel access priority basis. That change in channel access competition will lead to changes in safety packet loss and delay. This must be analyzed or tested. Additional impact of interference from FSS located above 5925 MHz, which the FCC describes as "heavily used,"²²⁷ should also be analyzed or tested.

The Phase I Test Plan also fails to mention a number of key tests that will be critical in evaluating the proposed sharing methods. For example, the following tests should be part of

Phase I:

- 11) A test to determine the impact of U-NII interference on the aggregate throughput of DSRC safety communications (*i.e.*, the total number of messages/second a receiver successfully decodes from its neighbors). The higher throughput vehicles can have, the more safety applications can be enabled and the more reliably a given safety application will perform. The tests need to consider both the case where U-NII interference is in the same channel as DSRC safety operations and the case where it is present on the channel adjacent to DSRC safety communication channel.

- 12) A test to evaluate the degradation of DSRC communication performance by moving from a 10 MHz channel to a 20 MHz channel. Under the "re-channelization" concept, DSRC operation over the lower 40MHz will need to be conducted over two 20MHz channels. The communication performance in a 20MHz channel compared to a 10MHz channel needs to be tested. Note that DSRC communications will expose different interference tolerance capability if the channel width is changed. Many of the tests described in the *Public Notice* need to be conducted for a 20 MHz channel. Several aspects of performance in 20 MHz channels relative to 10 MHz channels should be investigated that do not involve U-NII interference. One aspect is whether DSRC competition in a 20 MHz channel results in increased loss or delay compared to DSRC competition in two 10 MHz channels even in the absence of U-NII interference. Another aspect is whether there is a higher noise floor, which would reduce DSRC reception and carrier sense range. A third aspect is the immunity to delay spread, which occurs in outdoor multipath environments (but can be emulated in a lab as well) due to the shorter guard interval in 20 MHz OFDM symbols. A fourth aspect is the impact of relative speed between the communicating devices, which Qualcomm's prior filings show will generally cause excess loss for 20 MHz DSRC compared to 10 MHz DSRC.²²⁸ These aspects of DSRC degraded performance are especially important to test because, under the "re-channelization" approach, DSRC will be subject to this reduced performance always and everywhere – even when U-NII traffic levels are low or zero (including the case where the U-NII community chooses never to introduce products into the band).

²²⁷ See *Public Notice* at 4 n.19.

²²⁸ See, e.g., *Qualcomm Proposal*.

- 13) A test to characterize the influence of DSRC communications on the transmission behavior of U-NII devices operating on an adjacent channel. Under the “re-channelization” concept, U-NII devices may be present just below Channel 180 on which DSRC safety traffic will be sent. Due to cross-channel interference, U-NII devices may sense DSRC transmissions on Channel 180 and suspend their transmissions. This test will help answer the question that how much extra throughput the “re-channelization” proposal will have compared to “detect and avoid.”
- 14) A test to characterize the impact of different Carrier Sensing requirements of U-NII devices (*e.g.*, non-Wi-Fi CCA) on their interference to DSRC operations. The FCC notes that it “does not specify nor regulate CS requirements for U-NII devices.”²²⁹ However, different carrier sensing requirements mean different aggressiveness in using the channel, which could mean different levels of interference to DSRC. Although the FCC will not specify the characteristics of how U-NII devices detect each other, it seems essential for it to regulate the characteristics of how U-NII devices will detect DSRC (just as it regulates how the characteristics of radar detection in dynamic frequency selection).
- 15) Tests to gauge the DSRC transmission detection capability of specific prototypes running different interference mitigation techniques. Detection is the common element in the proposals of both the “detect and avoid” and “re-channelization” proposals. Different detection capability between U-NII prototype devices may translate into perceived difference between the two proposals. It is important to ensure that the prototypes are equally capable of detecting ITS transmissions.
- 16) A test to measure the increment in DSRC-to-DSRC interference due to re-channelization. The current channel plan allows dissemination of DSRC safety communications across all 7 channels. Re-channelization squeezes all safety related communications into just 3 adjacent channels. It will lead to overloaded channel and significant cross-channel interference, causing deteriorated DSRC-to-DSRC interference. We need to measure the PER and throughput for DSRC communications in such congested environment. The DSRC community has developed and standardized a channel congestion control protocol for safety communication. That protocol needs to be evaluated in a sharing environment in which U-NII traffic might be present that does not participate in congestion control. It also needs to be evaluated given the change in the mix of DSRC traffic on a given channel that will result from re-channelization (*e.g.* combining BSMs with non-BSM safety messages), even in the absence of U-NII traffic.
- 17) A test that measures the influence of U-NII interference based on the results of the test described above (“Test 6”).

²²⁹ See *Public Notice* at 15.

- 18) A test to determine how much DSRC traffic is required to silence U-NII devices under the “re-channelization” method. This test will provide a peek into the scale of potential benefits of “re-channelization” compared to “detect and avoid.” For example, it is possible that the two approaches offer similar comparable opportunities for U-NII devices to use the 5.9 GHz band in most places and at most times.

Phase II. Phase II of the Commission’s tests will need to consider a wider range of DSRC safety communication environments than the USDOT’s test plan.²³⁰ First, only BSMs and SPaT data were considered in the USDOT’s tests. Other types of messages, such as personal safety messages, were not considered. Second, DSRC receivers of the V2V tests in the intersection scenario were not moving. The channel would be different for static and dynamic communication links. Third, the number and distribution of U-NII devices in the intersection scenario were limited. Several U-NII devices located on different legs of the intersection and hidden to each other should be tested. Fourth, the experiments in Section 6 of the USDOT’s test plan²³¹ should be performed again using 20 MHz channels as envisioned by the “re-channelization” proposal.

Tests that should be included in Phase II but are not currently part of the USDOT’s test plan include:

- 1) Tests in a controlled environment that allows for longer device separation ranges;
- 2) Tests with a much higher density of devices; and
- 3) Tests to better assess the V2V safety application-level performance.

²³⁰ See NHTSA, *DSRC-Unlicensed Device Test Plan* (Aug. 2015), <http://bit.ly/29laYxz>. The USDOT test plan is sufficiently comprehensive in its combinations of DSRC device versus unlicensed U-NII channel, bandwidth, modulation, and power in indoor and outdoor environments and using multiple DSRC device types. However, the initial results will be baseline and interference results for surrogate U-NII-4 devices (*i.e.*, U-NII-3 devices modified to operate in the 5.9 GHz DSRC band). Placeholder baseline and interference test tasks have been identified for potential U-NII-4 devices when and if they become available. Until more information is available about the “re-channelization” approach, it is unclear how helpful these tests will be.

²³¹ See *id.*

Phase III. When it is released, the Commission’s Phase III Test Plan should specify a meaningful set of scenarios on which parties can comment. At the very least, these scenarios will need to cover different safety environments.

Moreover, the metrics involved with V2V crash-imminent safety applications are more important at the applications-level than at the lower-level communications protocols, which seem to be the focus of the FCC’s proposed tests.²³² This is due to the different crash scenarios and transient conditions involved with various crash-imminent safety applications. The applications-level requirements must be designed to meet the most critical combination of crash scenario, adjacent vehicular activity, geographical environment, as well as communications channel interference. Examples of the extensive testing required by – and the results obtained with – applications-level testing can be found in a series of reports published by NHTSA that document cooperative research between a group of automobile manufacturers and the USDOT.²³³

Additionally, the burden of proof that a sharing concept will not allow harmful interference should be on its proponent rather than incumbent operators. And multiple – likely many – prototype units would be required to adequately test a concept.

C. Timing of Testing.

The proposed timeline for the FCC’s tests is too aggressive. For example, initial feasibility testing of adjacent channel interference resulting from compressing all DSRC safety-

²³² See *Public Notice* at 8.

²³³ See NHTSA, DOT HS 811 492A, *Vehicle Safety Communications – Applications (VSC-A) Final Report* (Sept. 2011), <http://bit.ly/29oRKVS>; NHTSA, DOT HS 811 492B, *Vehicle Safety Communications – Applications (VSC-A) Final Report: Appendix Volume 1 System Design and Objective Test* (Sept. 2011), <http://bit.ly/29842ig>; NHTSA, DOT HS 811 492C, *Vehicle Safety Communications – Applications (VSC-A) Final Report: Appendix Volume 2 Communications and Positioning* (Sept. 2011), <http://bit.ly/29h33jR>; NHTSA, DOT HS 811 492D, *Vehicle Safety Communications – Applications (VSC-A) Final Report: Appendix Volume 3 Security* (Sept. 2011), <http://bit.ly/29h3pGU>.

of-life-and-property and public safety applications into the top three 10 MHz channels could likely be performed within several months, although this level of testing would only confirm the extent of redesign required for the current DSRC system. This redesign would need to occur before any significant re-channelization testing could be undertaken. It has taken many years to develop the current system under the current FCC rules, and a redesign of the DSRC system would likely require multiple years to ensure that it could meet the stringent requirements for safety-of-life applications required for a NHTSA rulemaking. As indicated in earlier comments, this system redesign and subsequent re-testing under the “re-channelization” concept would significantly delay the reduction in traffic fatalities and serious injuries associated with the anticipated NHTSA rulemaking requiring the transmission of the DSRC BSMs by all new vehicles.

As a result, the cross-interference and “network loading” tests in Phase I will likely be subject to significant time and resource constraints. The FCC should weigh its desire to perform the tests quickly against the public interest in ensuring that the proposed sharing methods are adequately evaluated. If necessary, additional testing personnel and equipment could help perform tests more quickly. It would cause concern if necessary tests are not performed due to perceived resource or time constraints.

VIII. CONCLUSION.

DSRC holds great promise to provide significant road safety, traffic management, and environmental services. These services support safer, faster, and more efficient travel on our nation’s roadways. These services could be severely undermined – and potentially extinguished – by harmful interference from U-NII devices in the 5.9 GHz band. The FCC therefore should proceed cautiously and avoid allowing U-NII use of the 5.9 GHz band without sufficient testing to demonstrate that sharing can occur without harmful interference to DSRC operations

throughout all seven channels. For these reasons, we oppose the “re-channelization” approach and propose that the FCC act as quickly as possible to review and discount this proposal. The FCC should also indicate with specificity the interference avoidance mechanism that will protect DSRC and implement key changes to its plans to test potential sharing mechanisms. As the FCC examines proposals to share the 5.9 band, DSRC deployments should move forward to bring the benefits of the technology to the public.

Respectfully submitted,

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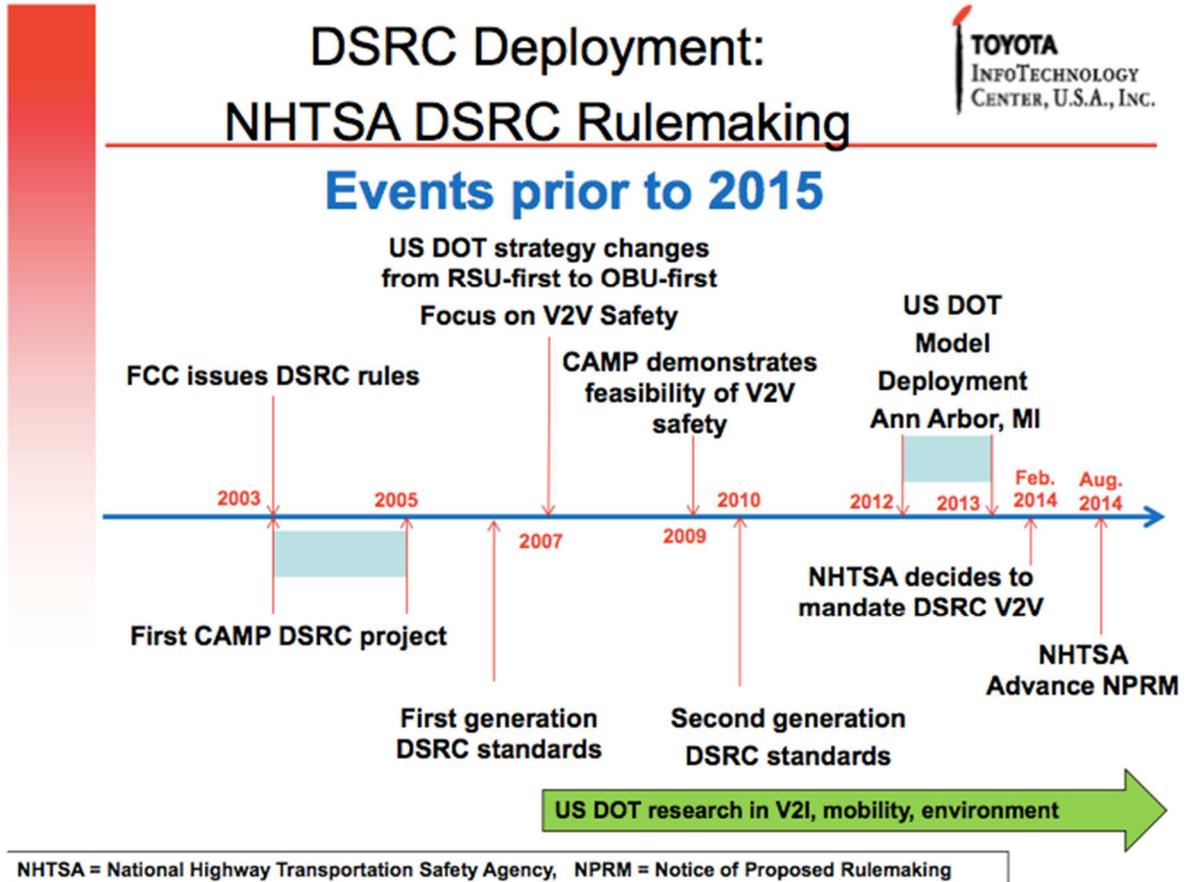
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Appendix A: DSRC Deployment Prior to 2015



Appendix B: DSRC Deployment Since 2015

