Statement of

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on

"Challenges and Opportunities in the 5 GHz Spectrum Band"

before the

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Committee on Energy and Commerce

Subcommittee on Communications and Technology

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Chairman Walden, Ranking Member Eshoo, and other Members of the Subcommittee, thank you for the opportunity to testify before you this morning. And thank you for holding this important hearing on the challenges and opportunities in the 5 GHz band.

My name is John Kenney. I am Principal Researcher at the Toyota InfoTechnology Center in Mountain View, California, where I lead our vehicular networking research team. I help represent Toyota in the Vehicle Safety Communications consortium, which performs pre-competitive research in cooperation with the U.S. Department of Transportation (U.S. DOT). I also represent Toyota in vehicle communication standards bodies in the United States and in Europe, and have been recognized by the IEEE Standards Association for contributions to the development of vehicular communication standards.

Toyota recognizes and fully appreciates that there is a spectrum crunch and that we must find new and innovative ways to maximize the effective use of the limited spectrum that is available. We have been – and continue to be – generally supportive of efforts to open up more spectrum for unlicensed uses. In principle, we also support the prospect of sharing spectrum with unlicensed devices in the 5.9 GHz band if it can be proven that no harmful interference will impair the safety-of-life mission for which that spectrum is allocated.

What is Dedicated Short-Range Communication (DSRC)?

There have been remarkable advances in the crashworthiness of vehicles in recent years, resulting in an impressive reduction in traffic casualties and fatalities. Despite this, however, tens of thousands of people are still dying in traffic accidents each year in the United States. Toyota and the automobile industry firmly believe that the next great opportunity to reduce injuries and fatalities from traffic accidents rests with the deployment of innovative new technologies that will prevent crashes in the first place.

Companies like Toyota are leading the way by outfitting vehicles with top-of-the-line sensors, radars, and cameras that can identify and notify drivers of potential hazards. However, these existing technologies have important limitations with respect to range, field-of-view, and line-of-sight. Vehicle-to-vehicle and vehicle-to-infrastructure communication is the technology that will allow us to overcome these challenges by allowing vehicles to identify collision threats at a greater distance or with a vehicle that is around a corner or behind a truck. The complementary combination of this communication technology and on-board sensors is critical to making significant progress towards our ultimate goal of zero casualties from traffic accidents.

Dedicated short-range communication, or DSRC, is such a technology. DSRC is a two-way, short- to medium-range wireless communication capability that allows vehicles to communicate with each other to detect and avoid hazards. DSRC-equipped vehicles broadcast precise information - such as their location, speed, and acceleration - several times per second over a range of a few hundred meters. Other vehicles outfitted with DSRC technology receive these “messages” and use them to compute the trajectory of each neighboring vehicle, compare these with their own predicted path, and determine if any of the neighboring vehicles pose a collision threat. This DSRC-enabled vehicle-to-vehicle communication capability paves the way for the next-generation of lane departure and forward collision warnings, sudden braking ahead warnings, do not pass warnings, intersection collision avoidance systems, and approaching emergency vehicle notifications.

DSRC vehicles can also communicate with DSRC-equipped roadside infrastructure, enabling additional information to be provided to drivers. This includes information about the potentially unique layout of an approaching intersection or road, the current and future state of upcoming traffic signals, and the existence of a potential hazard such as ice, fog, a disabled vehicle, a bicyclist, or a pedestrian.

If a DSRC-enabled vehicle determines that a potential collision or other hazard exists, the on-board system can warn the driver or, in some instances, take action to avoid an accident. Feedback to the driver can be conveyed audibly, visually through a heads up display, dashboard screen, or other signal, or through a haptic mechanism (such as a shaking steering wheel or vibrating seat) and can be formulated to range in intensity based on the risk.

In a 2010 report entitled *Frequency of Target Crashes for IntelliDrive Safety Systems*, the National Highway Traffic Safety Administration (NHTSA) concluded that connected vehicle technology – including both vehicle-to-vehicle and vehicle-to-infrastructure communication - has the potential to address scenarios accounting for approximately 80 percent of crashes involving non-impaired drivers. Specifically, NHTSA research showed that the technology could help prevent a majority of the types of crashes that typically occur in the real world, such as crashes at intersections or while changing lanes. NHTSA's analysis of communication alternatives also found that DSRC at 5.9 GHz is "the only communication option at this time capable of effectively and reliably providing this safety-of-life capability".

It is important to note that, although our initial focus is on safety applications, DSRC can – and almost certainly will - be used for many other applications beyond collision avoidance and related safety purposes. For example, DSRC can be used to assist with navigation, to make electronic payments (tolls, parking, fuels, etc.), to improve fuel efficiency through speed pacing at traffic lights, or to gather and disseminate real-time traffic information. In addition, just as the Internet has moved far beyond its original limited email and file transfer applications, DSRC is also likely to unleash creative and innovative connected car applications that go far beyond the immediate safety benefits that I am focusing on today. I have no doubt that DSRC will save lives, improve the environment, create jobs, and help the United States to maintain technical leadership in a field that will be an important contributor to economic growth in the future.

<u>What is the Current Status of DSRC Technology?</u>

I recognize that there may be some skepticism about DSRC technology and concerns that the benefits are being overstated or that the automakers will never bring the technology to the market. I can assure you that Toyota believes in and is committed to DSRC as a critical safety technology. In fact, we have already commercialized first-generation DSRC technology, and recently announced plans to commercialize second-generation DSRC, in other markets and would like to bring this technology to drivers of our vehicles here in the near future.

We are not alone on this. As you are aware, in 1999, the Federal Communications Commission (FCC) allocated 75 MHz of spectrum in the 5.9 GHz band to be used for DSRC. In 2003, the Commission adopted the licensing and service rules for DSRC systems operating in the band. Since then, U.S. DOT has been conducting research and field testing with Toyota and other automobile companies to demonstrate feasibility and to prepare for widespread deployment of crash avoidance systems that use vehicle-to-vehicle and vehicle-to-infrastructure communication. At this point, pre-production prototypes have been developed by a number of automobile companies, including Toyota, and are currently supporting demonstrations and large-scale evaluations of the applications that address the most critical crash scenarios.

During this time, work has been underway to develop the common technical standards for 5.9 GHz DSRC technology. In 2010, this work resulted in IEEE approving the 802.11p Wireless Access in Vehicular Environments (WAVE) amendment to the 802.11 standard for wireless local area networks (WLAN). Other core DSRC standards were also published in 2009 and 2010 by IEEE and SAE International.

In addition, in August of this year, Toyota and seven other automakers, including Ford, General Motors, Volkswagen, and Mercedes Benz, completed a year-long connected vehicle pilot program with U.S. DOT in Ann Arbor, Michigan. The Model Deployment, which included nearly 3,000 vehicles outfitted with DSRC technology from different manufacturers, demonstrated vehicle-to-vehicle applications in real-world driving scenarios and verified the maturity and stability of the standards. The results from the pilot program are currently being analyzed and assessed by NHTSA and are expected to inform a long-anticipated regulatory decision by the agency on the use of DSRC technology in future vehicles by the end of this year.

Automakers in the United States have been leading the way in the development of DSRC technology over the last decade. However, progress on DSRC is now occurring around the globe and American innovation in this area is being challenged. For example, in 2012, twelve automakers announced commitments to deploy vehicle-to-vehicle communication based on the IEEE 802.11p standard in the European Union by 2015. If the United States weakens its commitment to this technology in the final stretch, it will likely cede its leadership and the economic benefits of being the first to deploy the technology on an industry-wide basis will be lost to other regions.

<u>What Does the FCC's Notice of Proposed Rulemaking Mean for DSRC?</u>

As you are well aware, the FCC issued a Notice of Proposed Rulemaking earlier this year that solicited comments on opening the 5.9 GHz band to use by unlicensed devices.

Toyota is not conceptually opposed to sharing the 5.9 GHz spectrum with unlicensed devices and believes that it may be possible for DSRC and unlicensed devices to co-exist in the band. However, we also believe that the creation of a sharing framework, or the implementation of sharing rules, should not occur unless and until: (1) a viable spectrum sharing technology is identified; and (2) testing verifies that there is no harmful interference from unlicensed devices. Interference that results in delayed or missed driver warnings will undermine the system's entire foundation, rendering it essentially useless and putting the entire future of DSRC technology in the United States at risk. Although we are strongly committed to the technology, the automobile industry cannot responsibly deploy "safety-of-life" DSRC technology unless the possibility of harmful interference from unlicensed devices is ruled out.

In our opinion, Congress made an important and correct distinction in the *Middle Class Tax Relief and Job Creation Act* as it relates to the 5 GHz band. As you are aware, the law expressly required the FCC to initiate a proceeding to allow unlicensed devices to operate in the 5350-5470 MHz band. By contrast, there was no requirement by Congress for the FCC to initiate a proceeding to allow unlicensed devices in the 5.9 GHz band. Instead, the law required only that the National Telecommunications and Information Administration (NTIA), in consultation with other affected agencies, conduct a study to evaluate known and proposed spectrum sharing technologies and the risk to federal users if unlicensed devices were permitted. We believe that this Congressional distinction is critical and correctly supports the notion that further steps need to be taken before any kind of sharing regime is imposed in the 5.9 GHz band.

As you are likely aware, the preliminary NTIA study identified specific risk elements with respect to the co-existence of unlicensed devices with DSRC systems in the 5.9 GHz band. The study concluded that more work needed to be done to understand the challenges before the agency could conclude that the band can be safely opened up to Wi-Fi or other unlicensed use. The NTIA has stated its intent to finalize recommendations on the suitability of the band for unlicensed device operation by the end of next year.

The truth is that, as NTIA confirmed, there are unique technical challenges to sharing in the 5.9 GHz band that cannot be ignored. For example:

- Unlicensed devices currently operating in some other bands detect primary users whose position is most often fixed, such as in the case of radar installations. In these cases, a geolocation database of primary user locations may be sufficient to establish certain areas as safe for unlicensed operation. By contrast, DSRC devices are inherently mobile and can operate almost anywhere.

- Unlicensed signal detection technologies were not designed to detect, and may not actually be capable of detecting, DSRC signals.

- Wi-Fi devices currently detect a transition from a channel that is idle to one that is busy based on a 20 MHz Clear Channel Assessment (CCA) function. In contrast, DSRC signals use a 10 MHz channel. As a result, in order for CCA-based DSRC detection to be successful, a Wi-Fi device would need dedicated 10 MHz CCA detectors.

- DSRC channel access protocols were not designed with the co-existence of other wireless devices in mind and are not compatible with existing Wi-Fi channel access protocols. For sharing to be possible, it may be necessary for Wi-Fi devices to operate in the 5.9 GHz band only in places and at times when it can reliably be determined that DSRC devices are not present.

Toyota is committed to helping to validate a technical sharing solution in the 5.9 GHz band once one has been identified. We have been actively engaged with the Wi-Fi community and other stakeholders who are exploring possible sharing solutions that will alleviate any risk of harmful interference from unlicensed devices. We are also active and engaged members of the recently established Tiger Team through IEEE that is working on possible paths forward on this issue.

But we're not there yet and it's going to take a bit more time to see if we can get there. For now, the good faith efforts that are underway between the automobile companies, the Wi-Fi community, the FCC, the NTIA, and the U.S. DOT should be allowed to proceed. Let the stakeholder community continue to work together to determine the feasibility of sharing between unlicensed devices and DSRC systems.

In the meantime, we encourage the FCC to move forward with its proceedings to open up other bands of spectrum for unlicensed uses, including those within the 5 GHz band, if that is determined to be appropriate. Our request for further evaluation and deliberation applies only to the 5.9 GHz band.

Thank you, again, for the opportunity to testify before you today. We are pleased that the Committee is taking an active interest in developments within the 5 GHz band, and appreciate your willingness to fully explore both the challenges and opportunities that exist. I look forward to your questions.

JOHN KENNEY
Toyota InfoTechnology Center, U.S.A., Inc.
Summary of Written Statement

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