Software-Defined Features

In automotive electronics, software is the name of the game. It is the means by which automakers are creating customer-winning features quickly and inexpensively. While software has become an essential means to competitive advantage in the auto industry, it still has a long way to go before carmakers can make use of its full potential.

In the past, software has been at the service of automotive electronics hardware; now automotive electronics hardware will serve software. "The industry has been transformed from an era where hardware dictated what software could do, in terms of computational space; now it is software that defines the features and functions, and then we look for commodity hardware," said K. Venkatesh Prasad, a prominent Ford Research group leader.

To highlight the promise of software, Mr. Prasad explained that next-generation radios are being developed almost entirely with software components. So-called software-defined radios can be programmed to be multimodal, multiband and multifunctional devices that can be adapted, updated or enhanced with software upgrades, according to the Software Defined Radio Forum. "It won’t be long before other vehicle systems are defined by software," predicted Mr. Prasad.

### Aspects of Automotive Software

<table>
<thead>
<tr>
<th>Architecture</th>
<th>AUTOSAR, J ASPAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networks</td>
<td>CAN, FlexRay, MOST, Bluetooth, LIN</td>
</tr>
<tr>
<td>Development Tools</td>
<td>Requirements capture, Rapid prototyping, Algorithm development, Code generation, Software test tools, Virtual software/hardware development, Hardware in the loop (HIL) testing, Controller calibration tools, Tool interfaces and language standards</td>
</tr>
<tr>
<td>Applications</td>
<td>HMI (speech recognition and synthesis, graphical user interfaces, hands-free phone), Infotainment (navigation, traveler’s information, audio, video, communications)</td>
</tr>
<tr>
<td>Powertrain</td>
<td>Body</td>
</tr>
<tr>
<td>Chassis control system (braking, steering, suspension)</td>
<td></td>
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<tr>
<td>Diagnostics</td>
<td>Software Forms</td>
</tr>
<tr>
<td>Algorithms</td>
<td>Calibration data, Operating systems</td>
</tr>
<tr>
<td>Middleware, including application programming interfaces</td>
<td>Data including maps, music, video</td>
</tr>
<tr>
<td>Sources: VaST Systems Technology, The Hansen Report</td>
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</table>

Automotive FPGAs: Lower Costs, Shorter Time to Market

The automotive industry is beginning to take a hard look at how FPGAs (field programmable gate arrays) can contribute to shorter development cycle times and lower costs. FPGAs are logic devices that can be programmed by the customer, rather than the chipmaker, to perform specific functions. Because FPGAs can be reprogrammed, auto electronics suppliers can design a fixed hardware platform or architecture for multiple vehicle lines and differentiate the product by software as required. A telematics platform, for example, can be tailored for a luxury car with sophisticated features and functions or with just the basics for an entry-level vehicle.

FPGAs were invented more than 20 years ago by Xilinx Inc. (San Jose, California), and the company is the market leader in programmable logic devices, with over 50% of the total market for FPGAs. About 14% of its total revenue comes from consumer and automotive applications combined. Xilinx sees the automotive market for FPGAs growing by 25% to 30% over the next several years.

According to Xilinx, the automotive market for FPGAs reached about $50 million worldwide in 2004. A nother San Jose-based company, Altera Corp., is Xilinx’ closest competitor.

In 1998, according to Xilinx, a one-million gate FPGA cost around $2,000, compared with under $20 today. Harvey Steele, director and general manager for automotive products at Xilinx, explained why the automotive industry is now looking at using FPGAs rather than Application Specific Integrated Circuits (ASICs) (application specific integrated circuits) in some applications: “FPGA prices have dropped orders of magnitude and the requirements and complexity of automotive electronics are growing rapidly.” The MathWorks, provider of Simulink, the leading modeling and simulation environment, is at the forefront of automotive software development. “We’re just at the beginning of this,” suggested Paul Barnard, director of control design automation marketing for The MathWorks. “In powertrain, a lot of organizations realize they have to move in this direction, but they aren’t necessarily there today. They know it has to happen and they’re doing it for maybe 10% of their algorithms.”

Ford’s Mr. Prasad believes the industry has arrived only at the first stage of a complete embrace of software’s promise—a stage he refers to as “enlightenment.”

Turn to Software, page 3
FPGAs...

electronics in the areas of infotainment, telematics, driver assistance and image processing have risen dramatically. They have just crossed paths to where FPGAs are now a very cost effective solution.”

Xilinx maintains that even in volumes of 500,000 to 1 million per year, FPGAs can be more cost effective than A SICs over the life of the product, partly because the customer pays no NRE (non-recurring engineering) costs. Shorter time to market also contributes to making FPGAs a better solution. According to M. R. Steele, “It lets you lock in your hardware architecture and qualify it within the automotive guidelines, but it gives you the flexibility of working the software side of the design much closer to the start of production.”

Kevin Tanaka, Xilinx automotive marketing manager, noted, “Typically for an A SIC you need anywhere between 12 and 18 months for development. If a customer is really on a tight schedule, an FPGA could probably go in six months.”

Harman/Becker’s use of FPGAs to speed up development time for automotive multimedia systems gave the company a competitive edge in winning new business with Mercedes and BMW in Europe.

In-vehicle entertainment systems, navigation and driver assistance systems are all promising applications for FPGAs. One reason why Xilinx is “eating up DSP market share,” according to M. R. Tanaka, is because DSPs are serial processors. The high-speed parallel processing capability of FPGAs makes them especially well-suited for camera-based applications such as lane departure warning and adaptive cruise control. M. R. Tanaka said that Xilinx is getting inquiries for night vision and occupant sensing applications as well.

Xilinx and Altera agree that it is the European tier ones and OEMs who are leading the industry in adopting FPGAs. A Itera’s Tapan M. etka, strategic marketing manager for the automotive business unit, noted that in addition to Harman, early adopters include Bosch, Siemens, VDO and Valeo. A Itera’s FPGAs are in the Valeo-designed lane departure warning system recently introduced in the Infiniti QX45. Xilinx worked with Microsoft and Fiat in developing a telematics system based on Microsoft’s Windows Mobile for an automotive. (See page 8 for more on Windows Mobile.)

Xilinx also has booked orders with some Japanese multimedia and navigation suppliers. Neither Xilinx nor A Itera see any competition coming from Japanese semiconductor makers with FPGAs.

Honda’s Probe Cars Supplement VICS Traffic Info

Traffic congestion in Japan’s major cities remains a costly problem despite the aggressive mitigation efforts underway over the last decade. Over 11 million VICS navigation units had been sold in Japan as of December 2004, and 50% of all new cars come equipped with VICS navigation systems, according to ITS Japan. VICS (Vehicle Information and Communication System) navigation systems receive real-time traffic information for most of Japan’s major highways, free of charge, via FM multiplex broadcast and a network of radio and infrared beacons.

Honda InterNavi Premium Club members have access to traffic information for routes not covered by VICS. In September 2003 Honda launched a “floating car data” program, which uses cars equipped with Honda’s hard disk drive (HDD) navigation systems as probes. The probe cars transmit their location and a time stamp to the InterNavi Information Center, which compiles the data and makes it available to other InterNavi subscribers looking for traffic information outside the VICS coverage area.

More on Honda’s launch of cars as probes can be found in the November 2003 Hansen Report. Earlier this month, we checked in with Toyohi (Tony) Nakaizumi at Honda R&D for an update on how the program is working. Mr.

Nakaizumi was recently named senior chief engineer for Honda R&D in Tochigi, Japan. According to Mr. Nakaizumi, there were 165,000 Honda probe cars on the road at the end of April 2005. Roughly 40 million kilometers worth of data has been collected thus far. Data for approximately 100,000 km are reported each weekday; 200,000 km daily over the weekend. All Honda factory-installed HDD navigation units and some dealer option units can transmit probe data.

Probe-car-generated traffic information is provided to InterNavi members free of charge, but the customer must pay regular cellular phone fees to access the service. Honda is working to improve the quality and real-time capability of the traffic service over the next two to three years. In the future, additional services such as local weather and road surface conditions could be offered, but Honda has made no decisions yet about future products.

Toyota’s Next Generation G-Book

Toyota began offering its next-generation G-Book service in April 2005. G-Book A Ipha subscribers now have an emergency one-button call service, HELPNET, which connects them to an operator and automatically transmits the vehicle’s location. Later this summer some G-Book A Ipha-equipped models will be capable of automatically activating HELPNET when an airbag deploys, but automatic notification is not included in the first release.

Toyota’s G-Route Search combines VICS traffic information with past statistical data to forecast traffic congestion and suggest the best route.

THE HANSEN REPORT ON AUTOMOTIVE ELECTRONICS

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Page 2, May 2005

The Hansen Report on Automotive Electronics, Portsmouth, NH USA www.hansenreport.com
“The industry has heard the proclamations of what software can do. But we are not at the level where we have internalized that and said, ‘here’s how we actually derive value from this and here are the processes we therefore need, and here are the competencies we must put in place inside our businesses.’” A according to M r. Prasad, organizations won’t reach the second stage until they can “internalize the reality of software.” The third stage is execution. “There has to be a level of competency that would give the industry a different composition,” he said.

Clearly the automotive industry is enlightened about software. That is evident by the broad participation of carmakers and suppliers in the AUTOSAR partnership, which is developing standards for an architecture that will make software development far less complicated. Core AUTOSAR partners include BM W, Bosch, Continental, DaimlerChrysler, Ford, Opel, PSA Peugeot Citroën, Siemens VDO, Toyota and Volkswagen.

Toyota connects AUTOSAR to Nissan, Honda and the Japanese industry through the JASPAR (Japan Automotive Software Platform and Architecture) partnership.

Without AUTOSAR or other standard architectures, software development has been problematic. While the amount of software content in vehicles is mushrooming, the new software does not always yield proportional improvements in features. “You find anywhere from a dozen up to 80 electronic control units on vehicles today,” said Patrick Popp, director of the electronics controls and integration lab at General Motors. “At each of those ECUs requires the same basic software—a duplication of effort. We will move to some sort of centralized computing architecture that shares basic software,” he said.

IBM is an advocate of AUTOSAR and also a member. IBM’s director of automotive solutions, Erich Nickel, suggests that other standards must also be applied, such as the Unified Modeling Language (UML) and the Systems Modeling Language, along with systems engineering. IBM, which bought the company that developed UML, supports UML as “the industry-standard language for specifying, visualizing, constructing and documenting the artifacts of software systems.” M r. Nickel believes the automotive industry needs to adopt a top-down systems engineering approach to software development. “Today cars are designed from the bottom up—from component to subsystem to system. Given the complexity and interdependencies between systems, this no longer works.”

Many in our industry have been advocating top-down systems engineering for years, but its implementation has proven very difficult. Erich Nickel believes that part of the difficulty comes from the fact that a lot of innovation comes from suppliers, who are not completely cognizant of the overall vehicle system. “Carmakers must define the requirements and the architecture, and the suppliers have to develop according to this,” he said. “This is a main focus that IBM will bring to the automotive industry, to help it transform to new standards and new engineering methodologies.”

Modeling and simulation tools will continue to improve. GM’s Patrick Popp wants a seamless integration of the tool chain that starts with requirements and specifications and goes all the way to the verification and validation of the finished product. “Today I have to do too much coding to transfer computer models between different, incompatible tools,” he said. “That costs me too much time and introduces errors.”

A possible answer to tools incompatibility could come from IBM, which in 2001 released the Eclipse platform, an open-ended, language neutral, integrated development environment that could make automotive software developers more productive. IBM donated Eclipse as open source to the general software development industry. “This is far beyond automotive,” said Erich Nickel. “A bout 150 companies have already agreed to apply Eclipse in their tool sets. IBM will help the automotive industry get into this platform,” he added.

A long with seamless software development, software developers want software testing standards, especially for safety-critical systems such as steer- and brake-by-wire. “That’s critical,” said Paul Barnard of The MathWorks. “Being able to test and validate that the software is correct and safe is definitely going to be something the tools need to support.” Whether the automotive industry opts for a global standard for safety certification or if each carmaker develops proprietary standards remains to be seen. M r. Barnard noted, “A ll it takes is one or two really bad incidents and the government might step in and do something about it to make sure these things are safe.”

Another difficulty affecting full exploitation of the potential of software relates to the way carmakers and suppliers are organized. “There is a lot of division on where software goes done,” said Ken Waichunas, automotive driver of VaST Systems Technology. At the carmakers, most software is developed by powertrain groups, who are usually separate from other electronics and software development groups. VaST is an up-and-coming company that makes virtual models of microprocessors that can be run on a PC. With VaST microprocessor models, developers can test software without having to wait for an actual hardware prototype of a new chip.

Changing the automotive organizational culture may be the greatest obstacle to software development. “This is a big problem, especially when it comes to integrated functions such as stability control, which touches powertrain and brake control systems,” IBM’s M r. Nickel asserted. “You have a powertrain development organization; you have infotainment, body, chassis and others. A ll these groups have different suppliers, each with different software development methodologies and different tools.”

“Organizational inertia,” according to Scott Lehman, automotive industry manager for The MathWorks, has delayed the auto industry’s adoption of tools that automatically generate software code from tested models. M r. Lehman believes auto-code generation will see much greater use by automotive customers in the future. “While a significant number of engineers do use auto-code generation tools today, they’re only doing 10% of what they could be doing with the tools,” he said.

Thus far, software content has been most apparent in powertrain systems, body controllers and infotainment products. Microsoft has been focusing on infotainment at least since January 1997 and just continued on page 8
The Company Profile... Autoliv Inc.

**Autoliv Sales and Net Margin by Year**

1999 to 2004 Annual Growth of Sales: 10.0%

<table>
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<th>Year</th>
<th>$ millions</th>
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<tbody>
<tr>
<td>1999</td>
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</tr>
<tr>
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<tr>
<td>2003</td>
<td>5,301</td>
</tr>
<tr>
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**Net Margin**

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<th>%</th>
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</tr>
<tr>
<td>2003</td>
<td>5.1%</td>
</tr>
<tr>
<td>2004</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

**Autoliv Sales by Product**

- 2004 Sales: $6,144 million
- Other* 12%
- Frontal airbags, 26%
- Electronics, 9%
- Side airbags, 20%
- Seat belts, 33%
- *Includes airbag inflators, steering wheels and seat components.

**Autoliv Sales by Region**

- 2004 Sales: $6,144 million
- Europe, 57%
- ROW, 10%
- Japan, 8%
- North America, 25%
- Big Three, 16%
- Transplants, 9%

**Background**

Autoliv AB became a public company when its parent company, Electrolux, sold its holdings in Autoliv through a public offering in 1994 and the shares were listed on the Stockholm Stock Exchange. Three years later, Autoliv AB merged with Morton Automotive Safety Products (Ogden, Utah) to form Autoliv Inc. Since 1997 Autoliv's sales have grown 9.5% per year, nearly twice as fast as its served market. Acquisitions made mainly in 2002 and 2003 have contributed 3% per year to sales growth; currency fluctuations accounted for 1%.

Autoliv is organized into four component divisions: electronics, inflators, steering wheels and textiles. It is vertically integrated employing pyrotechnics capability to make inflators, a foundry to make steering wheels and weaving machines to make airbag textiles and seat belt webbing. The company also maintains software and electronics capabilities in house. In the markets it serves, Autoliv sees itself as the technology leader.

While Autoliv keeps its headquarters in Stockholm, Sweden, with 40 employees, it is listed as a U.S. company, incorporated in Delaware. Autoliv stock is listed on the New York Stock Exchange and on the stock exchange in Sweden. “We are truly a global company,” said Mats Ödman, vice president, corporate communications.

Autoliv operates 80 wholly or partially owned manufacturing facilities in 30 vehicle-producing countries and sells products to all major vehicle manufacturers.

Autoliv competes with TRW, Takata, Delphi and Key Safety Systems (formerly Breed Technologies), among others.

**Controlling Costs**

According to the company, its most efficient means of reducing costs is through the redesign of its products to take advantage of newer, more cost-effective components. Another approach is to consolidate its supply base. In a long-term project that began in 2003, Autoliv intends to reduce the number of suppliers that serve the company from 2,000 to just 500 by the end of the decade. “A Autoliv was built on acquisitions so we have suppliers of similar parts in Germany, Spain, France, the U.K., Sweden and so forth,” explained Mr. Ödman. Now with the common currency it’s much easier to have one supplier [of a particular part] for all of Europe.”

**Acquisition Objectives**

- Market coverage
- Global expansion
- Upgrade product line

**Divestment Objectives**

- Non-core products
- Low value-added products
- Cost reduction
- Plant rationalization

---

**Headquarters**: Box 703 81, SE-107 24, Stockholm, Sweden; Phone: 46-8-58 72 06 00; Fax: 46-8-24 44 93; email: info@autoliv.com; www.autoliv.com

**2004 Sales**: $6,143.9 million

**2004 Net Margin**: 5.3%

**2004 Free Cash Flow**: $367 million or 6.0% of sales

**2004 Return on Equity**: 13%

**2004 R&D**: 6.0% of sales

**Working Capital as of 3/31/05**: $359.4 million

**Products**: Primarily airbags and seat belts

**Top Customer**: Ford accounts for 23% of sales.

**Employees as of 12/31/04**: 39,765; research, development or engineering employees: 3,700

**Sales per Employee**: $155,000

**Stockholders' Equity as of 3/31/05**: $2,603.5 million

**Stock Market Capitalization as of 5/03/05**: $4.2 billion

**2004 Electronics Sales**: $534 million

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1 Autoliv is a Delaware, U.S. holding company with executive offices in Sweden.

2 Net cash from operations after capital expenditures but before acquisitions.

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Autoliv's share of the global Japanese market for airbags is about 17%, and for steering wheels its share is 21%. Autoliv has garnered 20% of the domestic Japanese market, most of which involves exported vehicles, which usually have more airbag content than cars sold inside of Japan. A utoliv maintains facilities in Tsukuba, Fujisawa and A tsugi, Japan.

Its success in Japan notwithstanding, A utoliv's most promising Asian region is Korea, where the company already has won a 33% share of the domestically produced vehicle market and expects more penetration as Korean carmakers set up production abroad, where their local Korean airbag suppliers aren't operating.

Products
◆ Frontal Airbags

A utoliv's share of the Western European airbag market declined from roughly 52% in 2000 to roughly 47% in 2004. The reason is, says Mats Ödman, “Sales of our most successful frontal airbag are going down because of competition.” For example, TRW has taken some Ford airbag business in Europe, while A utoliv has taken some Ford business in North America from TRW.

In 2004 A utoliv introduced an improved front airbag that affords more protection to the driver. By using an

Investments in Asia Spur Growth

Some of Autoliv's sales growth has been the result of progress made in Asia, where the company has been investing for the past five years. Asian vehicle manufacturers accounted for 22% of Autoliv’s revenue in 2004, compared with 18% in 2002.

◆ In 2003, Autoliv acquired the remaining 60% of the shares in NSK's Asian seat belt operations, which enhanced the company's presence in Japan. The operation had annual sales of about $150 million.

◆ Also in 2003 Autoliv acquired the net assets of NSI (Nippon Steering Industries), a joint venture between KIW and Autoliv's own steering wheel company in Japan, Autoliv Izumi. NSI has produced annual sales of about $20 million.

◆ In 2000, Autoliv acquired Izumi, Japan's second-largest steering wheel company with a quarter of the Japanese market. Mats Ödman noted, "As a Nissan keiretsu supplier, Izumi needed to partner with Autoliv so it could respond to Renault's global requirements for steering wheels."

◆ In 2002, following its acquisition of the Visteon Restraint Electronics business, which at the time was producing about $150 million in sales, Autoliv took over Visteon's engineering facilities in Hiroshima, Japan, with 25 engineers.

◆ In 2005, Autoliv purchased the remaining 40% of its Chinese joint venture, Autoliv Shanghai, which makes airbags. About 2.3 million vehicles were produced in China in 2004.

In order to reduce costs, A utoliv has made a special effort to move production to countries with low labor costs. In 2004, 39% of A utoliv employees were employed in low labor cost countries, up from less than 10% of employees in 1999.

The company recently divested several non-core or low value-added operations including steel stamping operations in France and the U.K., plastic production in Italy and Sweden and sewn bag production in the Netherlands and Sweden.

Markets

A utoliv says its served market for steering wheels, airbags and associated electronics has grown at 5% per year, reaching $17 billion in 2004. A utoliv’s airbag market has been held down somewhat by intense competition, which has depressed prices. While the unit demand for airbags, especially side-chest and side-head airbags, continues to rise, the price of frontal airbags has been dropping over the last 15 years, “from $100 each to about $50 each today,” according to Mats Ödman. Front airbags accounted for 42% of A utoliv’s total sales in 1997, but only 26% in 2004.

The market for seat belt systems has been growing at the rate of 4% per year since 1997, despite the fact that seat belts were introduced more than 40 years ago. That is partly because seat belt systems have been improved over the years with the addition of such features as pre-tensioners, automatic height adjusters and load limiters.
A utoliv-designed steering wheel with a fixed, non-rotating hub, the driver's airbag no longer has to be round. It can be made asymmetrical, rectangular or fitted with an additional smaller bag to provide optimum protection. The fixed-hub design eliminates the need for connecting coils and clock springs, which frees up space for designers to add direct cable connections for audio and accessory controls on the steering wheel. The fixed-hub steering wheel debuted on the 2005 Citroën C4; A utoliv is in the process of booking further orders.

**Inflatable Curtain Airbags**

A utoliv's fastest-growing product line is inflatable curtain airbags—sales grew by more than 50% in 2004 and accounted for 10% of all sales. Developed together with Mercedes and Volvo and first introduced in 1998, A utoliv produced about 13 million curtain airbags in 2004.

According to the Insurance Institute for Highway Safety, side airbags have reduced deaths among passenger car drivers involved in driver-side collisions by about 45% when the side airbag included head protection, and by 11% when the side airbag was designed to protect only the torso.

Side-impact collisions account for a quarter of all injuries to car occupants, but they account for more than one-third of the serious and fatal injuries. Inflatable curtains are also effective in preventing injuries and fatalities that result from rollover accidents.

A utoliv's inflatable curtain airbag is stored in the headliner above the doors and protects the heads of all passengers seated next to the struck side. The bag inflates in .025 seconds and stays inflated for several seconds because the bag is created without seams, which more quickly leak air. That extra time could be crucial in a rollover accident. Laboratory tests have demonstrated that the Head Injury Criterion (HIC) can be reduced by more than 90% when an inflatable curtain is used. The HIC is a tolerance level reference used to assess serious injury risk; it is only valid for head impacts against rigid surfaces.

Europe leads in side airbag applications with a 50% penetration rate on new vehicles, according to A utoliv. A sia is lagging except for the luxury export segment of that market. In the United States, A utoliv expects the demand for side airbags to take off once the U.S. government effectively mandates their usage on all light vehicles starting in 2009 with a three-year phase-in program. While side airbags are not specifically required, they will be widely used to meet the upgraded standards for side impact protection likely to be adopted later this year.

**Knee Bags**

Knee bags are growing nearly as fast as inflatable curtain airbags, but from a much smaller base. According to Mats Ödman, “Knee bags are the future. You reduce the number of head injuries by roughly 50% using airbags and the latest seat belt technology.” A sia’s result, more people survive frontal crashes only to suffer terrible leg injuries. In crashes where seat belts and airbags are installed, leg injuries account for 40% of all moderate and severe injuries. Without airbags and seat belts, leg injuries accounted for just 24% of injuries. “That’s why they’re in such seats,” said Mr. Ödman. However, some carmakers insist that adding yet another airbag will not have nearly the impact on safety as frontal or side airbags. Some carmakers will pass up knee bags to instead focus on active safety features that help to avoid crashes in the first place.

A utoliv was the first supplier to introduce knee airbags, in 1996.

**Seat Belts**

Airbags are designed to be used with seat belts; frontal airbags alone are only 12% effective in reducing deaths in all crashes, according to NHTSA, and 20%-25% in frontal crashes. A utoliv and its joint-venture partners produced more than 90 million seat belt systems in 2004, accounting for 33% of company sales. According to A utoliv, seat belts are estimated to reduce the overall risk of serious injuries in frontal crashes by 60% to 70% and the risk of fatalities by 45%. NHTSA estimates seat belts save about 11,000 lives in the U.S. each year.

Advances in seat belt technology such as pretensioners and load limiters have made seat belts even more effective, plus they reduce injuries caused by the belt during a collision. A utoliv’s latest seat belt technology is installed on the Peugeot 407. Where a crash is sensed, pyrotechnic pretensioners on the front seat and back seats are fired, which tightens each belt six inches to eliminate seat belt slack and protect against rib fractures. Load-limiters protect the chest by paying out the webbing to limit the belt force to the chest. Introduced in 1995, load limiters in combination with pretensioners and frontal airbags reduce the risk of life-threatening injuries by 75% in frontal crashes, according to A utoliv. A utoliv began producing seat belts in 1956.

**Mayday Platform for Volvo**

A utoliv ships from 60,000 to 70,000 telematics and telephone platforms to Volvo each year to support the carmaker’s Volvo On Call service. Volvo offers free safety and security service in the package price of £1,200 for the first five years. “We are equipping cars today with GSM functionalities—On Call can be used as a normal car phone—and also includes software and GPS components to detect where the car is,” explained Jan Carlson,
The Company Profile Continued

<table>
<thead>
<tr>
<th>Autoliv Global Manufacturing Footprint Compared with the Competition</th>
<th>Autoliv</th>
<th>TRW</th>
<th>Takata</th>
<th>Delphi</th>
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<tr>
<td>EL = Electronics</td>
<td>SB = Seat belts</td>
<td>AB = Airbags</td>
<td>SW = Steering wheels</td>
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</table>

global vice president of engineering, responsible for all engineering activities at A utilov. "In the event of an accident, it senses the number of airbags deployed, and automatically connects to the call center."

The Volvo business accounts for about 20% of the European emergency calling market, a market that may be poised for fast growth. A working group set up by the European Commission is trying to establish a standard emergency call system that would eventually equip all new vehicles with eCall systems starting after September 2009. (See page 8.)

New Product Strategy: From Passive to Active Safety

While the majority of the safety products A utilov makes are passive devices, which protect passengers once an accident has occurred, the company is moving into active safety products, which prevent crashes. For example, A utilov is developing and has already demonstrated a 24 GHz radar sensor that the company will first deploy in a pre-crash sensing system that pretensions the seat belts. Eventually, as the radar sensor is made more foolproof, it will be applied to airbag inflators and active safety systems including obstacle detection, lane keeping and blind-spot warning. "A ctive and passive safety are merging," said Jan Carlson. A utilov's strategy to move into active safety is in line with the company's long-term vision, which is "to substantially reduce traffic accidents, fatalities and injuries."

A utilov's growing interest in active safety is in keeping with the view held by Robert C. Lange, a top safety engineer from General Motors, who said that he was less interested in passive safety, "because adding yet another airbag would not save as many lives as preventing crashes in the first place." Mr. Lange's comment was made during an SA E Congress panel session on safety this past April. Still, said Mr. Carlson, passive safety will always play an important role at A utilov. "The seat belt is absolutely the most important safety equipment in the vehicle."

Night Vision

Among all of the new products that A utilov is developing, the company is expecting the most from infrared night vision. With a production order from one unnamed carmaker already in hand, A utilov will begin production at the end of 2005. "It is a medium-sized order," said Mr. Carlson. "When this goes to full production it could nearly double the world's production of infrared cameras." A utilov estimates the total number of IR cameras sold each year at 50,000, in all markets.

Designed to help drivers see pedestrians and animals at night, A utilov chose an infrared system, which is particularly sensitive to the radiation coming from warm bodies. The system can spot pedestrians as far as 500 meters in front of the vehicle, which gives the driver plenty of time to react to what he sees. It is especially adept at seeing passengers in the dark between two meeting cars, where the oncoming headlights can dazzle the unaided driver. While night vision got its start in the United States, today's greatest demand for night-vision systems is coming from Europe and Asia.

For now A utilov is content to display the camera image on the vehicle's existing navigation display but is considering development of displays that would pop up from the dashboard directly in front of the driver. A utilov is also looking at other ways to alert the driver when a pedestrian is in the vehicle's path, for example by sounding an audible alarm or vibrating the steering wheel or seat.

Radar/Vision Sensor

A utilov and the Ford Motor Company participate in a joint venture led by Sarnoff Corporation (Princeton, New Jersey). The JV has won a $5.1 million U.S. government Advanced Technology Program (ATP) grant. The funds will support the development of an integrated radar/vision system that will "detect approaching hazards, measure their rate of motion, determine if and where a collision will occur, and trigger mitigating actions, such as applying brakes, pretensioning seat belts and firing side airbags, with a near-zero alarm rate," according to the ATP announcement. Running through September 2007, the $10.4 million project will merge Sarnoff's vision-based systems capability with A utilov's radar technology. The active safety system has the potential of saving up to 16,000 lives and preventing 600,000 serious injuries annually, according to ATP.

Autoliv Products

| Airbags |
| Inflate curtains |
| Passenger |
| Driver |
| Thorax |
| Knee |
| Seat belt systems |
| Automatic height adjusters |
| Pretensioners |
| Steering wheels |
| On-call communications platforms* |
| Anti-whiplash seat |
| Electronics control modules |
| Sensors |
| Belt-in seats |
| Child seats |
| Integrated Isofix |

*Not yet in high volume production
Europe Works to Standardize Emergency Call Service

The European Commission has set a goal of reducing traffic fatalities by 50% by 2010. One strategy that could save an estimated 2,000 of the 40,000 lives lost annually is to get emergency responders to the accident site faster. The Commission joined with automakers, telecom providers and public agencies throughout Europe to develop eCall, a pan-European, in-vehicle emergency calling system based on Europe’s E112 location-based emergency assistance telephone service, already in place in many countries. The plan is to eventually equip all new cars in Europe with eCall devices, starting with models introduced after September 2009.

The work is coordinated through the eCall Driving Group, a working committee established by the European Commission under the eSafety Forum. The Driving Group is co-chaired by ACEA (European Automobile Manufacturers Association) and ERTICO.

Similar to GM’s OnStar, the proposed European system will allow drivers to place an emergency call manually, or the standard in-vehicle device could automatically initiate contact with the nearest local PSAP (Public Safety Answering Point) or private service provider based on information it receives from sensors in the vehicle. Data sent to the call center would include at least the following: time of the incident, the precise location, vehicle identification, service provider identifier and an indication that the call was sent manually or automatically, and possibly some way to qualify the severity of the accident, using data from vehicle sensors.

Under the direction of the European Commission, eCall is a voluntary program and its success depends entirely on the commitment and cooperation—and financing—by the member states, public service providers and private industry. A II stakeholders were asked to sign a memorandum of understanding, released in August 2004, to indicate their intention to participate. As of last month 40 participants had signed the non-binding agreement, including the ACEA on behalf of BMW, DaimlerChrysler, Fiat, Ford of Europe, GM Europe, Porsche, PSA, Renault, Scania, Volkswagen, Volvo and others.

A number of obstacles could derail the full implementation of eCall. For example, not all the member states have infrastructure in place yet to receive E112 calls. While Finland is on track to implement eCall nationwide in 2006, other states are much farther behind.

Carmakers, working through the ACEA, must develop a standard, low-cost in-vehicle telematics unit and define its content and functionality.

Protocols for sending and receiving data and voice communications must also be standardized. On May 4, 2005, eCall representatives met with the ETSI (European Telecommunications Standards Institute) to begin work on specifications for transmitting the minimum set of incident data from the vehicle to the nearest PSA P, using GSM/3G networks.

Perhaps more formidable than the technical and political obstacles is the need to develop a sustainable business model that provides sufficient revenue for all the players. Member states may consider providing incentives through tax breaks, insurance providers may offer discounted premiums for eCall-equipped cars and service providers may find a way to enhance revenues by providing additional, non-emergency, location-based services.