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SUBCOMMITTEE ON SURFACE TRANSPORTATION AND MERCHANT
MARINE INFRASTRUCTURE, SAFETY AND SECURITY

***How the Internet of Things (IoT) Can Bring U.S. Transportation
and Infrastructure into the 21st Century***

June 28, 2016

Chairman Fischer, Ranking Member Booker, and Members of the Subcommittee, thank you for inviting me to appear before you to discuss how the Department of Transportation is advancing the Internet of Things and its ability to transform communities.

America has led the world in transportation creativity, from the Wright brothers at Kitty Hawk to Ford's Model-T. Today, our ability to innovate continues to be the envy of the world. Over time, government has played a critical role fostering new innovations—the Global Positioning System, the Internet, and the advent of civil aviation are just a few examples of how the government has shaped the market in revolutionary ways. Over the past seven and a half years, the Obama Administration has strengthened our foundation for innovation through key investments and critical reforms to drive technological breakthroughs that will power our economy and inspire the world for generations to come.

Perhaps no sector better captures the imagination about how connectivity can improve the way we move. The potential impacts of fully integrated transportation infrastructure are profound. Zero transportation fatalities. Drastically reduced commute times. Diminished contributions to climate change. We know that over the next 30 years, America's population will grow by 70 million and the freight moving across our roads, rails, pipelines and airports will increase 45 percent. As a nation, we will not be able to build our way out of the growing congestion and all its effects. Instead, we have to be smarter about the capacity we have. Emerging technology has the potential to dramatically improve our lives.

The Wow Factor

- The next generation of mobility technology is in the early stages of deployment, giving us a glimpse of what is to come.
- Connected traffic signals that detect cars and pedestrians in real time, dramatically reducing risks to pedestrians, wait times at empty intersections, and sharing information with the network to anticipate and speed traffic flows across an entire city or region.

- Wayfinding applications that enable commuters to decide instantly the cheapest and most convenient way to get around, whether by reserving a parking space for their own car, activating a carshare vehicle, signing up for a carpool, biking or using public transit.
- Common payment systems that allow users to travel easily across modes and other solutions to help the unbanked and those without cell phones access these services.
- Connected vehicles that soon will help drivers avoid dangerous situations.
- Sensors that help engineers detect pavement and structural bridge problems and fix them before they become less safe and more expensive to repair; and
- Unmanned aerial vehicles (UAV) that can inspect bridges and pavements, observe on-going construction, and monitor and report traffic incidents.

In the immediate future, we anticipate seeing the increased deployment of technologies and access to data that will:

- help transportation planners better track how their networks perform so they can target their road building, prioritize essential roadway services, evaluate the need for truck parking solutions, and offer more responsive transit services;
- help spread out travel demand and encourage more sustainable choices by informing travelers and freight operators, nudging them to optimize and plan their trip slightly differently;
- help automate freight deliveries with robotic loading and unloading, maximize efficiencies along our freight network—including research on the operational and safety impacts of truck platooning;
- provide automated first- and last-mile public transit to encourage transit use and reduce parking needs;
- have the potential to dramatically reduce deadly crashes, cut losses in vehicle and infrastructure damages, and reclaim millions of hours of lost time through the deployment of fully automated vehicles; and
- make transportation projects completely paperless from planning to the post construction phase, saving time and money for State DOTs as well as contractors.

We know that this transformation will be driven by the private sector, and by our state, local and tribal partners, but the Department of Transportation is working to speed the benefits of the IoT, first; by building an enabling regulatory environment; second, by never wavering from our focus on safety, security and privacy; and third, by investing in catalytic research and technology deployments.

Finding Innovative Approaches

As Secretary Foxx has said, DOT is bullish on technology. The degree to which we can anticipate breakthroughs, remove obstacles and streamline efforts to enable innovation could mean the difference between shaping new markets or being subject to them. More than ever, transportation innovation can be restricted by the slow pace of legislation and rulemaking. Rapidly evolving technology will demand government flexibility: regulations may be necessary, but they can also provide the certainty to encourage innovation.

For instance, the National Highway Traffic Safety Administration (NHTSA) is systematically reviewing its current regulatory framework to identify and overcome any provisions that could

slow this transformation, including clarifying existing rules, developing a framework for federal and state regulations, and identifying new regulatory tools that might be required to meet DOT's safety mission in an era of rapidly changing technology. DOT's Volpe Center, on behalf of NHTSA recently completed such an evaluation for highly automated vehicles and found that, while existing regulations pose few regulatory barriers to automated vehicle systems, some design innovations (e.g., the elimination of a steering wheel and foot pedals) could complicate compliance with current standards. Soon, NHTSA will be unveiling the next steps of this framework, which have been informed by our state partners and will be fleshed out in partnership with industry.

In pursuit of a new partnership approach, this past March, NHTSA and the Insurance Institute for Highway Safety announced an historic commitment by 20 automakers representing more than 99 percent of the U.S. auto market to make automatic emergency braking a standard feature on nearly all new cars no later than NHTSA's 2022 reporting year. The unprecedented commitment means that this important safety technology will be available to more consumers more quickly than would be possible through the traditional regulatory process.

One of the most exciting areas that the Department is fully engaged in is pushing forward the safe deployment of connected and automated safety technologies in vehicles. The Department is leading the way forward in integrating both connected and automated vehicle technologies in a way that brings the benefits we all hear about. These include crash avoidance, reduced energy consumption and vehicle emissions, reduced travel times, improved travel time reliability and multi-modal connectivity, and improved transportation system efficiency and accessibility, particularly for persons with disabilities and the growing aging population. For example, the Federal Highway Administration (FHWA) is supporting research on systems to make travel easier for blind pedestrians and other travelers under the Accessible Transportation Technologies Research Initiative (ATTRI). In addition, FHWA will issue guidance and technical support tools on how to invest in infrastructure that enables the connected systems which will, in turn, increase safety, enhance mobility, deliver reliability and cut our carbon footprint.

Another exciting initiative is taking place at the Federal Transit Administration (FTA). The agency is administering the Mobility-on-Demand (MOD) "Sandbox," an effort to bring non-traditional partners together to promote enhanced, multimodal mobility concepts using advanced technologies and new business models for providing improved transportation service. One effect of the Sandbox will be to encourage multimodal connectivity and system interoperability so that transportation resources are interconnected and accessible to all potential users. The FTA understands that the best way to answer the question of whether new operational models might work is through real-world demonstrations that can measure the impacts on regional transportation system networks to see what the net benefits to travelers and local economies really are. Running these demonstrations will also allow the Department to examine how rules and regulations impact the implementation of MOD services.

Still, clear rules of the road that ensure safeguards to protect people must be put in place, as government seeks to spur innovation without compromising safety and privacy.

Security and Privacy

The Department has worked hard to support the design and deployment of connected vehicle technologies, such as vehicle-to-vehicle (V2V) communications, in a manner that protects consumers from unwarranted privacy risks and prevents unauthorized access to data. As envisioned, the connected vehicle system will contain multiple technical controls to help mitigate potential privacy risks and prevent tampering with equipment or data. For example, V2V broadcast messages will not contain data that identifies the vehicle or its owner. We also are working with privacy experts to develop algorithms to sanitize connected vehicle data sets, which will enable the Department to make connected vehicle data available publicly without putting consumer privacy at risk. Going forward, the Department plans to work with the Federal Trade Commission and stakeholders to ensure that we develop regulatory strategies and guidance in the area of consumer data privacy.

The Department of Transportation has spent time and resources understanding the nature and implications of cyber security. Since 2012, NHTSA has engaged the potential cyber security threats to automobiles through a diverse set of actions. Our approach includes:

- Encouraging the automotive industry to form an Information Sharing and Analysis Center to help the industry proactively and uniformly address cybersecurity threats, while challenging automakers to adopt proactive safety principles and develop best practices that enhance automotive cybersecurity;
- Collaborating proactively with other government agencies—including the Defense Advanced Research Projects Agency (DARPA), Department of Homeland Security (DHS), National Institute of Standards and Technology (NIST) and National Science Foundation (NSF)— as well as with vehicle manufacturers, automotive suppliers, and the security research community to protect against cyber threats and potential vulnerabilities; and
- Continuing to execute fundamental research aimed at improving the cybersecurity posture of automobiles with a focus on understanding real-time intrusion detection and response measures. We are also assessing solutions and sharing findings broadly to ensure that once a potential vulnerability or a hacking technique is identified, information about the issue and potential solutions is quickly shared with other stakeholders.

In expanding the use of drones the Federal Aviation Administration (FAA) laid out a responsible path with their Small Unmanned Aircraft System (sUAS) rule that is the first set of nationally uniform regulations for the commercial, educational and public use of unmanned aircraft. Building off the recently released UAS privacy best practices developed with industry in a Department of Commerce led multistakeholder convening, the Administration is launching a new privacy education campaign to encourage pilots, companies and others address the privacy implications of these new technologies.

We also recognize that major advances will be needed in Big Data management and analytics, in order to not be overwhelmed by the sheer volume of data. To meet this challenge, Secretary Foxx has called on all corners of the Department—particularly the Intelligent Transportation Systems (ITS) Joint Program Office (JPO)— to focus on managing and providing transportation big data to support new paradigms of data-driven operations. The ITS-JPO is funding multi-modal enterprise data management initiatives focusing on enabling effective data capture from

ITS-enabled technologies, including connected passenger, transit, and commercial vehicles; mobile devices; and infrastructure, in ways that protect the privacy of users.

Making Catalyzing Investments

In addition to the communications programs with which you are familiar – the Next Generation Air Traffic Control System (NextGen), V2V and vehicle-to-infrastructure (V2I) communications, wireless roadside inspections (WRI) for trucks and buses, and Positive Train Control (PTC) – we are making key investments that will speed a future in which all of our vehicles, road infrastructure, and even pedestrians are more safely connected.

The FTA and ITS-JPO are co-managing the MOD Research Program, including grants for the MOD Sandbox initiative to help public transit providers adopt new technologies, partner with emerging service providers and provide better transportation options to their constituents.

And, the ITS-JPO and FHWA continue to work on the three Connected Vehicle Pilot Deployment sites to speed safe and efficient truck movement along I-80 in southern Wyoming, improve vehicle flow and pedestrian safety in high-priority corridors in New York City, and deploy multiple safety and mobility applications on and in proximity to reversible freeway lanes in Tampa. The Department continues to collaborate with the private sector on the Freight Advanced Traveler Information Systems (FRATIS) demonstration project.

Through a partnership with the Port of Los Angeles, the Port of Long Beach and their private sector supply chain operators, FRATIS aims to establish a neutral benchmark showing benefits from improved operations, including measureable gains in port performance. This demonstration project is yielding improved on-time arrival for cargo pickup appointments, reduced truck waiting time at port terminals, decreased emissions, and improved fuel consumption.

FHWA also is supporting research on sensor systems that monitor and predict structural and pavement conditions. As these systems mature, they will aid asset owners in maintaining a state of good repair for legacy and new elements of the highway transportation system.

In December 2015, Secretary Foxx launched the *Smart City Challenge*—a national competition to implement bold, data-driven ideas that demonstrate the use of advanced data and intelligent transportation systems technologies to make our network safer, easier, and more reliable in one mid-sized city. The Department is partnering with Paul G. Allen's Vulcan Inc., NXP® Semiconductors, Amazon Web Services, Mobileye, Autodesk and Alphabet's Sidewalk Labs to provide the winning city with up to \$40 million plus \$10 million from Vulcan, and access to multiple technologies to support the Smart City demonstration. Perhaps more important, the Smart City Challenge is bringing together people, industries and sectors that have rarely communicated before, all jointly addressing urban mobility issues in a way that is more sustainable, more equitable, and safer than ever before.

Nearly every mid-sized city in America— 78 cities— answered the call by creating blueprints for the future of transportation today on their city streets. The seven finalist cities—Austin, Columbus, Denver, Kansas City, Pittsburgh, Portland, and San Francisco—proposed first-of-a-

kind use of these new technologies to solve the real-world challenges facing cities today. From self-driving shuttles that could cut in half the commute from underserved neighborhoods to job centers, to the use of smart sensors to accelerate freight delivery while improving safety. More than 150 diverse industry and non-profit partners have pledged more than \$500 million in resources, technology solutions, and support to help carry out these Smart City plans.

- **Austin, TX:** The fastest growing city in the nation with over 100 new residents a day, Austin faces unique challenges with growing congestion and increasing commutes. To target the challenges facing its commuters, Austin has proposed to remake the traditional “park-and-ride” into a “one-stop shop” with even more mobility options, including public transit buses, trains, car share, bike share, automated vehicles, and connected vehicles, to be strategically situated near community health centers, the area community college, housing developments, and the airport.
- **Columbus, OH:** The city proposed to deploy three electric self-driving shuttles to connect a new bus rapid transit center to a retail district, connecting more residents to jobs, and to use data analytics to improve health care access in a neighborhood that currently has an infant mortality rate four times that of the national average, allowing them to provide improved transportation options to those most in need of prenatal care.
- **Denver, CO:** Situated at the crossroads of three nationally important freight highways, Denver is applying its pioneering spirit to accelerate freight while improving safety. With partners like FedEx, Peloton, and UPS, Denver is equipping trucks with V2V communication technology to optimize routing and traffic signals and to experiment with connected, autonomous truck platooning, accelerating freight while reducing the impact on low-income neighborhoods that bear the brunt of this traffic flow today.
- **Kansas City, MO:** Kansas City proposed to revitalize a historically black and underserved community by installing ubiquitous public Wi-Fi along sidewalks and on new electric, connected public buses, including on self-driving shuttles connecting underserved areas with the existing streetcar route. Each bus stop will have large-screen, state-of-the-art kiosks to help residents access transportation information and will be equipped with voice-activated wayfinding technology to help the visually impaired navigate the city’s streets.
- **Pittsburgh, PA:** Pittsburgh is proposing to cut in half the time it takes workers from Hazelwood, a historically underserved community, to reach the city’s urban jobs core by partnering with Carnegie Mellon, a pioneer of self-driving technology, to construct a thirty minute loop for autonomous shuttles. Throughout the city, Pittsburgh will also deploy state-of-the-art traffic signal technology— proven to reduce congestion at street lights by forty percent— to significantly reduce travel and idle time for all residents.
- **Portland, OR:** Portland proposed to launch the nation’s first bulk-buy program for used electric vehicles (EV) to put affordable EVs in the hands of low-income drivers in demonstration corridors and promote electric car sharing and electric bike sharing in low-income communities. At the same time, Portland is partnering on autonomous vehicle demonstrations from campus shuttles and airport buses to self-driving taxis and tractor

trailers. Portland is also developing a smart housing app with real transparency about the true cost of an apartment, including both rent and transportation costs.

- **San Francisco, CA:** San Francisco has set a goal of eliminating one out of every ten single occupant car trips by shifting travelers onto carpooling and public transit. To increase uptake of innovative carpooling and ridesharing models, San Francisco envisions a system of new carpooling high-occupancy vehicle (HOV) lanes and reserved curbside pickup areas. In addition, San Francisco has proposed using self-driving cars to shuttle passengers for the first and last mile onto public transit. The city, long a leader in innovation, has also proposed sharing its learnings with a tech transfer network of 50 cities and 25,000 transportation professionals.

While the City of Columbus was named the winner, we are excited to see the innovation in their proposals and even more excited that 78 cities reached out to develop new local and regional partnerships, with hundreds of partners beyond those the Department has gathered.

Through Smart Cities, the Department has also developed new Federal relationships – most notably with the Department of Energy’s SMART Mobility consortium and with NIST’s Internet of Things-Enabled Smart City Framework– so that we can continue to move forward with the best knowledge of new technologies and innovative transportation solutions.

Altogether, the Department is using its dollars in a strategic way to fund primary research, speed promising technologies to market, convene unlikely partners at the local level and spur on the national conversation on the future of mobility.

Using Technology to Build the Communities We Want

The biggest lesson of the Smart City Challenge is that technology deployment is not an end to itself, but rather a means to build strong communities that create opportunity for all of its citizens. The Federal Government has focused on the IoT’s potential to make our national network more efficient, and to make our transportation system safer, but the 78 communities that applied to be part of the Smart City Challenge each articulated a vision for how connected infrastructure and enhanced mobility options will make the lives of their citizens better.

Together, the Smart City applicants are showing us what it means to think beyond the traditional transportation modes, and embrace the surprising and disruptive innovations coming from the private sector. These technological shifts could help increase access to opportunity in neglected and underserved communities and meet our environmental commitments at the same time.

As technology continues to advance, the Department, and all levels of governance, will need to anticipate, accommodate, and incentivize innovation; and to understand and mitigate the risks associated with new technologies to ensure that our transportation system remains safe, reliable, efficient, equitable and secure.

Thank you for the opportunity to discuss the Department’s vision and activities related to the Internet of Things. I am glad to answer any questions you may have.