Remarks Delivered by

David Strickland, Administrator

National Highway Traffic Safety Administration

Autonomous Vehicle Seminar

House of Sweden

Washington, DC

October 23, 2012

Thank you, Nicole, [Nicole Nason, former NHTSA Administrator] for that generous introduction.

I am honored to speak to you this morning, not only about autonomous vehicles, but also about the emerging crash-avoidance technologies that show so much promise for future highway safety.

As you know, the mission of the National Highway Traffic Safety Administration is to save lives, prevent injuries, and reduce the economic costs of road crashes. We maintain a data-driven focus on every aspect of driving safety and automotive innovation.

One reason that so many people are focused on automation is the potential benefit for seniors and the visually impaired. We know that about 90 percent of vehicle crashes can be attributed to driver error. The great promise of autonomous vehicles is that they may address the one component for which NHTSA cannot mandate a recall: the human factor.

Connected and automated vehicle technologies have the potential to transform the way we look at transportation and highway safety. While NHTSA has worked on crashworthiness issues for over 40 years and

will continue to make progress in this area, crash avoidance technologies and active safety offer amazing—perhaps unprecedented—potential for achieving large reductions in the number of fatal crashes. The best protection against a crash is to prevent it from happening in the first place.

In order for automated driving to be successful, we must have reliable technology and fulfill requirements for safety, privacy, security, and consumer acceptance. There is also a real need to develop performance specifications and non-traditional methods to validate the performance of a high level of automated driving where the vehicle is making decisions for the driver in complex driving situations. It's a challenge: There are no developed methods for doing this. We may need to depend on modeling and simulation of detailed traffic interactions that lead to crashes.

We must understand and develop standards and methods of operation that accommodate distinct levels of automated control. To help us do this, we think about the progressively higher levels of automation along a continuum that balances the roles of the driver and the machine, culminating in fully automated driving.

We are already familiar with Assisted Automation, where the driver has complete authority, but cedes limited fundamental control to the vehicle in certain normal driving or crash-imminent situations (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 driver is expected to be available at all times. An example would be a system that combined lane centering with adaptive cruise control for "hands-off" and "feet-off" driving. But it is still "eyes-on" driving; the driver must continually monitor the road and traffic.

For Conditionally Automated driving, the driver 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. Here it's "hands-off," "feet-off," and "eyes-off" until the driver (or the vehicle) decides that it's time for the driver to resume control.

In the Fully Automated mode, 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 may be the logical outcome of the many efforts at automation currently underway.

NHTSA has made a significant research investment in the potential applications of Assisted Automation types of technologies, including forward collision warning, crash imminent braking, and lane departure warning. The agency is encouraging manufacturers to install some of these technologies on vehicles through its New Car Assessment Program (NCAP) and is actively engaged in research that will help us decide whether to incorporate some of them into our regulatory regime.

Automated vehicles offer an important and challenging new method for reducing crash risk that we believe holds great promise. The question is what we should be doing in terms of research and demonstrations to ensure that this new technology is responsibly entering the market and is ready for the unexpected. We must anticipate, for example, how automated and non-automated vehicles will respond to each other. We must take care so as not to create unintended negative consequences that could affect the public's confidence in the technology.

NHTSA has been having extensive 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 its safe introduction.

The development of automated vehicles is a worthy goal, with great potential for improving vehicle safety. Our challenges include:

- **Understanding and evaluating driver behavior in these vehicles**
- **Developing performance requirements for the highly complex potential crash environments that they will encounter, and**
- **Ensuring that the systems (including sensors, maps, and software) are effective and reliable.**

We have developed a Motor Vehicle Automation Roadmap to examine the performance of automated technology as a vehicle safety system. As part of this work, we plan to conduct research on the reliability and security of software systems that support automated

vehicle control and on the performance of drivers interacting with these vehicles.

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 impaired driving. When a crash occurs today, we can usually determine largely through physical examination what factors contributed to it. This determination may be much more difficult

when control of the vehicle seamlessly transitions from the driver to the vehicle and its increasingly interconnected and intelligent electronic vehicle crash avoidance and mitigation systems. It is likely that NHTSA's regulations may have to evolve to address these aspects of automated vehicles.

NHTSA may also have to consider new methods of testing vehicles in order to specify minimum performance standards for automated vehicles. The agency's regulations currently focus on the performance of safety systems in discrete operating scenarios or test conditions. They require a certain minimum safety performance of a system and execute a test procedure to evaluate this aspect of performance.

On an automated vehicle, all of the vehicle's safety systems are connected and controlled through a

computer which must function in every driving scenario, so any test track testing in one scenario, or even multiple scenarios, may not cover the full range of performance of the vehicle. We must consider the cumulative cost of test track testing and the supplementary role that might be played by other methods such as simulation.

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 intelligent management of roadway traffic and reduce the burden of highway traffic on the environment. These potential benefits are additional reasons why the continued exploration of automated driving technologies is an extremely worthwhile endeavor. NHTSA's decisions on these technologies will

inevitably influence the manner and pace with which they are adopted.

NHTSA is seeking to be an active partner in the development and implementation of connected vehicle and automated driving technologies—an undertaking that requires collaboration with product developers, insurers, academia, and state and federal governments. The agency is planning to initiate research on emerging automated driving technologies later this fall.

Another very promising, and related, area of rapid technological development is vehicle-to-vehicle (or "V2V") communications, often referred to as "connected vehicles." As compared to automated vehicles, which involve technologies focused on an individual vehicle, V2V technologies provide communications between vehicles that can yield

enormous safety benefits, as well as environmental benefits. These two technologies are complementary. It's like the desktop computers of 20 years ago: they were immediately useful by themselves, but the real power and benefit came from "linking" them all together.

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 we plan 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 on data and a detailed analysis of the possible approaches to implementation. The data will come primarily from V2V vehicle testing programs and our Safety Pilot program, which consists of driver clinics and a large-scale model deployment.

Thank you.