New Concepts in BMW 7 Series

In redesigning the 7 Series for 2002, BMW’s electrical and electronics engineering expertise is unmistakable—manifest in a host of new features and functions and, less noticeable to consumers, in a highly-complex, sophisticated electrical system architecture.

We recently asked Hans-Georg Frischkorn, director of BMW’s electrical and electronics department, what he was most proud of and what was most remarkable about the new 7 Series, which was formally introduced on September 11 at the Frankfurt Auto Show. “Our biggest achievement in the 7 Series was to handle the complexity of the total electrical system, bringing it to the level of quality and reliability that is expected from a BMW.” The amount of software in the car is on the same level as a modern aircraft. There are about 70 control units, almost all of which have flash memory. With flash (electrically reprogrammable semiconductor memory), ECUs can be updated with new software—for repairs or with a new feature—without exchanging physical parts.

The overall architecture of the system includes a decentralized bus structure: one fiber-optic bus for safety functions and one fiber-optic bus for entertainment functions. BMW uses its ByteFlight event-triggered protocol for the safety bus because it is capable of high-speed data transmission, (10 M bps) and it protects against transmission errors, according to Mr. Frischkorn. Basic CAN is used for body electronics, and higher speed CAN for the powertrain. Transmission of data for entertainment functions, which also need a high data rate, is done with MOST, which currently transmits at

Telematics Computing Platforms—Many Alliances and Players

By the end of this decade, nearly half of all new vehicles produced worldwide will have a computing/communications platform capable of running a variety of telematics and multimedia applications, including direct access to the Internet. Broadly defined, telematics links computers with communications. When the term is applied to the automotive industry, communications are wireless and include GPS-determined data on the vehicle’s location. Telematics players come from information technology, telecommunications and the automotive industry, and they include service providers and content aggregators. The telematics industry has been developing ways to economically and seamlessly deliver telematics services end-to-end, from the service provider/content aggregators’ back-end servers to computing platforms in vehicles. In this article, we focus on the embedded computing platform.

The telematics platform embedded in the vehicle is made up of a microprocessor, an operating system and some application programming interfaces. Specific applications like navigation, or traffic information services run on top of the platform. Java middleware, or a Java virtual machine is an important optional platform component. A Java virtual machine (JVM) allows any type of computer to run applications written in Java.

Currently, embedded platforms like OnStar’s, which do not require a computer in the vehicle, hold the biggest share of the embedded telematics market. To receive OnStar services today, only a GPS receiver, a cell phone transceiver and a modem must be installed. As more carmakers install embedded computers capable of running telematics and multimedia applications, and as more appealing content is available, applications and services will generate the majority of revenue. That transition will happen before the end of the decade, as the price of on-board telematics hardware comes down. The hardware/software platform should ideally retail for no more than five- or six-hundred dollars.

The fledgling market for embedded telematics platform components is still fragmented, with no single company tackling development of the entire platform. Rather, suppliers have organized themselves into alliances around top component manufacturers. (Please see “Major Telematics Players” on page 3.) While most major carmakers say that some of their future telematics systems will be based on Java technology from Sun Microsystems (Palo Alto, California), it is surprising to see how successful Microsoft (Redmond, Washington) has been with its WCEfA (Windows CE for Automotive) platform. While there are many suppliers of microprocessors and operating systems, there are fewer suppliers of Java middleware.

Most carmakers and service providers around the world specify, or are considering specifying, Java middleware, the layer above the operating system and below the applications. The use of Java is one sure way to ensure multiple sources for hardware and software. The Java-based platform allows applications to be reused or updated, without starting from scratch, or they can be replaced with other Java-compatible applications. Java programs run on a Java virtual machine, independent of whatever may be underneath, which makes the JVM an essential element of Java’s portability feature. A variety of microprocessors can run most operating systems designed for the telematics market, and many platform de-
Telematics...

Signers are specifying that operating systems be compatible with Java middleware. A another popular telematics platform is Microsoft’s Windows CE for A utomotive, which consists of the Windows CE operating system and some application programming interfaces. While Java is an open standard with lots of applications written for it, W CEFA can accommodate only applications that are Windows based or those built around common standards, for instance, the Internet standard XML. Microsoft has been working on automotive computing platforms since it began developing the AutoPC in 1995; work on Windows CE was started in 1994. W CEFA works with microprocessors from the following manufacturers: Fujitsu, Hitachi, Intel, Matsushita Electric Industrial, Sigma Designs, SIRF Technology, STM microelectronics and Toshiba.

Lack of Java Certification: A Real Obstacle to Market Growth or Sun Hair-Splitting?

Sun’s Java technology is open to others, with some restrictions, and others along with Sun have developed or are developing virtual machines and other middleware according to Java specifications. Sun Microsystems has been active lately trying to drum up worldwide support for a standard version of the Java virtual machine. Jim DeStefanone, strategy and market development manager for embedded Java platforms, according to Sun, nor are other Java virtual machines, which are destined for auto applications. Mr. DeStefano suggested: “IBM has the Object Technology International (OTI) virtual machine [J9], which is not a certified, compliant Java machine. It is their own, proprietary version.” Sun says all Java virtual machines need to be certified so that all software applications written in Java can be run on any Java VM. That portability is particularly important to subscribers who want to use a variety of services from multiple vendors or shift to different providers.

Marc Erickson, project manager from Object Technology International, a subsidiary of IBM in Ottawa, Ontario, Canada, told us that Sun’s statement that J9 is uncertified is “untrue.” Indeed, corrected Mr. Erickson, “Our J9 virtual machine is certified; our development tools are Java compatible. They carry the ”Java Powered” brand name and the coffee cup logo.” Marc Erickson is IBM’s representative to the Java Community Process, a group that defines Java standards. According to Mr. DeStefano, while IBM is using the Java coffee cup logo, it is not proper, although Sun’s ”legal department has decided not to go after IBM because we don’t want to air dirty laundry.” Sun has indicated it expects little revenue from selling its own Java virtual machine. Sun’s real money comes from selling computer servers and software for the back-end office. Q N X Software Ltd. (Kanata, Ontario, Canada) spokesman Paul Leroux isn’t so sure. “They are splitting hairs. Sun has always said that certification required more than passing the test suite. Sun has insisted that every supplier also has to incorporate pieces of Sun intellectual property—for example Sun’s bytecode verifier—and pay royalties to Sun. Sun says their bytecode verifier is necessary for security,” said Mr. Leroux.

Despite Sun’s objections, JVMs not developed by Sun are penetrating embedded telematics platforms. These include, in addition to IBM’s J9, Chai from Hewlett Packard (Palo Alto, California) and Jeode from Insignia (Fremont, California). A cunia (Leuven, Belgium) has a JVM that it uses in its development platform but has not yet decided to market it as an embedded JVM.

continued from page 1

U.S. Motor Vehicle Theft

While aftermarket sales of vehicle security systems grew 6.3% in 2000, motor vehicle theft in the U.S. also grew. According to the FBI Uniform Crime Reports, motor vehicle thefts (reported to law enforcement agencies) were up 2.7% in 2000, after declining for the past decade.

According to a study by the National Insurance Crime Bureau, the three cities with the worst car-theft rates in 2000 were Phoenix, Arizona; Miami, Florida and Detroit, Michigan.

<table>
<thead>
<tr>
<th>Passenger Vehicles with Worst Theft Losses, 1998 - 2000 Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acura Integra 2-door</td>
</tr>
<tr>
<td>2. Acura Integra 4-door</td>
</tr>
<tr>
<td>3. Chevrolet Corvette</td>
</tr>
<tr>
<td>4. Cadillac Escalade 4WD</td>
</tr>
<tr>
<td>5. Lexus GS 300/400</td>
</tr>
<tr>
<td>6. Mitsubishi Montero Sport 4WD</td>
</tr>
<tr>
<td>7. BMW 7 Series long wheel base</td>
</tr>
<tr>
<td>8. Mercedes CLK</td>
</tr>
<tr>
<td>9. Audi A6 Quatro</td>
</tr>
<tr>
<td>10. Lincoln Navigator 4WD</td>
</tr>
</tbody>
</table>

Datatation: Highway Loss Data Institute

ISSN 1040-1105

THE HANSEN REPORT ON AUTOMOTIVE ELECTRONICS

© 2001 Paul Hansen Associates, 11 Wentworth Road, Rye, NH 03870, USA; Telephone: 603-431-5859. Fax: 603-431-5791. E-mail: hansen@nh.ultranet.com. All rights reserved. Materials may not be reproduced in any form without written permission. The Hansen Report on Automotive Electronics is published 10 times a year, monthly; July/August and December/January are combined issues. The annual subscription rate is $617 (North America), $657 (elsewhere). Back issues are available for $45 each; see our online index at www.hansenreport.com. Paul Hansen Associates is a strategy and market research firm consulting to the electronics industry.

Publisher/Editor Paul Hansen
Senior Editor Heather Parker
Managing Editor/ Brianne Wolfe
Circulation Manager

Telematics...

Continued from page 2

Major Telematics Players

Key Alliances

These companies have been among the most active at organizing a group of suppliers around a specific embedded telematics platforms:

◆ Microsoft
Platform: Windows CE for Automotive (WCEfA)

End-to-End (from back-end server to the vehicle): Microsoft is developing CarNet, a product that supports an end-to-end solution.

Microprocessors: Hitachi SH4 and Intel processors are the major processors supported.

Operating System/APIs: WCEfA

Java Middleware: Not yet, through WCEfA solution, supplier BSQUARE is a distributor of Insignia's Jodee JVM.

Active Customers: Denso, Bosch/Blaupunkt, Siemens VDO, Visteon, Delphi; Microsoft says that within the next 16 months it will be able to announce production deals with nine carmakers involving products from navigation to multimedia. Lear and Yazaki are also said to be developing WCEfA-based products. Denso has a production deal with Ford involving a multimedia/telematics product based on WCEfA.

Application and Service Providers: As of May 2001, the following were developing in-car telematics products to complement WCEfA: S3OF, Audeble, BSQUARE, EZOS, Fonix, InfoGation, InfoMove, Lernout & Hauspie, Oasis Silicon Systems AG, Telgaron, Telmatics, InfoGation, InfoMove, Lernout & Hauspie, Oasis Silicon Systems AG, Telgaron, Telmatics, InfoGation, InfoMove, Lernout & Hauspie, Oasis Silicon Systems AG, Telgaron, Telmatics.

◆ Motorola
Platform: mobileGT
End-to-End: Yes

Microprocessors: PowerPC from IBM or Motorola SP5

Operating System: QNX6 from QNX

The QNX OS can run on these processors: PowerPC, Intel's 86 and StrongARM and Hitachi's SH4.

Java Middleware: IBM's J9

Customers: Motorola has been working with OnStar and ATX among others.

◆ Intel
Platform: Personal Internet Client Architecture
Operating System: QNX6 and WindRiver's VxWorks

Java Middleware: IBM's J9

Microprocessor: Intel's XScale processor (the successor to Intel's StrongARM)

Other Platform Players

◆ Sun Microsystems

For nearly a year, Sun has been working in a non-exclusive relationship with OnStar to co-develop a standard JVM acceptable to both companies.

In Japan, NTT and Sun have been working together to study the feasibility of introducing Java into i-mode terminals, used widely in cellular phones. NTT has been investing in telematics and hopes to supply some version of i-mode to that application.

This September, Sun announced that it would cooperate with Targasys to define Java technology for telematics applications. In a press release, the partners wrote that their work together will be aligned with the work in the States by Sun and OnStar. A telematics services company, Targasys is a subsidiary of Fiat, which is part of General Motors.

◆ WindRiver

The maker of the VxWorks operating system hopes to parlay its success in navigation to the telematics market. Of the twenty-one makers of navigation equipment that WindRiver tracks, the company told us that VxWorks supports twelve of them including, Sony, Xanavi, Pioneer, Magneti Marelli, Siemens/VDO, Fujitsu-Ten and Harman Becker.

Major Service/Content Providers

◆ OnStar

Based on GM's commitment to install computing/communications platforms widely across vehicle lines, OnStar, with 1.5 million subscribers, is currently the leading player in the world of telematics. Two key OnStar suppliers are Motorola and Verizon.

Besides parent GM, OnStar customers include Honda, Toyota and Subaru.

◆ NTT

Based on the success of i-mode web portals in Japan, NTT is investing big in telematics worldwide. In Japan, NTT has made an alliance with NTT Comware Corp. (Tokyo, Japan) and Sony to develop a telematics platform for Honda and Nissan. To further exploit its success with i-mode, NTT has invested $9.8 billion in AT&T, according to a report published by Nikkei Business Publication.

◆ Vodafone

British communications giant Vodafone owns Passo, a key telematics player in Europe.

Vodaphone Passo entered into a telematics partnership with Ford of Europe. Passo purchased 20% of ATX.

◆ ATX

ATX seems to have found new life, especially after the announcement that Ford and Qualcomm's service provider Wingcast would be delayed for about a year until MY 2003. ATX, which established the Lincoln RESCU emergency call center, has made a new deal to provide telematics services to Lincoln customers. Motorola and Sprint will also participate in the Lincoln project. ATX also supplies services to Mercedes USA's telematics program called TeleAid, begun in MY 2000. Recently BMW has signed up ATX as its U.S. supplier.

2000 World VehicleProduction byManufacturer

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Total Vehicle Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GM</td>
<td>8,133,375</td>
</tr>
<tr>
<td>2. Ford</td>
<td>7,322,951</td>
</tr>
<tr>
<td>3. Toyota-Daihatsu-Hino</td>
<td>5,954,723</td>
</tr>
<tr>
<td>4. Volkswagen Group</td>
<td>5,106,749</td>
</tr>
<tr>
<td>5. DaimlerChrysler</td>
<td>4,664,660</td>
</tr>
<tr>
<td>6. PSA Peugeot Citroen</td>
<td>2,879,422</td>
</tr>
<tr>
<td>7. Fiat- Iveco</td>
<td>2,641,444</td>
</tr>
<tr>
<td>8. Nissan-Diesel</td>
<td>2,628,783</td>
</tr>
<tr>
<td>9. Renault-Dacia-Samsung</td>
<td>2,514,897</td>
</tr>
<tr>
<td>10. Honda</td>
<td>2,505,256</td>
</tr>
<tr>
<td>11. Hyundai-Kia</td>
<td>2,488,321</td>
</tr>
<tr>
<td>12. Mitsubishi</td>
<td>1,827,186</td>
</tr>
<tr>
<td>13. Suzuki-Maruti</td>
<td>1,457,056</td>
</tr>
<tr>
<td>14. Mazda</td>
<td>925,876</td>
</tr>
<tr>
<td>15. BMW</td>
<td>834,628</td>
</tr>
<tr>
<td>16. AvtoVaz</td>
<td>755,997</td>
</tr>
<tr>
<td>17. Daewoo</td>
<td>716,250</td>
</tr>
<tr>
<td>18. Fuji-Subaru</td>
<td>581,035</td>
</tr>
<tr>
<td>19. Isuzu</td>
<td>539,085</td>
</tr>
<tr>
<td>20. Gaz</td>
<td>227,673</td>
</tr>
<tr>
<td>21. Changan</td>
<td>203,127</td>
</tr>
<tr>
<td>22. Tata-Telco</td>
<td>193,580</td>
</tr>
<tr>
<td>23. MG-Rover</td>
<td>174,885</td>
</tr>
</tbody>
</table>

Total of Above: 55,278,939
Other Manufacturers 3,113,437
Total World Production 58,392,376

Data: OICA (Organisation Internationale des Constructeurs d'Automobiles)
Directed Electronics Inc. was founded in 1982 by Darrell Issa and his wife, Kathy, just two years after Mr. Issa sank the couple’s life savings into an electronics manufacturing firm in Cleveland, Ohio. That business did contract manufacturing in order to concentrate on product development. Today the main contractor is Nutek Corp., whose manufacturing facility in Hsin Tien City, Taipei, Taiwan, is ISO 9002 and QS 9000 registered. With 200 employees, Nutek is dedicated to the manufacture of auto alarms and alarm accessories. Directed also has other contract manufacturers in Taiwan, China and the Philippines, and sometimes hires contract engineers. Less than 20% of R&D expenditure is made with contractors. By 1990, all Directed products were manufactured outside, most all by low-cost workers in Asia. Directed’s decision to manufacture outside has resulted in very high productivity: Sales per employee is $552,000.

Mr. Issa has been very active in the California Republican party for the last six years. He was elected to the U.S. House of Representatives on November 7, 2000. In order to concentrate on Mr. Issa’s campaign, the Issas sold Directed in December 1999, to Trivest, a Miami-based private investment firm. At the time of acquisition, Trivest’s senior managing director Troy D. Templeton noted: “We strive to acquire world-class businesses with dominant market [positions].”

Trivest had bought, repackaged and sold 90 middle-market companies, totaling about $2 billion in value, during the period from its incorporation in 1981 to year-end 1999. On January 1, 2001, Jim Minarik joined Directed as president and CEO; he was recruited from Clarion of America, where he was also president and CEO. Mr. Minarik and Darrell Issa had known each other for years, in part through their association with the Consumer Electronics Association. Mr. Minarik followed M r.
I. The Company Profile Continued

**Directed Brand Names**

2000 Total Sales: $101 million
- Non-branded products, 10%
- Viper, 25%
- Clifford, Python, Hornet (Japan), Automate, 33%

**Target Markets for Directed Brands**
- **Automate**: Security products exclusively for new car dealers
- **Clifford**: High-end security
- **Hornet (Japan)**: Entry-level security
- **Python**: Mid-range to high-end security
- **Sidewinder**: Mid-range to high-end security
- **Valet**: Line of remote-control convenience products
- **Viper**: Directed's main security product brand; mid-range to high end

**2000 Total Sales: $101 million**

- Viper, 25%
- Clifford, Python, Hornet (Japan), Automate, 33%
- All other brands, 32%

**Sales and Marketing**

Directed has roughly a 33% share of the U.S. aftermarket for car alarms, remote-keyless entry and remote-car starting systems; that is up from 24% in 1995. Those three product lines accounted for 83% of what Directed sold in 2000. Directed markets its products through approximately 3,200 retailers, which together operate about 6,000 stores. Directed also sells its products through 34 distributors operating in 44 countries.

Directed has increased sales every year since incorporation 19 years ago. In the past, the aftermarket for security systems, including convenience and remote start systems in the United States, was growing at 6% to 8% annually, but is now closer to 2% to 3%. In the five-year period from 1987 to 1995, Directed's annual sales growth was 47%. Despite the current flat U.S. aftermarket for security systems, Directed has realized decent sales growth in the last five years. Directed sales grew 10.4% per year from 1996 to 2000. The company claims profits have also been good, though Directed would not disclose net margin.

The current, almost-flat growth in the U.S. aftermarket is directly related to increased sales of factory-installed OEM systems. Mr. Minarik estimated that remote keyless entry is currently approaching 70% penetration rate at the factory and the penetration rate of factory-installed security systems is still under 50%. Directed suggests that the consumer is often given the false impression that keyless entry systems provide some form of security. The aftermarket is left with selling add-on products that turn the factory-installed products into true security systems.

In the 1980s, Mr. Issa recalled that some in the industry believed that as OEMs entered the market, the aftermarket for security products would disappear. Yet, according to the Consumer Electronics Association, aftermarket sales for security products has grown from $165 million in 1996 to $218 million in 2000. (Please see chart on page 6.) The same thing was said about aftermarket audio, noted Mr. Minarik. "The reason the aftermarket is still growing and prospering is that it has survived by innovating."

**Partnerships and Acquisitions**

In July of 2000, Directed purchased the assets of the bankrupt Clifford Electronics Inc., a major player in the aftermarket vehicle-security business. Roughly twenty Clifford employees agreed to relocate from Clifford headquarters in Chatsworth, California, to Directed headquarters in Vista, California.

Associated with premium-priced automotive security systems and remote car starters, Clifford Electronics-branded products sell in the range from $300 up to $1,500 per system. The acquisition should expand Directed's customer base since the majority of Directed's security systems are sold in the $200 to $300 range. The Clifford brand is now Directed's second-largest brand in terms of sales; Viper is still number-one. Mr. Issa said at the time of acquisition: "I am elated by the synergies we have uncovered in the area of technology and intellectual property. Directed's patented Nuissance Prevention circuitry and Clifford's patented FACT (False Alarm Control Test) are the two dominant anti-false alarm technologies in the world."

The Clifford acquisition also provided Directed with a sales office in Mitcham, Surrey, England, which Directed hopes will help expansion into Europe. Opening its U.K. headquarters in Surrey, in 1992, Clifford won Car HiFi magazine's annual award of Best Security System for six consecutive years. Clifford also has some sales in Latin America, the Pacific Rim and other parts of Europe.

Directed told The Hansen Report that the company is interested in pursuing other acquisitions of technology or distribution channels, as well as potential partnerships or alliances involving technology, supply, sales and marketing. However, Mr. Minarik related that another acquisition is not the primary way Directed expects to grow. "Most of our growth will come from expanding our distribution of new and existing brands."

**New Products**

Every day, Directed has 16 technical support people talking to dealers around the country, and that helps them learn about problems in the field. These technical support people provide feedback to Directed product planners and engineers so they can continue to make Directed products easy to install, a key strength for the company. Ease of installation will continue to be a focus of new product development.

While the company has been a small player in the mobile audio business, and so far offers no video or entertainment products, Directed intends to grow its share of the mobile audio market and the rear-seat entertainment market in the continued on following page.
Directed Electronics Inc.

near future. New aftermarket products include the following:
- Longer-range remote keyless entry systems that do not violate FCC rules
- Two-way, long-distance remote systems
- Two-way automatic vehicle location (AVL) systems and Web-based maps
- Enhanced Serial Protocol (ESP2) used to integrate AVL with security/remote start systems
- Branded rear-seat entertainment products
- New cross-branded audio products (making use of existing Directed brands in other categories)
- Vehicle interface connectors

Long-Distance, Two-Way Remotes
In the fourth quarter of 2001, Directed will bring to market a transmitter-receiver system with a sophisticated remote that allows data to be sent to the vehicle, for example, to start the engine, lock or unlock the vehicle or turn the vehicle lights on or off. The remote will also be able to receive and display data coming from the vehicle, for example, whether the car is locked. The long-distance, two-way system will be priced from $600 to $800.

Automatic Vehicle Location
In the coming weeks, Directed will beta test a new AVL product that allows the driver to control the vehicle's security system by telephone; the company plans to make control possible via a home computer as well. AVL is an add-on to existing Directed keyless-entry and remote-start systems. The AVL system includes a vehicle-mounted GPS receiver and is capable of two-way communications. The product lets users track their vehicles on a map and also draw a virtual fence geometrically around their home, so they can be notified (by phone, fax and/or email), when their vehicle is driven beyond the virtual fence. Later versions of the product will notify owners by phone when their car's alarm triggers. Directed's AVL system will be priced lower than similar systems already on the market.

Rear-Seat Entertainment Systems
Over the last few years, the U.S. mobile electronics industry has pounced on the opportunity to sell rear-seat multimedia/entertainment systems to OEMs and aftermarket customers. Directed has had such plans for a few years but did not follow through on them. A new line of rear-seat video and audio products will be announced in the fall of 2001, launched in time for the Las Vegas Consumer Electronics Show in January 2002.

The company believes that good engineering is a key competitive strength that has enabled the company to design products that are easy for retailers to install. If that theory holds up, it should motivate retailers to aggressively sell Directed's new video products. Directed will focus its rear-seat entertainment product line on these premium-priced products that are particularly easy to install:
- Overhead-mounted video monitors and playback mechanisms
- Headrest-mounted video monitors
- Videocassette players
- DVD players
- Audio/video signal switchers

Audio Products
"Back in 1992, when the U.S. auto Sound aftermarket was a $1.4 billion market, people were saying that the OEM's would take over autosound," said Jim Minarik. "That hasn't happened." The audio aftermarket has actually grown to $2.2 billion in 2000, according to the Consumer Electronics Association. Less than 10% of Directed's sales in 2000 was audio products.

Directed is now determined to make audio a significant product line. Today, all Directed audio products use the brand name Directed Audio, but the company will add new audio products and give existing audio products other brand identities. Directed's strategy is to use its more successful brand names and play off their success. For example, Viper, a mobile-security product brand, is very well known, accounting for 25% of Directed sales and Directed's number-one brand.

While Directed will not develop audio head units, the company says it will expand its audio component product line with more amps and speakers, priced both above and below existing products. Directed's existing audio products ranked by sales are: (1) premium amps, analog and digital, (2) subwoofers and (3) speakers. Directed's amplifiers and speakers have won several awards for performance. For example, the Directed 1100d, 1100-watt, class D, subwoofer amplifier has won world records at sound pressure level and dB drag events. In one sound-pressure-level event, Directed speakers and amplifiers combined to produce a deafening 173 dB.

Directed Facilities

<table>
<thead>
<tr>
<th>Locations</th>
<th>Floor Space</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vista, California</td>
<td>102,000 sq. ft.</td>
<td>175</td>
</tr>
<tr>
<td>Surrey, England</td>
<td>20,000 sq. ft.</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>122,000 sq. ft.</td>
<td>183</td>
</tr>
</tbody>
</table>

Note: No manufacturing is done at Directed facilities.

The Hansen Report on Automotive Electronics, Rye NH USA www.hansenreport.com
The Company Profile Continued

Vehicle Interface Connectors

Directed claims it is the first and only mobile aftermarket security company to install products that can interface to the vehicle’s OE data digital bus. Mr. Minarik elaborated: “We have interface modules in our accessory line, and they make it possible for our dealers to quickly install our alarms and remote starts.” The modules provide two-wire access to the vehicle’s digital data bus, by which Directed products can control door locks, trunk relay, dome and exterior lights, as well as plug into the existing vehicle security system. In 2000, Directed introduced its Jeep Interface Module (JIM) and later its AutoTune 417A/Hornet 700J data-bus security system. Both these products won Innovations Awards at CES. The JIM acts as an interface between the Jeep data bus and a separate Directed security or remote start system. The 417A/Hornet 700J is a complete security system that interfaces with the data bus of Grand Cherokees as well as certain GM vehicles.

The Automotive Multimedia Interface Collaboration has been developing a standard interface to the vehicle: the IDB-C (ITS Data Bus-CAN) interface lets an aftermarket supplier easily plug into the vehicle’s communications network using a standard connector. It allows the supplier access to some data and some systems in the vehicle, although the aftermarket company would need to cut deals with each OEM to get authorized access for that vehicle line. While Directed will not fight IDB when it finally comes, Mr. Minarik summed up Directed’s position: “We cannot wait for the AMIC IDB interface, which is moving like a glacier. ... Vehicle data buses are getting increasingly complex every year, so we must move forward with our own vehicle interfaces. If we sit around and wait, we will have no business.”

Mini-Profile... Code-Alarm Inc.

Headquarters: 950 E. Whitcomb, Madison Heights, Michigan 48071; phone: 1-248-583-9620; www.code-alarm.com

2000 Sales: $27 million
2001 Sales: Roughly $27 million, estimated
Products: Security alarms, remote keyless entry systems and remote car starting systems
Ownership: Pegasus Capital Advisors owns 80%; Ford is in the process of becoming a minority stakeholder.
Employees: 100, plus an additional 50 temporary contract workers in manufacturing
Engineers & Technicians: 25, roughly half are engineers
Key Brands: Code-Alarm and Chapman

Background

Code-Alarm is a QS9000 company that manufactures and sells security and remote control products through three marketing channels: mobile electronics retailers, the original equipment aftermarket and tier-one suppliers. In the mid-1970s, vehicle security businesses in the aftermarket either dropped out or were consolidated, and by 1990, there were 60 or so small businesses and three leaders: Code-Alarm, the largest, followed by Clifford Electronics and then, Directed Electronics Inc. By 2001, Directed was the new leader, followed by Audovox (Hauppauge, New York) and then Code-Alarm.

For over a decade, Code-Alarm was actively litigating against Directed and others in the security products industry. In one of its many suits, Code-Alarm sued Directed in 1993, just as DEI was about to win a major piece of dealer-installed business with General Motors. Code-Alarm had also bid on the business, and GM chose not to award the business to either supplier. Code-Alarm abandoned legal proceedings in 2000, and according to the company, legal entanglements stemming from 1993 onward have sapped its financial resources and led to substantial management reorganization. Pegasus Capital Advisors, an equity management company, began investing in Code-Alarm in 1997 to support the company’s legal battles and is now an 80% owner, with an option to bring that holding up to 90%.

In March 2001, Code-Alarm completed its management reorganization. Rand Muller, who founded the company with his brother, Marshall Mueller, in 1979, had been board chairman but will now take on the newly created position of vice chairman of the board. He no longer has day-to-day operating responsibilities; his brother left the company in 1989. Code-Alarm’s new board chairman is a minority investor: Douglas H. Graham of Detroit Technology Ventures LLC, a private venture capital firm in Bloomfield Hills, Michigan. Since November 1999, Peter Stouffer, a 14-year veteran of Code-Alarm, has been president as well as chief operating officer, and in March, the board named him to the additional post of chief executive officer.

Code-Alarm reported that first-half-1999 sales fell 31% to $16.9 million, profit margin was minus 22.9%, and market capitalization had shrunk to $696,000. In 2000, cash flow was negative, and year-to-date in 2001, cash flow is still negative. Code-Alarm’s stock price has dropped steeply. Six years ago, it sold for $15 per share, and on August 9, 2001, was trading at 25 cents per share; the stock’s 52-week high was $1.15 and the 52-week low was 6 cents, according to www.thestandard.com.

Code-Alarm was traded on the NASDAQ until April 1997. In November 1999, with 290 shareholders, the company filed an SEC Form 15, Certification of Termination of Registration. Still publicly-traded, Code-Alarm, is an over-the-counter security. Its share price is quoted in pink sheets in the National Quotations Bureau, a daily publication that lists the market makers’ bid-and-asked prices from the prior day. Code-Alarm has just two market makers.

continued on following page
Launched in January 2001, PowerCode is an all-in-one remote vehicle control system that is flexible and upgradeable by means of plug-and-play cartridges. With the PowerCode system, installers can easily accommodate many different vehicle interfaces and features by plugging in the appropriate PowerCode memory cartridge. Each PowerCode installation includes a main computer with 11 relays and the plug-in cartridge, which can have one of ten different groups of features, called feature sets. Many comfort and security features are available, including remote engine starting from 500 feet, engine disabling, keyless entry, remote defrost and headlight illumination.

“A major benefit of the technology is that consumers won’t have to rip out their old system to add new security or convenience features,” suggested Dennis M. Dermoit, in charge of marketing and sales for Code-A-Larm. “Now you simply replace the memory cartridge with one that has [the desired] new features.” Retailers do not need to carry very much inventory, just the computers and the particular cartridges that would appeal to their customers. Retail prices for PowerCode products range from $250 to $600, depending on features.

Ford and PowerCode


BMW...

22.5 Mbps. Mr. Frischkorn notes that the next generation of MOST will be faster, easily capable of sending images.

Despite huge power demands on the electrical system, BMW was able to stay with a 12-volt battery. That was done with an intelligent power management system, which efficiently monitors and controls the load so the battery can maintain its charge. The power management system even detects when the engine is off, so the battery can maintain sufficient charge to start the engine.

iDrive

Among the many impressive new electronics features 7 Series customers will appreciate is the human machine interface called iDrive, BMW’s innovative control and display concept. iDrive ranks functions by importance and frequency of use and places the controls most important to motoring and safety on or near the steering wheel, within easy reach of the driver. The next level of driving tasks, like control of the headlights and temperature settings, are controlled on the instrument panel by conventional switches. The third level of functions, those that the driver adjusts less often, like communications levels and entertainment choices, are nevertheless the largest category of options and features in a modern car. Remarkably, a single input device, the Controller, commands all of them. Together the Controller and the Control Display comprise the 7 Series Control Center.

Located at the front of the center console, the Controller looks like a large rotary knob and acts like a stationary computer mouse. Pushing the Controller knob north, south, east or west accesses four different menu lists: communications, climate control, entertainment and navigation. Or pushing the knob diagonally, northeast, southeast, southwest or northwest accesses four other menus. BMW ASSIST, configuration, vehicle and help functions. Menus items are accessed by turning the knob, which is programmed to provide virtual dents so the driver knows where he is in the list. Pressing down on the knob moves you to a different menu level.

The Controller selections are presented on a multifunction display, which is located in the upper section of the instrument panel, midway between the driver and passenger, as close to the windshield as possible for easy viewing. “The concept of an hierarchic functional Control Center unit that brings all the comfort functions together in easy reach of the driver is really a breakthrough that is overdue in the vehicle,” suggested Mr. Frischkorn.