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Smart Cars and Trucks: Spectrum Use for Vehicle Safety

Background

Increasing the autonomy of cars and trucks is seen as an effective way to reduce the 94% of vehicle-related accidents that are caused by human error. While some semiautonomous safety technologies, such as automatic braking and adaptive cruise control, are in use today, autonomous safety technologies under development would require cars and trucks to communicate with each other (vehicle-to-vehicle, or V2V) and with their surroundings (vehicle-to-infrastructure, or V2I). V2V communication is expected to reduce the number of accidents by improving detection of oncoming vehicles and providing driver warnings. V2I communication is expected to help highway operators monitor and manage traffic and provide drivers with information such as weather and traffic conditions. These technologies are part of a congressional mandate to invest in and advance a broader set of intelligent transportation systems to improve traffic flow and safety.

For vehicles to communicate wirelessly, they need access to radio frequencies. In the United States, the Federal Communications Commission (FCC) manages commercial use of the radio frequency spectrum, and allocates spectrum for specific uses. In 1999, the FCC allocated 75 megahertz (MHz) in the 5.9 gigahertz (GHz) band to Dedicated Short-Range Communications (DSRC) uses. DSRC technologies, installed in cars and trucks and on roadways, enable V2V and V2I communications.

Integrating DSRC technologies in vehicles and on roadways is in its early stages. Meanwhile, the proliferation of cell phones and other devices has increased demand for spectrum, and a competing technology, Cellular Vehicle-to-Everything (C-V2X), has emerged as an alternative to DSRC for vehicular communications.

In December 2019, the FCC proposed rules that would reallocate the lower 45 MHz of the 5.9 GHz band for unlicensed use (e.g., Wi-Fi), and allocate the remaining 30 MHz for transportation and vehicle-related use. Of the 30 MHz, the FCC proposed to grant C-V2X exclusive use of 20 MHz of the segment. It is seeking comment on whether the remaining 10 MHz should remain dedicated to DSRC or be dedicated to C-V2X. The FCC commissioners noted that DSRC has evolved slowly and has not been widely deployed, and the rules are intended to ensure the spectrum supports its highest and best use. This decision has competitive implications for the automotive, electronics, and telecommunications industries, and may affect the availability of safety technologies and the path toward vehicle automation.

DSRC

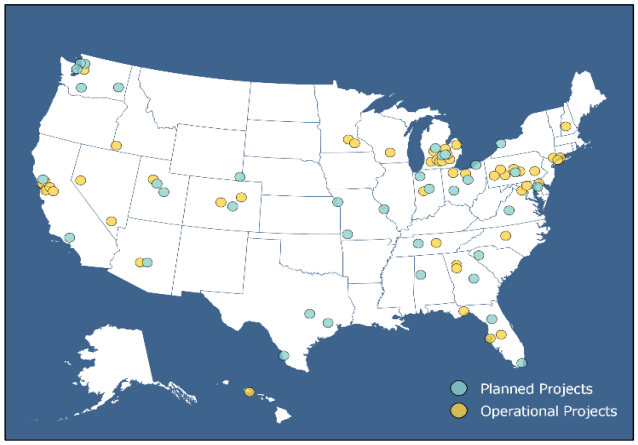
In 1998, the Transportation Equity Act for the 21st Century (TEA-21; P.L. 105-178) directed the FCC, in consultation with the U.S. Department of Transportation (DOT), to consider spectrum needs for transportation, including the DSRC wireless standard. The goal of the initiative was to leverage technologies to improve traffic flow and safety.

From FY2003 through FY2014, DOT provided about $570 million for research, development, and testing of DSRC technologies. In 2015, it awarded $43 million to three pilot sites (with an additional $9 million in local matches):

- **Safety in a large metropolitan area.** The New York City Department of Transportation is outfitting 8,000 taxis, buses, and sanitation vehicles with DSRC safety devices to demonstrate connected-vehicle capabilities focused on alerting drivers to potential crashes and reducing accidents with pedestrians.
- **Interstate routes and commercial vehicles.** During severe winter weather along I-80 in Wyoming, DSRC technologies are used to notify cars and trucks of disabled vehicles. Vehicles rebroadcast the warning. The goal is to prevent weather-related crashes.
- **Mid-sized urban area.** Cars, buses, and pedestrians are part of a DSRC pilot in downtown Tampa, FL, that alerts drivers to reduce speeds when approaching heavy traffic, when forward collisions may be imminent, and where intersections are unsafe.

In addition to these pilot projects, several manufacturers in the United States and Europe have begun integrating DSRC technologies into cars and trucks; truck platooning (the linking of multiple trucks into a convoy through V2V communications) has been demonstrated on U.S. highways; and additional DSRC deployments are underway in more than two dozen states (see **Figure 1**.)

Figure 1. DSRC Deployments



Source: CRS, based on data from Volpe National Transportation Systems Center (DOT), May 2019.

Notes: DOT has 52 operational projects and 35 more planned, including more than 26,000 devices deployed on vehicles in urban, rural, and suburban settings.

Proposed DOT Standard

At the end of the Obama Administration in January 2017, the National Highway Traffic Safety Administration (NHTSA) proposed a new federal safety standard that would require all new light vehicles—passenger cars, sport-utility vehicles, and pickup trucks—to be equipped with DSRC technology by 2023. Proponents say that this mandate is necessary to ensure compatibility and connectivity across all vehicles and systems. DOT projected that implementing it could prevent more than 1,000 fatalities annually. The Trump Administration has taken no further action on this proposal, stating that DOT should remain technology-neutral. Instead, the Administration states that the 5.9 GHz band should remain dedicated to vehicle safety, but should be open to multiple technologies.

New Technologies

As governments and industry were deploying DSRC, new wireless technologies emerged with their own spectrum needs. These include Wi-Fi and C-V2X.

Wi-Fi

In 2012, Congress directed the FCC to determine whether the 5.9 GHz band could be shared to support unlicensed devices such as cordless phones, wireless speakers, and Wi-Fi devices (P.L. 112-96, Title VI, Section 6406). In response to a July 2016 FCC Public Notice seeking comments, some commenters proposed that all users share the entire 75 MHz band, while others proposed that DSRC safety-of-life applications have a separate segment. The FCC is conducting testing to determine whether Wi-Fi uses could cause interference with DSRC technologies. In a December 2019 report, DOT stated that "channel test results showed the potential for cross-channel interference, having an impact on DSRC performance," which likely informed the FCC decision to assign spectrum to each user.

C-V2X

Working through the 3rd Generation Partnership Project, a standards organization for global wireless networking, some automakers and telecommunications and technology companies created the C-V2X standard in 2017. Like DSRC, C-V2X can operate independently from the cellular network for V2V and V2I communications. C-V2X can also connect to cellular networks and is expected to be able to use future 5G networks. 5G, when fully deployed, is expected to provide high-speed, low-latency (i.e., reduced lag time) services needed for autonomous vehicles, allowing information between vehicles and infrastructure to be shared almost instantaneously.

The 5G Automotive Association (5GAA), a consortium of automakers, technology companies, telecommunication providers, standards bodies, and others, supports C-V2X. The 5GAA asserts that C-V2X performs better than DSRC in testing and is emerging as the global standard. In 2018, 5GAA petitioned the FCC for spectrum in the 5.9 GHz band to develop and deploy C-V2X. Testing of C-V2X has so far been limited to select highways in a few cities.

Policy Considerations

The reallocation of spectrum may encourage investment in certain technologies and priorities and disinvestment in others. Congress may wish to consider whether reallocating the 5.9 GHz band would advance national priorities and best serve the public interest.

In the debate leading up to the decision, DSRC advocates, such as the Safety Spectrum Coalition, which includes the Association of Global Automakers and the American Trucking Associations as well as many state departments of transportation, contended that DSRC should continue to be supported, noting that millions of dollars have been invested. The coalition maintains that the technology has been thoroughly tested and deployed, is improving highway safety, and may be able to co-exist with C-V2X.

The Coalition for Safety Sooner—comprising 15 state DOTs and other state highway authorities—argued that it is not in the public interest to delay the deployment of currently available safety technologies (e.g., DSRC) while waiting for other technologies (e.g., C-V2X, 5G) to emerge.

Automakers took different positions based on their differing technology plans. Cadillac has already included DSRC in some models, so any loss of DSRC spectrum may affect its connected car plans, investments, and services. Volkswagen and Toyota had paused DSRC deployment due to the lack of a federal standard and spectrum uncertainties, and also because they saw benefits in C-V2X; the reallocation of spectrum for C-V2X may drive these companies to invest in C-V2X. Ford had already announced it would deploy C-V2X in its new vehicles in 2022; thus the reallocation of spectrum for C-V2X would likely benefit Ford.

While the debate was framed as a choice between DSRC and C-V2X, DSRC advocates, 5GAA, transportation agencies, and safety advocates agreed that the 5.9 GHz band should remain dedicated to vehicle safety uses and should not be made available for other purposes. In contrast, the Wi-Fi Alliance, whose members include major electronics companies such as Apple and Cisco, along with consumer groups and wireless internet service providers, argued for the spectrum to be shared between transportation and Wi-Fi users. These groups argued that sharing the band with unlicensed uses (e.g., Wi-Fi) would expand public access to broadband and better serve the public interest.

Telecommunications providers and technology firms stand to benefit from more spectrum for C-V2X and Wi-Fi. C-V2X relies in part on cellular networks and has the potential to increase their customer base and revenues. Wi-Fi enables interconnection of devices to telecommunication networks, and is needed to support new 5G networks and services.

The challenge for policymakers is balancing the interests of multiple stakeholders: investors in DSRC who committed funding to develop car and truck safety technologies and other intelligent transportation systems; consumer safety advocates who want currently available technologies to be diffused quickly; potential users of Wi-Fi services, including consumers and telecommunications firms seeking to deploy 5G networks; C-V2X advocates eager to deploy the next generation of vehicle safety technologies; and the nation at large, which could benefit from the deployment of new technologies that would improve vehicle safety, make

roadways more efficient, and yield economic gains that often accompany the development of new technologies.

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