Remarks by

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Transportation, like nearly every other sector of our lives today, is being transformed by rapid advancements of technology. Today, lower-cost sensing and computing technology are increasingly able to be used to evaluate the driving environment and a driver's performance.

Automated driving is the ultimate outgrowth and vision of this capability. However, in order for automated driving to be successful, we must have reliable technology that fulfills not only requirements for safety, but must also protect privacy, ensure security, and be accepted by consumers.

There are several stages on the road to full automation, beginning with Assisted Automation. In this stage, the driver has complete authority, but cedes limited control to the vehicle in certain situations. In critical safety situations, the vehicle steps in using technologies such as enhanced steering control, automatic braking, adaptive cruise control, or lane keeping.

Monitored Automation involves shared authority: The driver cedes primary control, but is still responsible for monitoring and safe operation. The human is expected

to be available at all times to take over. An example would be a system that combined lane centering capability with adaptive cruise control for "hands-off" and "feet-off" driving. But it is still "eyes-on" for the driver who must continuously monitor the road and traffic.

For Conditionally Automated driving, the human can cede full control authority under certain traffic and environmental conditions, but is expected to be available for occasional control. The car is responsible for safe operation. We consider the current Google concept to be in this category. It's "hand's off," "feet-off," and "eyes-off" until the driver decides to resume control, or the car tells him he must resume control.

In the final stage, Fully Automated driving, the driver provides destination or navigation input, but is not

expected to be available for control. Responsibility for safe operation rests solely on the automated systems. We know of no such vehicle being designed for civilian highway use at this time, but at some time in the future this is the logical outgrowth of automation currently underway.

NHTSA has made a significant research investment in the potential applications of Assisted Automation types of technologies, including, crash imminent braking, and lane keeping assist systems. The agency is actively engaged in research that will help us decide whether to incorporate some of these into our regulatory program.

Automated vehicles offer an important but challenging new method of reducing crash risk that we believe holds great promise. The question is what should we be

doing to ensure that this new technology is responsibly entering the market so as not to create unintended consequences that could adversely affect the public's confidence in the technology.

NHTSA has been having discussions with Google and numerous car makers about plans to deploy this technology and the issues that we believe are going to be important to ensuring its safe introduction.

The development of automated vehicles is an extremely important goal, with great potential for improving vehicle safety. Our challenges include: understanding and evaluating driver behavior in these vehicles; developing safety requirements that will ensure their ability to navigate safely the highly complex crash environments that they will encounter; and ensuring that the systems (including sensors, maps, and

software, etc.) are made secure and reliable in ways that do not compromise privacy.

The introduction of automated vehicles has the potential to change not only the way that vehicles operate but also the way we at NHTSA regulate them. Most of NHTSA's safety standards assume the need for a human driver to operate required safety equipment. A vehicle that drives itself challenges this basic assumption.

This is also true of state efforts to govern motor vehicle safety. State highway safety programs overwhelmingly focus on preventing driver behaviors that are deemed unsafe such as speeding or drunk driving. When a crash occurs today, we can usually determine what driver, vehicle, and roadway factors contributed to the crash. This determination may be much more difficult when

control of the vehicle seamlessly transitions from the driver to the vehicle. It is likely that NHTSA's regulations may have to evolve to ensure that the states and the agency have the information they need to accurately reconstruct why and how crashes occurred so that current problems can be corrected and future vehicles can be made even safer.

NHTSA may also have to consider new methods of testing vehicles in order to ensure their compliance with the minimum performance standards for automated vehicles. The agency's regulations currently focus on assessing the performance of safety systems in one or at most a very few discrete operating scenarios or test conditions. They require a certain minimum level of safety performance of a system and set forth a test procedure to test this aspect of performance. On an automated vehicle, all of the vehicle's safety systems

are connected and controlled through a computer. These must function together in a wide variety of driving scenarios. The ability of a vehicle to perform well in one scenario may not assure that it can perform well in others. So testing performance in a single scenario, or even several scenarios may not provide sufficient assurance about the full range of performance of the vehicle. At the same time, we must consider the expense of multiple track tests for a single vehicle model and whether there are alternative approaches that could supplement track testing.

In addition to the potential safety impact of automated vehicles, the agency is also aware that these technologies have significant added potential to contribute to using roadway capacity more efficiently and smoothing traffic speed and flow, thus reducing the burden of highway traffic on the environment. These

potential benefits make the continued exploration of automated driving technologies a very important endeavor—and NHTSA's decisions on these technologies will inevitably influence the manner and pace with which they are adopted.

To date, two states (Nevada and Florida) have enacted legislation that explicitly provides for testing and operation of autonomous vehicles on their roadways. Nevada was first. It enacted legislation in June 2011 and issued regulations in March 2012. Florida followed in April 2012. And now legislation has been passed in the legislature and sent to the governor for signature in California, the home state of Google and the state on whose roadways nearly all of the Google testing has taken place over the last couple of years.

Both the Nevada and Florida legislation allow testing of autonomous vehicles on public roads. The Nevada legislation also allows these vehicles to be operated on public roads for purposes other than testing, while Florida limits their operation strictly to testing. The pending California legislation is a bit more expansive. It requires the state legislature to be notified in advance if vehicles are to be operated on California roadways without the presence of a driver in the vehicle and it contains more detailed requirements that autonomous vehicles must meet before being operated in the State (for purposes other than testing). If the California legislation is signed into law, implementing regulations must be issued no later than January 2015.

Another very promising area of rapid technological development is vehicle-to-vehicle (or "V2V") communications, often referred to as "connected

vehicles." V2V technologies involve communications between vehicles that we believe can yield significant safety and environmental benefits. It is likely that as automated vehicle concepts continue to develop and become more mature, vehicle-to-vehicle and vehicle-to-infrastructure communications will be key aspects of these systems. Automation is analogous to the desktop computer of 20 years ago; although desktops were immediately useful by themselves, the real power and benefit came from "linking" them together into a network.

Even without automation, Connected Vehicle Technologies have the potential to address approximately 80 percent of the vehicle crash scenarios involving unimpaired drivers. Because of the potential safety benefits and increasing maturity of this technology, NHTSA has announced that in 2013 it plans

to make a decision about the Agency's next steps for Connected Vehicle Technology as it relates to light duty vehicles—and a decision for heavy duty vehicles in 2014.

NHTSA's decision-making will be based in large measure on the data collected during a model deployment of vehicles in Ann Arbor, Michigan, and a detailed analysis of the possible approaches to implementation. The data will come primarily from V2V testing programs, and our Safety Pilot, which consists of driver clinics and a large-scale model deployment.

The model deployment includes approximately 2,800 cars, trucks, and buses equipped with vehicle-to-vehicle communications devices. These vehicles will send and receive electronic data from other equipped vehicles at the site and translate data for six safety applications

that warn the driver if and when specific safety hazards occur.

Ultimately, blending or fusing V2V communications with increasing levels of vehicle automation could result in the most dramatic safety improvements in our nation's driving history. That's why we think we are on the brink of an amazing era in automotive safety. But the challenges are substantial; the research must be thorough, and industry and government must work together to get it right.

Thank you.