WRITTEN STATEMENT OF
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HEARING ON

U.S. Surface Transportation: Technology Driving the Future

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Chair Comstock, Ranking Member Lipinski, and Members of the Committee, thank you for the opportunity to appear before you today to discuss the breadth and opportunities of the Department of Transportation's research, development and technology (RD&T) programs.

We all recognize that effective and implementable transportation research and technology products are essential tools for maximizing the Federal investment in transportation infrastructure and operations. We need to make our transportation system smarter – more efficient and effective. That's why the Department sent you a new and improved GROW AMERICA Act on March 30. GROW AMERICA is a fully-funded, comprehensive multiyear proposal, which includes 350 pages of smart policy prescriptions and substantial funding growth, including for research and technology, all focused on the future.

The future of the U.S. transportation system in all modes has the potential to be safer, cleaner, more efficient, durable and resilient if the necessary research is performed and results

implemented. All functions, from planning, to construction, to environment, to operations and maintenance, benefit from well-designed and well-funded research and technology programs.

Secretary Anthony Foxx has highlighted the challenges we face, and suggested some of the possible paths forward, in his visionary framework, *Beyond Traffic 2045: Trends and Choices*. If you have not had a chance to review the results of this excellent assessment prepared by staff from across the Department, including leadership from my own organization and our Volpe National Transportation Systems Center, I would encourage you to do so and to provide us your comments. *Beyond Traffic* is informed by the information and opinions provided by the leading thinkers and organizations in American transportation and, more importantly, by regular Americans who engaged with us through multiple webinars and other virtual sessions. We were especially pleased to see the response of young people early in their transportation careers, with whom we made a special effort to connect – after all, we are talking about the future they will be living in.

Beyond Traffic analyzed the condition and performance of our transportation system today, and also forecasted how it will look and perform 30 years from now. *Beyond Traffic* reveals that, if we don't change, in 2045, the transportation system that powered our rise as a Nation will instead slow us down. Transit systems will be so backed up that riders will wonder not just when they will get to work, but if they will get there at all. At the airports, and on the highways, every day will be like Thanksgiving holiday travel is today.

This is not a picture of our inevitable future. Our purpose in producing this report was to analyze the latest data and trends shaping transportation so we could objectively frame critical policy choices that need to be made. Some of the key questions we are asking are: How will we move better? How will we knock down barriers to new technologies that promise to make travel safer and more convenient? For example, we recognize that:

- Technological changes and innovation may transform vehicles, infrastructure, logistics, and the delivery of transportation services to promote efficiency and safety.
- New sources of travel data have the potential to improve travelers' experience, support more efficient management of transportation systems, and enhance investment decisions.
- Automation and robotics will affect all modes of transportation, improving infrastructure maintenance and travel safety, and enabling the mainstream use of autonomous vehicles.

All of these technology and data trends are happening now. I will spend the remainder of my testimony discussing how the Department's RD&T programs are seeking both to enable, and to take advantage of, these fast-moving developments, many of which are coming from outside the traditional transportation industries.

Vehicle-to-Vehicle Technologies and Vehicle Automation

GROW AMERICA invests $935 million over six years in the future of vehicle safety and innovation, including the advancement of vehicle automation and vehicle-to-vehicle technologies. The Administration made accelerating deployment of vehicle-to-vehicle (V2V) technologies, and swiftly advancing the framework to enable automated vehicles, a priority in

the FY 2016 budget request, by seeking $158 million for the Intelligent Transportation Systems (ITS) research program, a 68 percent increase over FY 2015 enacted levels.

On May 13, Secretary Anthony Foxx directed the National Highway Traffic Safety Administration (NHTSA) to accelerate the timetable for its proposal to require V2V technology in new vehicles. He also committed DOT to rapid testing to ensure that the wireless spectrum used by V2V is not obstructed by radio interference. And, he has asked NHTSA to make sure our regulatory framework encourages the deployment of demonstrated traffic safety innovations. Together, these steps will support the current revolution in connected vehicle technologies while also making sure those technologies are safe.

The ITS Program, funded through the Research, Technology, and Education (RT&E) Program and managed by my office through the ITS Joint Program Office, is fully multi-modal. While public attention falls on the vehicle side of our work, we continue to conduct critical research in multi-modal vehicle-to-infrastructure safety and mobility applications. We also continue to advance our work on integrating data streams from multiple sources – roads, transit, freight and vehicles – to increase mobility, efficiency, and capacity while decreasing congestion, travel times and environmental impacts. Phase 1 of the Connected Vehicle Pilots Deployment Program, the solicitation for which closed in mid-March, will further Connected Vehicle implementation, not just for safety, but also to advance both mobility and efficiency applications.

In connected vehicles and automation, we intend to pursue:

- Connected Vehicle Implementation – This program will fill any research gaps identified by NHTSA to support light vehicle safety rulemaking efforts, and will provide research to speed the adoption of safety capabilities for heavy vehicles.
- Vehicle-to-Infrastructure (V2I) – Our research will also develop the capability to use smart infrastructure to support warning drivers of road hazards such as intersection collision, slippery road surfaces, excessive speed on curves, and other conditions that present hazardous or dangerous conditions to drivers. The purpose is to accelerate the next generation of safety applications through widespread adoption of V2I communications to reduce crashes, injuries, and fatalities. This research will also provide valuable information to support the FHWA deployment guidance and accelerate implementation of connected vehicle systems by State and local agencies to increase mobility, freight efficiency, and capacity.
- Automation – This research will enable and accelerate the development and deployment of automated vehicles, ensure safe and efficient operations of emerging technologies and systems, and maximize public benefits by leveraging connected vehicle technologies, infrastructure-based solutions, and other approaches. Building upon the connected vehicle safety research as the logical "bridge" to safe introduction of automated vehicles, the program would undertake three major pilot activities that could demonstrate and evaluate the transformational potential of automated vehicles in a real-world environment while reducing deployment risks for industry and society. These research pilots would facilitate defining performance requirements, as well as objective and threshold performance criteria. This in turn would enable the government, automotive industry, equipment manufacturers, and the standards development organizations to define the

preconditions needed to commercialize and deploy affordable automated vehicle fleets in the U.S. with safety performance superior to today's human-operated vehicles.

- Vehicle-to-Pedestrian – The Department is engaged in a study to identify vehicle-to-pedestrian (V2P) applications that would warn the driver, pedestrian, or both of an impending collision using Dedicated Short Range Communications (DSRC) technology, and is estimating the potential benefits of such warnings. In FY 2014, the Department reviewed and assessed operational and prototype pedestrian detection and warning systems, held two focus group meetings on technology acceptance and usability, and began analyzing the role of DSRC and other communications methods. In FYs 2015 and 2016, the Department plans to test V2P technologies at the Turner-Fairbank Highway Research Center's intersection test bed for market readiness and real world implementation. Both intersection and non-intersection (i.e., mid-block) crashes will be tested. The Department is further considering a project to develop, test, evaluate, and modify a Connected Vehicle safety application that alerts pedestrians of bus movements around bus stops, using V2I and potentially V2P communications.

Dedicated Short Range Communications

At this point, I would like to address a topic I am told is of interest to the Committee, that of the suggested sharing of the Dedicated Short Range Communications (DSRC) spectrum band upon which V2V and V2I communications rely, with unlicensed WiFi devices. All of this V2V and V2I success, and the standards that support it, and the move along the continuum to automation, are based upon the unimpeded availability of the 5.9 gigahertz (GHz) DSRC spectrum. Allocated in the U.S. and internationally for transportation safety, the 5.9 GHz band

was specifically selected to enable the ten-times-per-second exchange of information needed to bring to reality the safety improvements that remain the primary goal of ITS research. We recognize that spectrum is a scarce national resource and that it is important to find ways to expand wireless broadband capacity. DOT continues to believe that saving lives is the most valuable use of this spectrum.

As you know, the FCC in February 2013 published a Notice of Proposed Rulemaking (NPRM) proposing unlicensed (U-NII) device operations in the 5850-5925 MHz band.[1] DOT has been engaged with the FCC and the NTIA to address the technical questions raised by this proposal, and to support the 5850-5925 MHz band feasibility study required by Section 6406 of the Middle Class Tax Relief and Job Creation Act of 2012. DOT has established testing capabilities so that we can analyze interference and sharing possibilities. We are also working with FCC and NTIA to clearly identify the test requirements, facilities and timeline to support testing of interference mitigation techniques that may be employed by 5.9 GHz U-NII devices if they become available from industry.

I want to emphasize that DSRC availability, and the safety benefits proven through the Ann Arbor Safety Pilot Demonstration, undergird and made possible the NHTSA Advance Notice of Proposed Rulemaking (ANPRM). This demonstration testing, and the ANPRM, are the results of almost 20 years of careful and coordinated research and technology development by the auto industry and its suppliers, and DOT, focused on safety and mobility. Public safety

[1] The FCC references the DSRC spectrum band (5.85-5.925 GHz) as Unlicensed National Information Infrastructure (U-NII)-4.

technologies must be well-proven, reliable and mature to be effective. The NHTSA ANPRM concluded that DSRC-reliant safety-critical applications are proven effective, and that the life-saving benefits of DSRC devices far outweigh the costs of mandating those devices in light vehicles. DSRC also supports NHTSA's ongoing work toward a decision on a heavy vehicle rulemaking.

We are ready to work with any interested party to review and analyze U-NII sharing proposals for the 5.9 GHz band. To date, only conceptual sharing proposals have been discussed, and no 5.9 GHz U-NII devices have been offered for testing and analysis. To protect DSRC's life-saving potential, real-world device testing will be required to ensure that potential U-NII devices do not cause harmful interference to critical ITS safety applications in the 5.9 GHz band, as required by the FCC's rules. To this end, DOT has maintained the Ann Arbor test bed beyond its original planned lifetime, and put in place additional spectrum testing agreements and other facilities, to be as ready as possible for live interference testing.

We will also deliver the "Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications Systems Deployment" report, focused on DSRC, as required by Section 53006 of the Moving Ahead for Progress in the 21st Century Act (MAP-21). Secretary Foxx has challenged us to accelerate delivery of the report to you, and we are working to meet his challenge. On April 28, we received the recommendations resulting from the required National Research Council review of the draft report. The review committee agreed with DOT's draft report about the benefits that DSRC technology offers compared with other communications technologies for safety-critical messages, and also agreed that proposed spectrum sharing in the

5.9 GHz band is the most serious risk and uncertainty of relying on DSRC for safety-critical messages. The committee, however, also identified other unknowns and uncertainties that the report should address, which we are doing before submitting the report to Congress.

Vehicle Safety Research

Continuing with vehicle safety research, the FY 2016 Budget provides NHTSA with $114 million to support safety goals through behavioral research and demonstration programs that focus on issues like distraction and combatting impaired driving, as well as on collecting and analyzing crash data. A total of $7.1 million is requested specifically to conduct research on advanced and emerging technologies and alternative fuel vehicles that require thorough testing to ensure that their level of safety for vehicle occupants is comparable to that of other vehicles.

NHTSA research supports numerous planned or active rulemakings, for example:

- NHTSA consideration of heavy vehicle rear underride guards.
- Agency regulatory actions on child restraint performance standards in side and frontal impacts.
- Possible regulatory actions on frontal oblique crashes, including repeatability and reproducibility testing and analysis.
- Initiating research to evaluate inclusion of an advanced small female dummy into adaptive rear seat, side impact, and frontal oblique testing.
- Supporting potential implementation of a new brain-injury criterion.

NHTSA funding also supports the continued crashworthiness and defect investigations research work of the Vehicle Research and Test Center (East Liberty, OH).

The Federal Motor Carrier Safety Administration (FMCSA) is requesting $10 million for multiyear Research and Technology programs focused on producing safer drivers and carriers. The Research and Technology program provides scientific safety research on driver behavior, carrier operations, and technology applications. These contributions have proven critical in supporting agency safety rulemakings, identifying enforcement priorities, and facilitating technology transfer to the marketplace. FMCSA research will continue to develop enhanced enforcement technologies, measure driver safety, evaluate the safety implications of automated and semi-automated vehicles, and examine how commercial motor vehicles can safely use alternative fuels. These projects provide the underpinnings for the Agency's rulemaking and enforcement priorities. For example, recent research findings demonstrated the safety benefits of carriers' use of electronic logging devices to keep track of driver work hours.

Highways

The President's Budget requests $496 million for the Federal Highway Administration's (FHWA) Research, Technology, and Education (RT&E) Program to provide for a comprehensive, nationally coordinated highway research, technology, and education program, of which $158 million supports ITS Research as discussed earlier. GROW AMERICA carries forward the MAP-21 restructured FHWA research, development, and technology activities, which include a highway research and development program, a technology and innovation deployment program, and a training and education activities program. Research supporting innovative finance efforts is also included. I'd like to highlight some of FHWA's exciting work:

- The Every Day Counts (EDC) initiative seeks to increase innovation at every stage of the highway project lifecycle, and I think is a model of how Federal agencies might better

partner to move research results into practice. Launched in 2010 as a partnership with State and local agencies, EDC has now moved into a third phase focusing on "efficiency through collaboration and technology." These innovations are helping States and localities demonstrate and deploy research results in daily practice, supporting the goals of shortening project delivery times, enhancing roadway safety, reducing congestion, and improving environmental sustainability.

- The Second Strategic Highway Research Program (SHRP 2) was authorized by Congress in 2005 to investigate the underlying causes of highway crashes and congestion in a short-term program of focused research. Managed by the Transportation Research Board of the National Academies, in partnership with the Department and the American Association of State Highway and Transportation Officials (AASHTO), and including many other partners, SHRP 2 targeted goals in four interrelated focus areas: safety, renewal, reliability and capacity. While the research phase has wrapped up, implementation – which began for completed products in 2012 – is moving forward swiftly. FHWA and AASHTO are now promoting their sixth round of SHRP 2 products through the Implementation Assistance Program, with next year's seventh round products already announced. GROW AMERICA provides up to $25 million for SHRP 2 implementation to accelerate innovation delivery and technology implementation.
- FHWA's Turner-Fairbank Highway Research Center sits just up the George Washington Parkway in McLean, Virginia, and I know of few better ways to understand what we do in RD&T than visiting Turner-Fairbank. I invite you to follow President Obama's example – he went to Turner-Fairbank in July 2014 to celebrate our advances in connected vehicles and infrastructure – and visit the laboratories to learn about work in

ITS, advanced operations, human factors, structures, and other research to make highways safer, more efficient, and more environmentally sustainable.

Multimodal Freight Research

Everyone agrees that unsafe freight movements, and freight congestion on all modes, are costly – in lives, increased economic burden, hampered trade, and increased idling emissions and other environmental impacts. All of our operating administrations have programs that address in some way their specific portion of the freight challenge, but few are research and technology-oriented. The Department is prioritizing freight projects through Transportation Investment Generating Economic Recovery (TIGER) grants and other formula programs, by various cross-modal activities and data sharing, and by pursuing the MAP-21 requirements to develop a National Freight Policy, National Freight Network, and National Freight Strategic Plan.

However, what is needed is a multi-modal, collaborative freight research program that brings all parties to the table – shippers, carriers, forwarders, and all levels of government – to address our common issues, issues that are growing as we project that freight volume will increase 45 percent by 2045. GROW AMERICA establishes the National Cooperative Freight Transportation Research Program to provide the research and analytical support to meeting national freight goals. The Program includes a specific, targeted focus on improving the safety of hazardous materials transportation and handling.

GROW AMERICA will improve data and technology support to national freight goals by strengthening the Bureau of Transportation Statistics' (BTS) ability to require responses to

freight and intermodal data surveys, and by enabling nationally-consistent statistics on maritime port performance. The lack of robust, multi-modal freight data is a hurdle to assessing the condition and performance of the national freight system as required by MAP-21; GROW AMERICA efforts to improve data collection are key to rectifying this problem. In addition, the Act will add an ITS freight research, demonstration and applications focus to the ITS Research Program goals. I should note that BTS, a designated independent Federal statistical agency, is also a part of my office. BTS manages and shares statistical knowledge and information on the Nation's transportation systems, including statistics on freight movement, geospatial transportation information, and transportation economics. BTS' flagship product is the Commodity Flow Survey, which is the primary source of national and State-level data on domestic freight shipments by American establishments in mining, manufacturing, wholesale, auxiliaries, and selected retail and services trade industries. *Beyond Traffic* and other DOT publications draw key statistics on freight movement, as well as on passenger travel and the economic consequences of transportation, from BTS.

Hazardous Materials and Pipeline Safety

The safe transportation of hazardous materials is a responsibility shared by all modes of transportation. To continue to build upon its string safety record, the Pipeline and Hazardous Materials Safety Administration (PHMSA) is requesting $22 million in R&D funding for FY 2016.

The Hazardous Materials Safety R&D program is conducting research with the outcome goal of minimizing the risks associated with multimodal transportation. It analyzes these risks to

better understand the contributing factors and to minimize potential impacts, and uses those results to focus research efforts on areas that inform and guide potential future changes in regulations, industry safety practices, alternative opportunities for training development, and global intermodal transport efficiency demands for hazardous materials. PHMSA intends to continue to implement strategies outlined in its *2012-2017 R&D Strategic Plan* and is conducting projects that focus on the safe transport of energy products, particularly crude oil by rail (in close coordination with Federal Railroad Administration (FRA)) and liquefied natural gas (LNG). Increasing domestic production of LNG has resulted in more LNG being transported within the U.S. In addition to nitrogen (inert gas), LNG is primarily comprised of methane along with small amounts of ethane, propane, butane, and some trace amounts of heavier alkanes– all highly flammable gases.

Rail Safety

A critical element of freight and passenger movement is America's rail system, which has been much in the media of late. To continue decades-long progress in rail safety performance, FRA is requesting $3.4 billion in additional resources in FY 2016 to focus on the three most pressing rail safety issues we believe are facing us today:

- Increasing rail transportation of crude oil and its derivatives, such as liquefied petroleum gas, significant levels of rail transportation of ethanol, and preparation for rail shipments of LNG.

- Passenger rail safety issues that have surfaced so far in the wake of Metro-North Commuter Railroad and Amtrak accidents.[2]
- Highway-rail grade crossing, pedestrian safety, and trespass prevention.

While this portion of the Budget Request is not specifically R&D, all aspects of it draw upon past successes in rail research and technology to implement safety strategies and to guide these investments. For example, work performed by FRA and our Volpe Center on the improved crashworthiness of passenger cars found its way into the new car designs deployed by Metrolink in California. When February's Metrolink crash occurred in Oxnard, while it was a tragedy that the engineer died, the new cars clearly reduced deaths and injuries among the passengers.

The President's Budget requests $39.2 million for further rail safety-related research and development activities, including continued support for the Short Line Safety Institute and research on the safe transportation of LNG. FRA will continue its long-term research programs to reduce accident numbers and rates and mitigate the consequences of accidents by investigating railroad safety issues related to human factors, track, rolling stock, hazardous materials, highway-rail grade crossings, trespass, train control and communications systems and other systems. There is $25 million in R&D funding requested to support the proposed Rail Service Improvement Program in GROW AMERICA by making investments at the Transportation Technology Center (TTC) in Pueblo, Colorado.

[2] For example, the National Transportation Safety Board's investigation of the May 12, 2015, Amtrak derailment in Philadelphia is ongoing.

I would also note that GROW AMERICA provides $3.05 billion to assist with the implementation of Positive Train Control (PTC) technology.[3] Previous PTC research focused on shared freight/passenger commuter PTC technical issues and commuter rail PTC compliance to prevent train accidents and incidents on those transit systems. FRA research continues to assist in the nationwide deployment of PTC systems. This activity is a cooperative effort between FRA, Class I railroads, the Association of American Railroads, and other interested parties. This cooperative effort includes technology exchanges and field-testing on the railroads. One of the key elements is the use of FRA's PTC test bed at the TTC to ensure the proper functioning and reliability of the new technology.

Transit Research and Training

In addition to working with FRA on commuter rail safety, the 2016 President's Budget requests $60 million, an 82 percent increase over FY 2015 enacted, for the Federal Transit Administration (FTA) to support research activities that improve the safety, reliability, efficiency, and sustainability of public transportation systems by investing in the development, testing, and deployment of innovative technologies, materials, and processes. These activities will help to create "Ladders of Opportunity" for transit-dependent populations that will help improve access to jobs and educational opportunities. The funding request also includes:

- Transit Cooperative Research Program – provides funding to the National Academy of Sciences to conduct investigative research on subjects related to public transportation.

[3] A PTC system is designed to prevent train-to-train collisions, over-speed derailments, worker injuries from train incursion in the work zones, and train accidents and incidents from movement through track switches in the wrong position.

- Technical Assistance – enables FTA to provide technical assistance to the public transportation industry, with an emphasis on improving access for all individuals and transportation equity.
- Human Resources and Training – enables FTA to carry out human resource and training activities within the transit industry, as well as to establish a competitive workforce development grant program. FTA's goal is to improve the skill sets, knowledge, and abilities of transit industry employees that operate increasingly complex vehicle and equipment systems, and to build new pathways into the transit industry for job seekers.

University Transportation Centers

GROW AMERICA enhances the effectiveness of the current University Transportation Centers (UTCs) program by enabling funds to flow into cross-disciplinary university transportation research, by expanding the sources for grant matching funds to include funding from more Federal-Aid accounts and funding provided by other DOT operating administrations. GROW AMERICA also suggests technical corrections to eliminate guidance that caused confusion for some of the universities seeking to submit proposals.

Since the late 1980s, Congress has acknowledged the important contributions made to transportation research, technology transfer, education and workforce development by America's universities. The UTC Program, managed for the Department by the Office of Research, Development and Technology in my office, is recognized as the flagship university research, education, and technology transfer program. Designed to address cross-modal and multi-modal issues, the UTC Program is one of the few opportunities for DOT to support advanced research,

by enabling universities to use their cross-disciplinary capabilities to conduct the advanced work for which they are well suited.

Covering over 120 universities that bring expertise in multiple disciplines, both traditional (civil engineering) and not (public health, psychology and sociology, studying safety culture), UTCs enable the systemic, interdisciplinary, cross-modal research we need to address increasingly complex challenges that cross traditional boundaries. I am personally pleased that the Department's emphasis on reaching out to Minority Serving Institutions (MSIs) and other underserved groups is adding to our expertise pool. Of the 35 UTC grantees selected in the MAP-21 competition, ten are MSIs, and another 31 MSIs receive funding as team members of a UTC consortium.

UTCs do this while educating undergraduate and graduate students in the technical and problem-solving skills we need moving forward – a "win–win" if I've ever heard one. In 2014, the MAP-21 UTC consortia supported 1,369 undergraduate and graduate students in their transportation-related studies, and awarded 269 degrees – 63 of them doctorates. I always enjoy the opportunity to meet with the bright young students at our UTCs, to hear about what exciting new things they are developing in the laboratories and classrooms, and how their own lives are changing even as they add to our transportation knowledge. I encourage the members of this Committee to take those opportunities as well.

Multimodal Research and Research Coordination

My office was created to manage multimodal research programs and initiatives, and to improve coordination of transportation research within the Department and with external researchers. As noted earlier:

- the Intelligent Transportation Systems (ITS) research program is a multi-modal hub of research activity and has applications across the surface and maritime operating administrations within the Department;
- the University Transportation Centers (UTC) program supports cross-cutting research and workforce development across the entire transportation enterprise; and
- the Bureau of Transportation Statistics (BTS) provides trusted data and statistics on multi-modal freight movements and passenger travel, on the economics of transportation, and on transportation system performance.

In addition, my office is home to three other important cross-modal program offices:

- Volpe, the National Transportation Systems Center (Cambridge, MA) – for over 40 years, Volpe's Federal staff has helped the transportation community navigate its most challenging problems. Volpe's mission is to improve transportation by anticipating and addressing emerging issues and advancing technical, operational, and institutional innovations across all modes. Volpe is 100 percent funded by sponsor projects and receives no appropriated funds. In addition to supporting all DOT operating administrations and the Office of the Secretary of Transportation, Volpe provides multimodal and multidisciplinary expertise to deliver transportation-related innovation to

sponsors from other Federal agencies, State and local governments, and international partners.

- The Transportation Safety Institute (Oklahoma City, OK) – TSI supports the Department's goal to reduce transportation-related deaths and injuries through quality instruction to those entrusted with enforcement and ensuring compliance. For 40 years, TSI has provided training to Federal, State, and local governmental, private sector, and foreign transportation professionals on a cost-recovery basis. More than 800,000 students have received TSI's high-quality safety and security training in aviation, highway traffic, transit, motor carriers, and hazardous materials.
- Positioning, Navigation and Timing (PNT) & Spectrum Management – manages the critical technical task of enabling DOT to fulfill its mandate as the lead civil agency for PNT under the President's National Space Policy (2010). Plans and goals for FY 2016 include:
    - Conducting testing and analysis to ensure protection of the Global Positioning System (GPS) from systems that may cause interference. DOT is implementing the GPS Adjacent Band Compatibility Assessment Plan to research the maximum aggregate power level that can operate in the radiofrequency bands adjacent to GPS without causing harmful interference. The requested funding addresses growing interference to GPS from other sources, with a goal of protecting existing and evolving uses of space-based PNT.
    - Supporting ongoing evaluation of spectrum sharing technologies to determine whether use of Dedicated Short Range Communications (DSRC) for safety-critical

connected vehicle (V2V and V2I) technology applications can co-exist with operation of wireless services.

- Increasing oversight of civil funding and participation in GPS acquisition, development, operations, and modernization.

Improving transportation research coordination is a primary function across my organization. I have already mentioned several cross-modal research projects; our staff have set in place processes to standardize research coordination and technology transfer processes. Chief among these was the creation of the DOT Research Hub, a publicly-accessible database of research projects funded by DOT. My office often leads in coordinating transportation research capabilities with Administration initiatives, and in working with other Federal agencies where there is mutual benefit. Our Volpe Center's multi-modal expertise, and projects that cross modal boundaries, certainly aid in this coordination. I'd like to share with you three recent research coordination success stories, one inside DOT and two outside.

Competitive Academic Agreement Program: PHMSA wanted to reach out to the academic community for outside-the-box pipeline transportation solutions and innovations to address critical pipeline safety needs. PHMSA worked with our UTC grants program staff to develop the competitive grants guidance, based in part on the highly-successful UTC Program competitions. The Competitive Academic Agreement Program (CAAP) began in 2014, already has 79 students involved with the research, and is building an internship program. Their projects are diverse in scope, but all aim to address safety challenges like pipeline damage prevention, leak detection, and pre-regulation pipe. PHMSA is now building CAAP partnerships with

nationally recognized pipeline-related organizations to formally host student presentation sessions. In the long run, PHMSA plans to adopt the most-promising findings into the core research program for further investigation and collaboration with their pipeline safety partners.

Clean Transportation Sectors Initiative: We are collaborating with the Department of Energy's National Renewable Energy Laboratory to support the Clean Transportation Sector Initiative. The collaboration is looking at best practices that can be used by research practitioners and policy makers in the mapping of optimal directions for the future of the transportation sector and the leveraging of its intersections with other economic sectors such as power and agriculture. This will help lay the foundation to characterize different future transportation sector scenarios that demonstrate the interaction and evolution of the following elements: various networks of fuel, vehicle, and infrastructure technology; critical material requirements; potential disruptive technology impacts; and the applicability to different modes of transportation. This characterization will facilitate the ability to compare and demonstrate the potential integration of pathways towards optimal system deployments that will span the next half-century.

Cyber Physical Systems: My office holds a position on the National Information Technology Research and Development Cyber Physical Systems Senior Steering Group. As a result of coordination through that interdepartmental initiative, the ITS Joint Program Office collaborated with the National Science Foundation on a call for proposals on Cyber Physical Systems. This work follows on the successful project-level collaborations that the FHWA Exploratory Advanced Research Program has been managing for several years.

The Department needs to be more involved in cross-agency research on priority national topics, both to bring transportation expertise to national issues that transportation touches, and to learn more directly from other agencies whose work bears on ours. GROW AMERICA creates a Priority Multimodal Research Program enabling cross-agency research and innovation along three priority areas: infrastructure systems resilience and recovery; advanced research towards a Zero Emissions Transportation System; and a multimodal STEM (Science, Technology, Engineering, and Mathematics) Education and Workforce Development program.

Conclusion

In conclusion, I am excited about the positive impacts that our effective RD&T programs are bringing to the safety, state of good repair, economic competitiveness, quality of life in communities, and environmental sustainability goals of the Department. We are addressing serious issues in serious ways for the benefit of the American public and the American economy. I look forward to answering your questions.