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Bumper to bumper

As more and more safety technologies, such as Lane Departure Warning (LDW) systems, are added to heavy trucks and even light vehicles such as passenger cars, the US Department of Transportation (USDOT) has put a programme in place to investigate the impact the various subsystems have on each other and the advantages that can be gained by combining the subsystems into a single Integrated Vehicle-Based Safety System (IVBSS). The USDOT's vision of IVBSS just may be the future of onboard vehicle safety.

According to an April 2007 report by the National Highway Traffic Safety Administration (NHTSA), "The goal of IVBSS is to accelerate the deployment of integrated crash warning systems for passenger cars and heavy commercial trucks to prevent rear-end, lane change, and run-off-road crashes."

The intention of the IVBSS is to provide a single integrated interface to warn a driver when his or her vehicle is about to strike a vehicle travelling in front, hit a stationary vehicle or object in the roadway, drive off the road, approach a curve that requires a lower speed, or collide with a vehicle when changing lanes.

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The potential reduction in rear-end, lane change and run-off-road collisions by implementation of a comprehensive IVBSS is 48 per cent

The USDOT has teamed up with the University of Michigan Transportation Research Institute (UMTRI) to lead the IVBSS programme. Other team members include ITS America (ITSA), Visteon Corporation, Eaton Corporation, **Honda** Research and Development Americas, Cognex Corporation, Battelle Memorial Institute, International Truck and Engine Corporation, Con-way Inc., the Battelle Memorial Institute and the Michigan Department of Transportation. The Volpe National Transportation Systems Center is serving as an independent evaluator.

According to Jim Sayer, Project Manager for UMTRI, the IVBSS programme is looking to answer two questions. First, how might the performance of a subsystem be enhanced by information from the onboard sensors from another subsystem? And second, how can multiple subsystems be integrated into a vehicle to deliver the appropriate warning(s) without overwhelming the driver?

Multiple technologies

The IVBSS platform combines radar, image processing and GPS technology. For heavy trucks, the platform consists of an LDW system, a

forward crash warning system, and a Lane Change/Merge (LCM) warning system. The platform for light vehicles includes these three systems and a fourth system for curb speed warning.

Technology for the IVBSS platforms is provided by current subsystem developers. The heavy truck IVBSS platform prototype is being designed and integrated by Eaton Corporation, with systems and oversight by International Truck and Engine Corporation.

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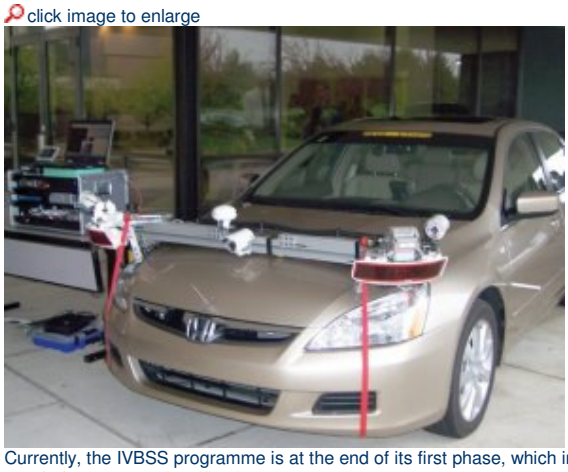

Currently, the IVBSS programme is at the end of its first phase, which involved development, proof of concept and verification

The light vehicle system is being developed and integrated into Honda Accords by Visteon Corporation in collaboration with the Honda North America R&D Center. In addition, the LDW and LCM systems on both platforms are being built in cooperation with Cognex Corporation.

The initial development stage for the heavy truck IVBSS platform utilised a Chevy Suburban pulling a trailer to simulate the size and scope of a tractor-trailer rig. The prototype system consists of: two forward-looking radars on the front of the truck (located at the edges of the bumper); a forward-looking camera; dual sets of side-looking radar; rear-looking radar; rear-looking cameras; and GPS technology.

Keeping it simple

The warnings from the IVBSS are intended to be intuitive and delivered with the primary purpose of increasing the driver's situational awareness with relation to imminent threats that could cause a crash.

"The system must avoid confusing and distracting the driver unnecessarily with information overload," explains John Kovacich, Eaton's Project Manager. "We want to help the driver, not contribute to driver error."

"We have tried to simplify the messages," Sayer adds. "In the passenger car, for example, we have broken the warnings down into two basic messages. For curve speed warning and forward crash, we provide a signal to get the driver to slow down.

For LCM and LDW, the system gives a cue to get the driver to return to their lane."

Signals differ for each of the warnings. For example, an alert that the vehicle has crossed a lane marker or left the roadway may have an auditory signal that sounds like a rumble strip. If a hard obstacle lies ahead, such as a parked car or Jersey barrier, the forward crash system may give a combination of more urgent warnings.

The IVBSS prototype for heavy trucks provides auditory and visual signals from each side of the cab, near the side view mirrors, alerting the driver to the location of the possible danger.

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The initial development stage for the heavy truck IVBSS platform utilised a Chevy Suburban pulling a trailer to simulate the size and scope of a tractor-trailer rig

Warning arbitration is where the integration of the subsystems becomes vital. The system is being designed to prioritise warnings and issue them appropriately when multiple threats occur.
The timing of crash alerts is also an important system design consideration, especially in the case of serious crash threats. The system is being designed to allow drivers who are unaware of a potential crash risk to react in time, to assess the situation and to complete appropriate evasive manoeuvres.

The alerts will not recommend any actions and the system will not take control of the vehicle, however, leaving the decision-making with driver.

In addition, the system may inform the driver when driving too fast for system operation, or when environmental conditions such as poor visibility or precipitation impact upon system performance.

The team has also established a set of 'Do not warn' scenarios to guide system developers. This is intended to alleviate situations that would cause false alarms or nuisance alerts; IVBSS team leaders see this as critical to driver acceptance of the system.

Testing continues
The IVBSS initiative was officially launched in November 2005 with a four-year plan. The budget for the project is $31.6 million project, of which $25 million is being funded by the US Government.

Currently, the IVBSS programme is at the end of its first phase, which involved development, proof of concept and verification. The team built prototype vehicles for both platforms and has demonstrated integrated functionality in a series of verification tests on test tracks in Ohio, Indiana and Michigan as well as on the road.
"We use professional drivers at this stage to test the system's full capabilities because regular drivers might chicken out before the warning comes," notes Muqtada Husain of Visteon.

The team is now waiting for approval to move forward into phase two, which will involve equipping two fleets of vehicles with IVBSS - 18 passenger cars and 10 trucks. The fleets will function in extended pilot tests and actual field tests over 12 months.

For the truck tests, the IVBSS team will be working with a commercial carrier fleet based in southeast Michigan. Meanwhile, passenger car drivers will be a random sample of licensed drivers in southeast Michigan.

UMTRI will analyse all the data collected, including information on IVBSS system, driver and vehicle performance, as well as vehicle location and driving environment. Baseline data on each driver (to assess how participants drive without the IVBSS system in place) will also be obtained, and drivers will receive training prior to their use of a test vehicle.

"The head of safety for the test fleet is very anxious to get this system," says Sayer. "He has driven it, and he thinks his drivers will appreciate it. We also think drivers of passenger cars will appreciate the system. Whether they will be willing to purchase the IVBSS remains to be seen, however."

In the end, the IVBSS initiative will provide USDOT with the information needed to advance the deployment of automotive safety products, including objective test procedures and safety benefits estimation. Objective test procedures will promote compliance with performance specifications and allow USDOT to issue consumer information such as safety star ratings.

The question of how and when the IVBSS systems will be made commercially available, however, is as yet undetermined.

Great potential
According to USDOT, rear-end, roadway departure and lane change crashes account for about 60 per cent of all light and heavy vehicle crashes and approximately half of all fatalities due to vehicle crashes. One of the beliefs driving the IVBSS initiative is that a system combining three or four warning functions into one integrated system could prevent a substantial number of crashes each year, saving lives, preventing injuries and reducing the negative economic impacts of roadway crashes.

The potential reduction in rear-end, lane change and run-off-road collisions by implementation of a comprehensive IVBSS is 48 per cent, according to Chris Lane of **ITSA**.

At this point results are speculative, however, and Sayer admits that even after phase two testing is complete the sampling simply is not broad enough to garner definitive results.

"Chances are we won't even see a crash," Sayer says. "We may see some near misses or potential crashes that were mitigated by system, but it is hard for a field operational test of this size to see the true benefits projected over a much larger fleet.

"Although the potential is a 48 per cent reduction in collisions, we don't necessarily expect to see that. We can't guarantee that the driver will respond in time to all the warnings." ·

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