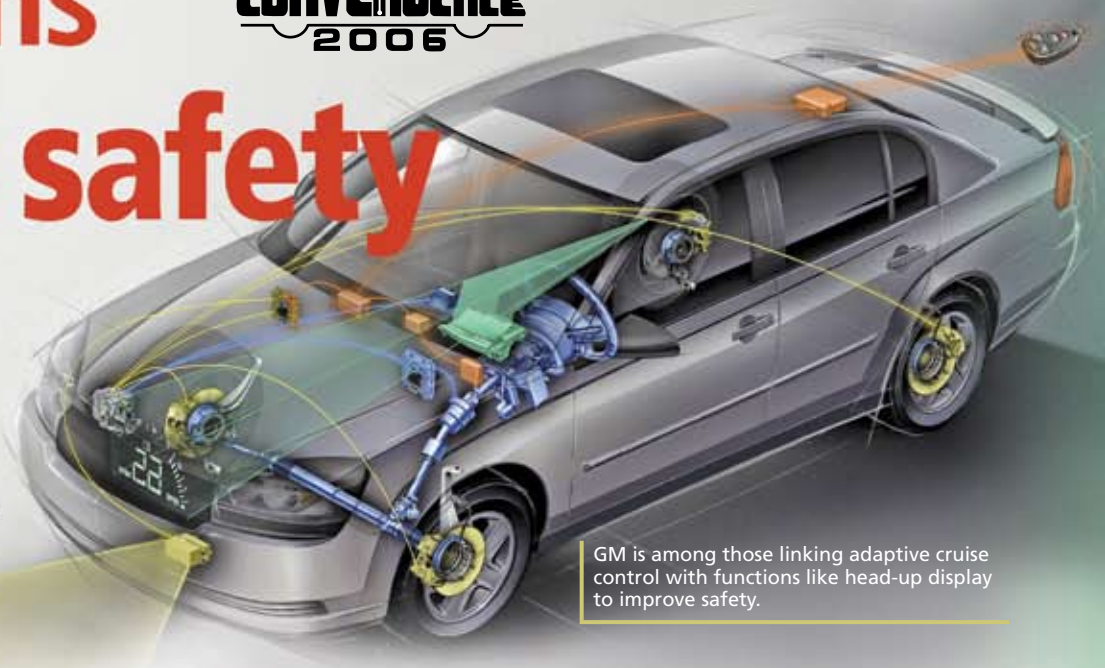
Update CONVERGENCE 2006

Systems drive safety

Engineers are using a holistic approach to design safer vehicles by adding functions and integrating multiple subsystems.

by *Terry Costlow*



GM is among those linking adaptive cruise control with functions like head-up display to improve safety.

There is a single theme for those developing the next generation of safety equipment: systems. Engineers are no longer thinking about discrete elements, they are focusing more on combining related technologies to provide more benefits.

The systems approach ranges from the time-tested technique of adding more functions to an existing controller to the more complex integration of different functions such as braking, steering, and powertrain management. As the automotive industry prepares for Convergence, the show's reinvention theme is forcing product developers to step back and look not at electronic controls, networks, or mechanical features but at the totality of driving.

"To take the next step, you need to address things with a systems approach, even going to the driver to make sure you're not overloading them," said Bob Rivard, Vice President of Advanced Technology at Robert **Bosch**, who is also a Chair for one of the Convergence safety sessions.

In some instances, developers are simply extending the capabilities of existing products, making simple products into more complex systems that offer features that take stress away from drivers while minimizing the possibility of accidents.

"We have the capability to go from adaptive cruise control to low-speed ACC," said Larry Burns, **General Motors**' Vice President of R&D and Strategic Planning and Convergence Chairman. "That will excite customers. When they're stuck in traffic, they can lock on to the car in front of them and move forward in start-stop traffic with a lot less stress."

At the same time, simple and complex systems are being linked together. The shift from passive to active safety comes with a push to weave systems together, using cruise control or lane-departure systems to warn of impending collisions. Their data is used by brakes and steering to avoid accidents, while seatbelts and airbags are readied in case the accident is unavoidable.

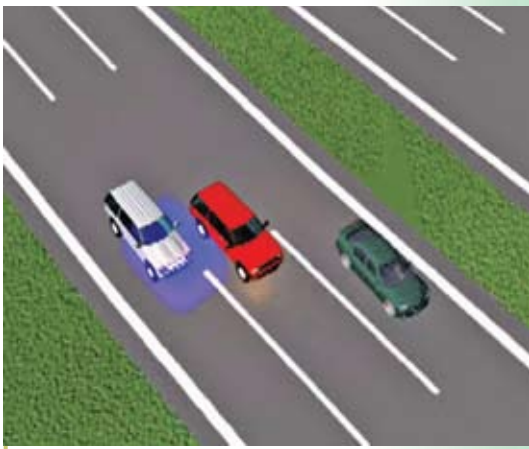
Networking in flux

A key element for interlinked systems is communications. When stability controls, braking, and powertrain controllers work in tandem, safety can be enhanced to avoid more accidents. However, making sure that all these signals arrive in the brief time surrounding a potential accident goes beyond the capabilities of networks on today's vehicles. "CAN doesn't have the speed for many safety-critical applications," said Rivard.

Design engineers are currently getting around that problem by dedicating networks to specific tasks. "Some use only 50% of the bandwidth so they're sure signals won't get lost; that's why you've got four, five, or six CAN nets piling up in a car," said Matthias Poppel, Worldwide Automotive Marketing Manager at **Texas Instruments** (TI).

That is prompting some vendors to turn to FlexRay, which was originally promoted for drive-by-wire applications. FlexRay uses time stamps to provide determinism, ensuring that critical messages will not be lost or delayed, he added.

FlexRay, originally developed for by-wire steering and other applications, will



Lane-departure and side-alert warnings are sounded when Delphi's camera systems sense danger.

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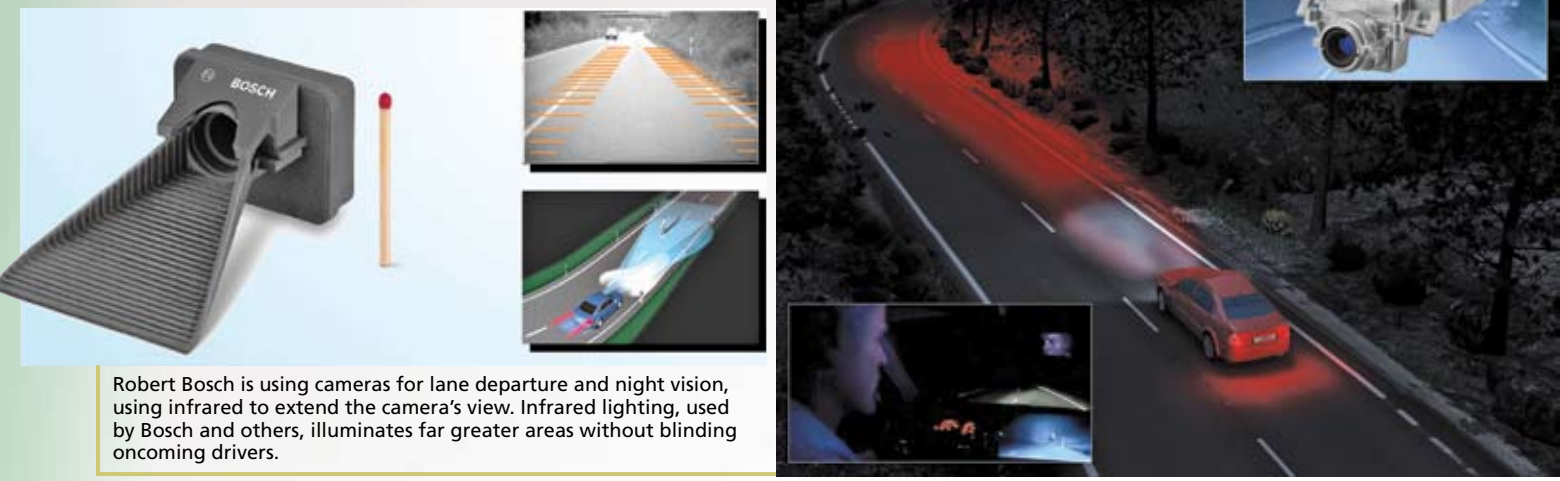
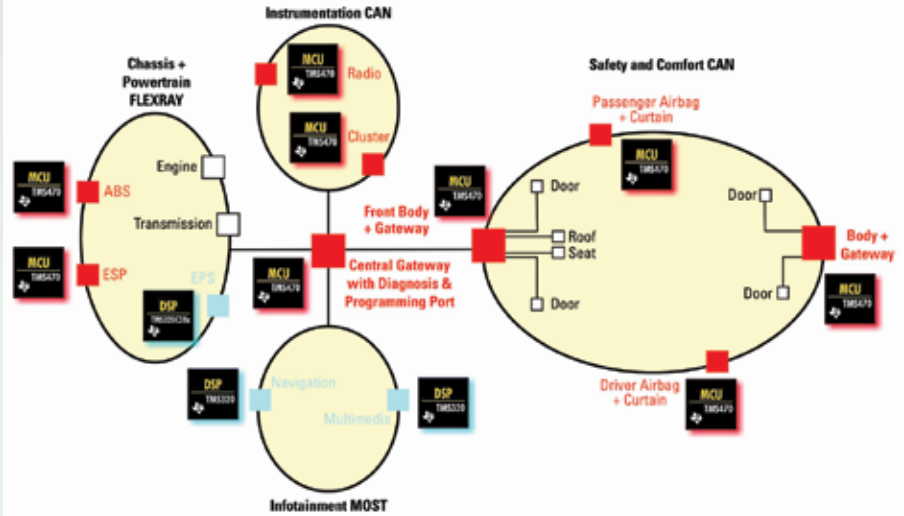


Robert Bosch is using cameras for lane departure and night vision, using infrared to extend the camera's view. Infrared lighting, used by Bosch and others, illuminates far greater areas without blinding oncoming drivers.



FlexRay is being added to networking architectures, as shown in this TI example, providing determinism needed for safety.

show up as a safety bus in 2008 model vehicles, Poppel predicted. **Philips**, **Freescale**, and other chipmakers are striving to assist automakers who tap the network for safety applications.

Many facets to consider

While more software and communications make life more challenging for product developers, this complexity cannot carry over to drivers. A driver puzzling over night-vision images, hearing lane-departure messages, and listening to navigation might easily lose control, or tire, prompting an alert from a drowsy driver monitor. And that is not to mention the challenge posed by the exploding world of infotainment equipment.

"People have all these features and functions they want in a car, yet we have to figure out how to bring them in without distracting the driver," said Ronn E. Jamieson, Director of GM's HVAC group and the Convergence Vice-Chair.

That has prompted a focus on voice-control systems. Recently, **Pioneer Electronics** (USA) tapped **IBM**'s Embedded ViaVoice software to add speech to its AVIC-Z1 aftermarket navigation system. "Safety is one of the key reasons voice is starting to take off," said Barbara J. Britt, Program Director, Embedded Voice Development, IBM Application Integration Middleware. "Even selecting a radio station is distracting."

The broad view of vehicle safety goes well beyond the body of the vehicle. The legal issues playing a critical role in anything related to accidents will be addressed during Convergence. "We've even got a professor from **Emory University** to talk about tort reforms and how to deal with liability issues," said Rivard.

The new focus on safety is also changing the testing field. Active safety systems such as braking and suspension are expensive to test, partially because the dynamics are difficult to simulate in the lab, requiring in-vehicle measurements on a road course. In-vehicle tests and the data-acquisition systems that facilitate them must run from battery power, so systems must accept dc power and provide safety isolation.

Test gear must have sufficient memory to store the data from the track test yet still be small and light so it does not change the dynamics of the vehicle. "Custom hardware solutions have been implemented to test the active safety systems," said Brian Betts, Data Acquisition Group Manager at **National Instruments**. "However, recent advances in commercially available test systems make it much cheaper to build in-vehicle test systems with general-purpose, commercially available hardware and software."

Peering into the future

The systems approach is even being considered for new technologies that are moving into vehicles. Over the next few years, cameras are expected to become an important element in the push to

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Memory devices from Ramtron provide the speed and non-volatility that is needed for airbags and archiving.

National Instruments is providing standard test equipment that is small and light enough for extensive road testing.

continue making cars safer. They are being considered for lane-departure warning, occupant detection for smart airbags, and other areas beyond the backup assistance that is already in use.

Once cameras are on board, engineers and marketers are likely to use them for more tasks. For example, a lane-departure camera may look at vehicle lights. "If you're following at night, it could recognize taillights and dip your light beams or go from high to low," said Glen Wiedman, Chief Engineer for Integrated Safety Systems at Delphi. "The same could occur for oncoming traffic."

Both camera and chip providers are gearing up for a solid market. **STMicroelectronics** is preparing automotive-grade versions of the CMOS (complementary metal oxide semiconductor) sensors it sells in other markets, saying that by 2010 many cars will have two to six cameras. The company contends that CMOS images are a better option than CCD (close-coupled device) chips used in many commercial cameras.

"They have low system cost, low power consumption, and a 120-dB dynamic range so they can detect images under low- and high-light conditions," said Hubert Geitner, MEMS Business Development Manager at STMicro.

Another safety technology, night vision, is being altered to take advantage of the advances in cameras. Early night vision systems used temperature sensors, but they missed inanimate objects such as signs or debris on the highway. Cameras provide a more realistic representation of the upcoming environment.

"We use infrared light so it's like having high-beam capabilities without blinding the oncoming driver," Wiedman said.

Now, the challenge for night-vision systems is how to give drivers important information without forcing them to look at a screen. Head-up displays are one alternative. Another is to sound an alarm that might tell the driver there seems to be something out of the ordinary coming up.

Even when these technical challenges are overcome, night vision faces hurdles beyond those involved with cameras with conventional light sources and simpler user interfaces. "We have to get over the cost-to-value equation," Rivard said. "This is pricey technology."

Forget me not

While design engineers move towards a broad system view, they must still look closely at the elements used to build that system. One of the many semiconductor categories that is currently getting a lot of attention is memory chips. As the volume of software soars, memory sizes are also rising.

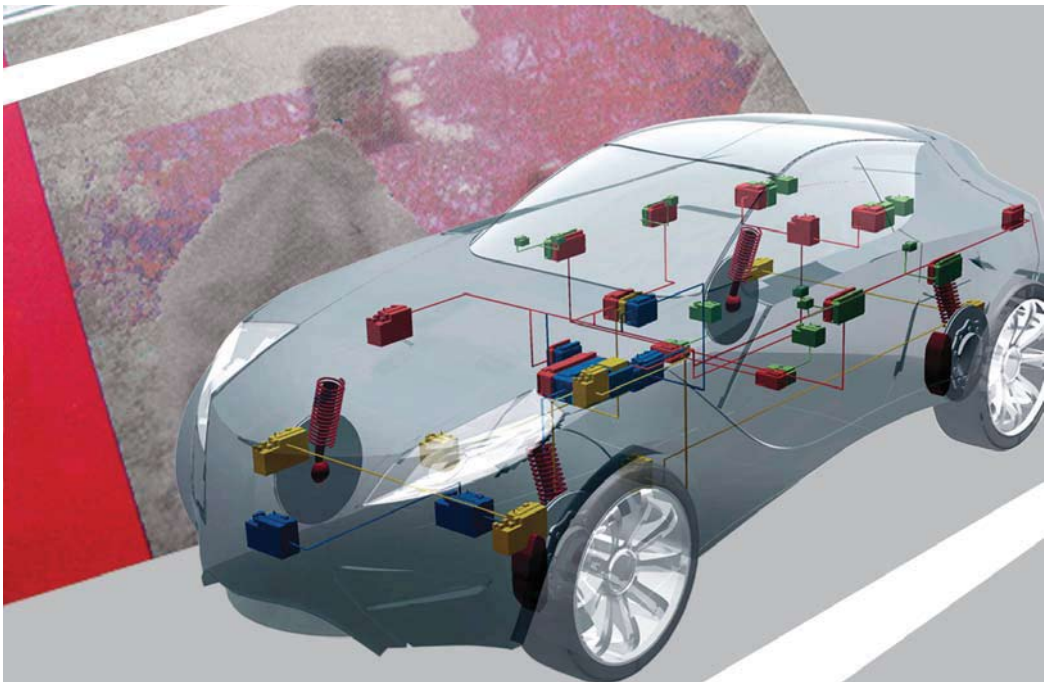
Flash memory has been a key storage medium for much of this software, offering non-volatility that is critical in the automotive environment. However, a handful of automakers have begun using **Ramtron**'s ferroelectric random access memory (FRAM) for airbags. The company recently added **Hyundai** to a list of eight automakers using the memory option.

"We write very quickly, and you can write as many times as you want without impacting the chips," said Mike Alwais, Vice President of FRAM Products at Ramtron. He noted that conventional flash memory provides the necessary non-volatility, but its write times are long enough that it is possible data will be lost in accidents when power is cut. Flash memory also degrades after multiple writes, a problem FRAMs do not have, he added.

Conventional memories are also undergoing changes. Flash memory and SRAM (static random access memory) are holding more data, increasing the chance of random errors, and smaller line widths on the die make them more susceptible to outside factors that can cause soft errors such as random bit flips. That is prompting auto design engineers to borrow techniques used in other fields.

"We'll see either parity bits or error correcting code," TI's Poppel said. When errors occur, these techniques provide warnings so the system can determine whether there is an error that warrants shutting down the system or retrying a command, he added.

Freescale has also begun marketing its magnetoresistive RAM, which offers both the speed of SRAM with the non-volatility of flash memory. Though the company has not yet announced a shipment date for automotive-grade devices, transportation is expected to become a solid portion of the technology's sales. ***aei***



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