

Do connected commercial vehicles make sense?: White paper

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Introduction

As an important part of today's life, automobiles have continued to evolve since they were invented. Nowadays, vehicles are expected to be much safer and reliable. With the development of information and communication technologies, equipping vehicles with wireless communication capabilities is expected to be the next pinnacle for automotive revolution. Connected vehicles are cooperative, coordinated and well-informed. They will be responsible for maintaining safety on road by giving lane change warnings, collision detection and merging traffic. It can also provide smart and green transportation by fleet management, intelligent traffic scheduling and traffic signal control.

What are the benefits of connected vehicles?

Connected Vehicle technology aims at tackling some of the biggest problems in the transportation industry--in the areas of **safety**, **mobility**, and **environment**.



-How Will Connected Vehicles Improve Safety?

According to the National Highway Traffic Safety Administration (NHTSA) there are over 5 million crashes on the roads every year. In these crashes, over 30,000 people die, and many sustain serious injuries. According to the Centers for Disease Control, vehicle crash is the leading cause of death among young children and young adults. Another NHTSA study of connected vehicle technologies stated that they have the capability to reduce up to 80 percent of crashes, this would save a number of lives and avoid millions of crash related injuries.

While the number of deaths in road accidents has decreased significantly due to airbags, anti-lock braking system, and other technologies, the focus now shifts to prevent accidents in the first place. Connected vehicles on the highway would use short-range radio signals to communicate with each other so that every vehicle on road would be aware of the position of nearby vehicles. The vehicles will receive, transmit and continuously monitor signals that will provide them with a 360-degree view of nearby vehicles and drivers would receive alerts of dangerous situations. The system will be operating in background and will alert only if an unsafe situation is developing so not to distract the driver. In many situations, drivers will be warned of dangers that they are not aware of and can't even see. By limiting the number of crashes, thousands of lives can be saved and millions of injuries will be prevented. The technology will alert for potentially dangerous situations that are developing and provide with the tools to avert crashes or reduce their consequences.

There are two modes of communication between vehicles and other things.

1. Vehicle to Vehicle

Through in-car warnings, drivers will be alerted about impending crash situations. The system will alert the driver of the risk of rear-end collision when cars ahead are stopped. The driver will receive a warning that a car which is ahead of the trailer in front of him has slammed on its brakes, giving him enough time to avoid crashing into the rear end of the trailer. Or if the driver is about to change the lane on highway, he might be notified that a vehicle is moving in his blind spot. Or that it's unsafe to pass a truck ahead of him as a car coming from the opposite direction is moving very fast.

2. Vehicle to Infrastructure

By "talking" with the roadside infrastructure, drivers may be alerted when they enter a school zone, if some workers are working on the roadside, or if a traffic light is about to change. Other applications can warn about poor road conditions or about dangerous road curves. Or an oncoming car, out of sight, entering into their lane to avoid obstacle on road. Or if someone is about to run a red light as they're nearing an intersection.



-How Will Connected Vehicles Improve Mobility?

Along with the safety potential of these connected vehicles, they also promise to optimize travel times. Traffic managers can control the flow of traffic more easily with the communications data available and lessen developing congestion. Signals in connected vehicles will help to generate new data about how, when, and where vehicles travel. Transportation and traffic managers can use this data generated by vehicles on the roads, by sensors imbedded in the infrastructure, and by mobile devices to keep traffic flowing smoothly. New mobility applications will enable us to plan the most efficient, time-saving, and greenest commute.

Waiting in traffic can be very frustrating. It not only can cause a lot of stress, it also wastes valuable time. In fact, the 2012 Urban Mobility Report from the Texas A&M Transportation Institute (TTI) states that Americans lost 5.5 billion hours stuck in traffic on U.S. highways in 2011. That amounts to almost one full working week for every traveler. A report from USDOT indicates that connected vehicles may be able to reduce travel-time delays caused by congestion by more than 30%.

Here the system will let us know beforehand about a backup forming in the lane. The driver will receive notice to slow down, change lanes, or even take a changed route. Another application could also enable a disabled pedestrian to cross a busy intersection using a wireless device to communicate with a traffic signal.

-How Will Connected Vehicles Help the Environment?

Traffic congestion wastes the fuel equivalent of almost a third of the flow of the Alaska pipeline every year. Connected vehicle technology will have a major impact on the environment by reducing fuel consumption and emissions. Each year 4 billion gallons of fuel is lost due to traffic congestion. Tailpipe emission from automobiles is the largest human-made source of greenhouse gases. Vehicles in traffic or in stop-and-go pattern emit out more GHGs than those traveling in free-flow, according to the TTI. The Environmental Protection Agency reported that the transportation sector made up 28 percent of the nation's GHG emissions in 2012. Connected vehicle technology has the potential to make a significant contribution in reducing the environmental impact.

With up-to-the-minute information of traffic conditions, finding alternate routes, rescheduling the travel or switching to public transport will greatly reduce emissions. Traffic signals can be adjusted to help make fewer stops and starts when driving or giving priority to transit vehicles at intersections which would increase the number of people passing through an intersection and help public transport to follow their schedules also making public transportation more appealing.

How Does Connected Vehicle Technology Work?

A packet of data that contains information about vehicle position, heading, speed, and other information relating to a vehicle's state and predicted path will be shared between connected vehicles and the infrastructure. Also, the technology doesn't depend on "line of sight" communication. So if a car ahead is braking hard on the other side of a hill, the driver will be notified even though it is not visible. Connected vehicle technology is also less expensive to install than radar and camera equipment in vehicles. This will enable it to become standard equipment in the future on practically all vehicles.

The communication flows is based on a networking technology known as dedicated short-range communications (DSRC), similar to Wi-Fi. DSRC offers opportunities for fast, secure, and reliable communications. Basically every vehicle on the road, will use DSRC, to attain 360-degree awareness of nearby vehicles. To function safely, a connected vehicle system needs to ensure the trustworthiness of communication between vehicles. The source of each message needs to be trusted and message content needs to be protected from outside interference.

References

1. http://its.dot.gov/cv_basics/index.htm
2. Transparency Market Research, Connected Car Market -Global Industry Analysis, Size, Share, Growth, Trends and Forecast, 2013-2019, 2013.
3. H. Hartenstein and K. Laberteaux, VANET: vehicular applications and inter-networking technologies. Wiley Online Library, 2010.

