HEVs: High Cost, Low Volume

Despite the fact that the domestic Japan automotive industry is still in the doldrums— domestic Japan automotive production in 1999 calendar year was down 1.5%, according to JAMA and Pemberton Associates (Warwickshire, UK)— Japan automotive electronics suppliers did better in the fiscal 1999 than in the past few years. There are at least two reasons the numbers below look better than expected: Auto electronics content worldwide is still growing, as a percentage of the vehicle's total cost, and Japan suppliers like Denso are doing well in overseas markets. The fiscal year we refer to as 1999 is from April 1, 1999 to March 31, 2000.

Aisin Seiki
FY 1999 Consolidated Sales: ¥1,000.6 billion ($9.3 billion)
Change from FY 1998: up 10.2%
Net Profit: ¥18.0 billion ($166 million) or 1.8% of sales. Net profits increased 111% from last year.
FY 2000 Estimates: Sales are estimated to grow 2%, to ¥1,020 billion ($9.4 billion), but the company estimates a loss of ¥17.5 billion ($161 million).

Alpine Electronics
FY 1999 Consolidated Sales: ¥171.1 billion ($1.58 billion)
Change from FY 1998: down 3.0%
Net Profit: ¥3.1 billion ($28.6 million), or 1.8% of sales, compared to 1.5% last year.
FY 2000 Estimates: ¥175.0 billion ($1.61 billion), about the same as the prior year; net margin is expected to remain at 1.8% of sales.

Clarion
FY 1999 Consolidated Sales: ¥153.3 billion ($1.4 billion)
Change from FY 1998: down 23.2%
Operating Margin: 1.3% of sales, down from 3.5% of sales last year.

Denso
FY 1999 Consolidated Sales: ¥1,883.4 billion ($17.4 billion); 99% of total sales is automotive. Operations in the Americas generated 23% of sales.
Change from FY 1998: up 7.1%; automotive sales

THE HANSEN REPORT ON AUTOMOTIVE ELECTRONICS
A Business and Technology Newsletter

1999 Roundup of Japanese Auto Electronics Business

HEVs: High Cost, Low Volume

A s much as 50% more fuel-efficient than conventional vehicles, hybrid electric vehicles (HEV) will be commercialized, even though today they are significantly more expensive to manufacture than conventional vehicles. Initially, carmakers will bring hybrids to market to get experience, not short-term profits. For example, H onda's newly commercialized HEV, the Insight, is capable of 64 miles per gallon but has a $10,000 cost premium compared with a similar conventional vehicle, and Toyota's second-generation H EV Prius will deliver 56 miles per gallon but with a $17,500 cost premium.

In 2003 Ford will debut a hybrid electric version of the Escape sport utility vehicle that will get 40 mpg in city driving. G M recently announced that in 2004 it will make a hybrid-electric version of the Chevrolet Silverado/GMC Sierra full-size pickup, which will be 15% more fuel-efficient than the non-H EV version. M ore H EV s will come to market as the following conditions come to pass: battery technology improves, the cost of power electronics comes down, fuel prices go up driving demand, or governments provide market incentives that cover some H EV costs. In addition, as higher H EV production volumes are anticipated, prices will drop and H EV s will become commonplace perhaps in 15 years.

A s an interim step on the road to green vehicles, carmakers will equip cars with 42-volt power supplies and with ISA s (integrated starter alternators). While hybrid vehicles have ISA s, the only two commercial H EV s today require huge, expensive batteries; H onda's is 144 volts, Toyota's is 288 volts. Forty-two volt ISA s yield fuel savings and lower emissions at a cost consumers are more likely to accept. Plus, 42-volt ISA s will provide significantly more electrical power than conventional, belt-driven alternators for the power-hungry features that consumers desire. (For more on the integrated starter alternator, see our special report 42-Volt Power: A n O pportunity to Redefine the Vehicle.)

PNGV
U S C A R members DaimlerChrysler, Ford and G eneral M otors are the three carmakers involved with the U nited States' Partnership for a New Generation of Vehicles (PNGV), a cooperative R & D program between the federal government and U S C A R (U nited States Council for A utomotive Research). Set up in 1993 by President C linton, PNGV is one of a number of consortia within U S C A R. A review of the PNGV research program published on June 15, 2000 by the N ational A cademies' N ational Research Council provides an excellent picture of the state of the art of hybrid electric vehicles, both those powered by combustion engines and those powered by fuel cells.

PNGV established three goals in 1995:
(1) Significantly improve national competitiveness in manufacturing for future generations of vehicles;
(2) Implement commercially viable innovations from ongoing research on conventional vehicles;
(3) Develop vehicles to achieve up to three times the fuel efficiency of comparable 1994 family sedans.

A s carmakers have worked to meet Goal 3, they have met many of the criteria of Goal 1 and Goal 2. T hat is demonstrated by the high level of new technology introduced in the concept vehicles developed under the PNGV program. (See table on page 3.)

Goal 3—developing sedans with fuel economies up to 3 times the mileage achieved in 1994 or about 80 miles per gallon—was itself a sufficiently challenging goal. M oreover, it carried a caveat that may be impossible to meet: T he new generation of vehicles must also be comparable to conventional sedans in terms of...
Hybrids...

is still a long future ahead for the gasoline/diesel-fueled internal combustion engines.

Hard to Meet EPA Tier 2 Emissions Standards

DaimlerChrysler, Ford and General Motors decided to power their concept HEVs by diesel engines because diesel engines promise significantly better fuel efficiency than spark ignition engines run on gasoline. In 1999, the U.S. Environmental Protection Agency announced its proposed Tier 2 standards, which were much more stringent than expected. Tier 2 goes into effect with MY 2004 vehicles, and calls for cutting nitrogen oxide emissions from 0.4 grams per mile to 0.07 grams per mile for cars. Most SUVs would have to come into compliance by 2007, with the largest SUVs complying by 2009. Tier 2 standards apply to all vehicles regardless of fuel type.

In the National Research Council’s opinion, the challenge to meet Tier 2 standards with the diesel engine “will be enormous.” The Tier 2 emissions standards would be “attainable only with a fuel economy well below 80 miles per gallon, and even then, will be difficult to achieve in production vehicles with adequate probability for meeting the certification period of 100,000 miles.” With a diesel engine, exhaust-gas after-treatment systems would require 75% and 50% reduction efficiencies for nitrogen oxides and particulate matter, respectively.

As a result, it is “very unlikely” that by 2004, PNGV will be able to deliver production prototypes of a diesel/electric hybrid vehicle that meet PNGV’s goals for emissions, fuel economy and cost. Instead of a diesel power plant, the partnership could employ a gasoline engine. With a gas spark-ignition engine, the hybrid vehicle would be able to meet Tier 2 emissions but it would fall far short of the 80 mpg fuel economy goal. Stratified-charge gasoline engines are 15% more efficient (if unthrottled) than model year 1993 engines; stratified-charge diesels are at least 23% more efficient than MY 1993 engines. While fuel cells could meet Tier 2, the development of fuel-cell vehicles in time for mass production by 2004 is considered “highly optimistic.”

High Costs

Cost—as with all new technologies—is the major problem for carmakers trying to...
develop a production HEV by the 2004 deadline.
- PNGV is $900 over its target cost of $2,100 for the engine and exhaust control system alone.
- Batteries for hybrids are projected to be at least three-times too costly.
- Fuel cell systems are projected to be at least five-times too expensive.
- Meeting cost targets for power electronics will require “breakthrough developments” in both components and manufacturing technologies.
- DaimlerChrysler said that its ESX 3 PNGV concept vehicle would cost several thousand dollars more than a conventional vehicle to manufacture—a $7,500 price premium would be necessary.

Given the high costs, the program's National Council reviewers make this recommendation: “If the federal administration wants to promote the deployment of high-fuel economy PNGV-type vehicles, they may have to evaluate the advisability of providing temporary incentives (e.g. tax rebates) to offset higher initial vehicle costs.” Nevertheless, the review notes that even without cost parity with conventional vehicles, the ultimate PNGV goal of reducing fuel consumption would be served by large market penetration of some of the new technologies demonstrated in PNGV concept cars.

**PNGV Funding T threatened**

A t about the same time as the National Research Council was recommending the federal administration look at incentives to offset high HEV costs in promoting the deployment of PNGV-type vehicles, the House of Representatives was moving in the opposite direction. In June 2000, the House voted to eliminate government funding for the PNGV program. In July, however, the Senate restored PNGV funding; the bill is currently in conference committee. Some opponents view the funding as corporate welfare, which is inappropriate in a time when carmakers are making record profits. Others are opposed to PNGV’s selection of diesel engines for the primary power plant; environmentalists, for instance, view diesel pollution as especially unhealthy.

Ford's 2003 Hybrid-Electric Escape

Ford is right in tune with the National Research Council’s suggestion that mass production of new technologies demonstrated already by concept vehicles could meet PNGV’s goal of large fuel savings, albeit less than 80 mpg. Ford announced plans for a production HEV, designed to be the cleanest, most fuel-efficient SUV worldwide when it debuts in 2003. Ford’s first HEV will be a family-sized sport utility model, a strategy meant to pique customer interest and encourage volume production. In the U.S., the hybrid Escape will deliver about 40 mpg in urban driving with gasoline as the fuel. Sold in Europe, under the Maverick name, its fuel-efficient operation should make it appealing to European customers as well.

The Ford Escape HEV will feature an electric drivetrain to augment its fuel-efficient four-cylinder gasoline engine. With regenerative braking and stop-start capability, the Escape, equipped with a 280-volt battery, will accelerate like an Escape equipped with the V-6 engine, according to Ford. The hybrid Escape’s driving range on a single tank of gasoline is more than 500 miles. Extremely clean operating, it will achieve California SULEV emissions rating, as well as meet Euro IV emissions requirements in Europe, which will become mandatory in MY 2005.

### Specifications for Production HEVs and Concept HEVs

<table>
<thead>
<tr>
<th>Toyota Prius</th>
<th>Honda Insight</th>
<th>DCX Dodge ESX3</th>
<th>GM Precept</th>
<th>Ford Prodigy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acceleration (m/hr)</strong></td>
<td>0-60 in 14.1 sec.</td>
<td>0-60 in 12 sec.</td>
<td>0-60 in 11 sec.</td>
<td>0-60 in 11.5 sec.</td>
</tr>
<tr>
<td><strong>Passenger capacity</strong></td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Fuel economy</strong></td>
<td>56 mpg</td>
<td>64 mpg</td>
<td>72 mpg</td>
<td>80 mpg</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>550 miles</td>
<td>600 miles</td>
<td>400 miles</td>
<td>380 miles</td>
</tr>
<tr>
<td><strong>Emissions</strong></td>
<td>SULEV</td>
<td>ULEV</td>
<td>$10,000 cost premium</td>
<td>Tier 2 at default levels***</td>
</tr>
<tr>
<td><strong>Affordability</strong></td>
<td>$17,500 cost premium</td>
<td>$10,000 cost premium</td>
<td>Low-sulfur diesel</td>
<td>Not affordable**</td>
</tr>
<tr>
<td><strong>Curb weight</strong></td>
<td>2,734 lbs.</td>
<td>1,856 lbs.</td>
<td>33 kW (44 hp)</td>
<td>2,592 lbs.</td>
</tr>
<tr>
<td><strong>Fuel</strong></td>
<td>Gasoline</td>
<td>Gasoline</td>
<td>10 kW (13.5 hp)</td>
<td>Low-sulfur diesel</td>
</tr>
<tr>
<td><strong>Engine type</strong></td>
<td>Inline 4 cyl. DOHC</td>
<td>3 cyl./12 valve/ VTEC</td>
<td>28 12V-modules with 1.1 kW-hour</td>
<td>3 cyl./12 valve/ (VNT)</td>
</tr>
<tr>
<td><strong>Electric motor</strong></td>
<td>Permanent magnet</td>
<td>Ultra-thin motor/300 kW</td>
<td>DC brushless PM</td>
<td>Panasonic (350V)</td>
</tr>
<tr>
<td><strong>Peak/continuous power</strong></td>
<td>33 kW (44 hp)</td>
<td>10 kW (13.5 hp)</td>
<td>15 kW (20 hp)/3 kW</td>
<td>25 kW (34 hp)/16 KW</td>
</tr>
<tr>
<td><strong>Batteries</strong></td>
<td>Panasonic 28V</td>
<td>Panasonic 144V/ 65 amp-hr</td>
<td>Lion 150V</td>
<td>Nissan 350V/ 3 kW-hr usable</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td>240 D-size modules</td>
<td>120 D-size modules</td>
<td>peak power 22 kW</td>
<td>28 12V-modules with liquid thermal mgmt.</td>
</tr>
<tr>
<td><strong>Braking</strong></td>
<td>Electronic-controlled CVT</td>
<td>5 speed MTX</td>
<td>EMAT - 6 speed</td>
<td>Automatic shift manual</td>
</tr>
<tr>
<td><strong>Affordability</strong></td>
<td>$17,500 cost premium</td>
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<td>4 cyl./16 valve</td>
</tr>
<tr>
<td><strong>Emissions</strong></td>
<td>SULEV</td>
<td>ULEV</td>
<td>targeted for Tier 2</td>
<td>Intercooled turbo</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>550 miles</td>
<td>600 miles</td>
<td>Tier 2 at default levels***</td>
<td>35 kW (47 hp)/3 kW</td>
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<tr>
<td><strong>Passenger capacity</strong></td>
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<td>2</td>
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<td>3 phase AC</td>
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</table>

* Hypothetical cost premium disadvantage compared with a conventional vehicle
** Ford has committed to production of an HEV with a $3,000 cost premium (assumed to use gasoline).
***Tier 2 emission levels in the Clean Air Act for consideration by the EPA. Since the announcement of Tier 2 standards, these are no longer valid.

A utomotive sales in 2000 are estimated to be $3.0 billion (outside sales only).

Motorola's corporate strategy, as expressed in the 1999 annual report, states: "We are strategically focused on harnessing the power of wireless, broadband and the Internet to deliver end-to-end network, embedded and chip-based solutions for the individual, the work team, the vehicle and the home." Motorola Inc. is encouraging AIEG, TCG and SPS' Transportation Systems Group to work together more closely than ever. Hoping to blend their separate business strategies and cooperate on basic architectures, the three groups have jointly made presentations at technology fairs and shared a booth at the SAE Congress in March 2000. Motorola announced plans to open a new engineering and sales facility in Farmington Hills, Michigan, that will house the three automotive businesses. When completed in 2001, the 125,000-square-foot facility will double the size of the current facilities in Detroit and will accommodate 500 people.

Motorola AIEG Background

A utomotive sales come from three groups: Motorola Automotive Industrial and Electronics Group (AIEG), Motorola Telematics Communications Group (TCG), and the Transportation Systems Group, the latter is within Motorola Semiconductor Products Sector (SPS). This company profile focuses on two of these businesses, AIEG and TCG. In 1999, automotive sales from the three groups were $2.7 billion (outside sales only, excluding intra-company transfers).

Motorola AIEG says it is one of the world's top three manufacturers of pressure sensors, along with Delphi and Denso. Other auto suppliers make larger quantities of engine controllers, but AIEG probably makes the greatest variety, speculated Dave M. Elka, senior vice president and general manager of the Automotive Industrial and Electronics Group. While Visteon continues to make engine controllers for Ford, and Delphi supplies GM, Motorola AIEG now has some engine-controller business at both Ford and GM as well as Chrysler, Honda and Magneti Marelli. Motorola AIEG has for years supplied one-third of Ford's requirement of EEC-V engine controllers, but M entorola will not be participating in the manufacture of Ford's new 32-bit powertrain controller. That business went to Visteon, according to Silicon Valley auto electronics consultant Myles Kitchen (Danville, California).

AIEG uses glass-epoxy circuit-board technology for the majority of its electronics hardware. The most popular packaging technology is Motorola's Polybent, a polyimide insulation on aluminum substrate that also functions as module housing. The most prevalent packaging approach is hybrid technology, bare chips on ceramic substrate.

Motorola AIEG Background

Despite its name the AIEG is now focused entirely on the automotive industry. Last year AIEG sold its last non-automotive business, ballast-manufacturer Motorola Lighting Inc., to Osram, a division of Siemens. By far, Motorola AIEG’s largest selling product line is engine control units, accounting for over half of all shipments. Sensors are also an important product line, and Motorola AIEG has been a supplier of pressure sensors, along with Delphi and Denso.

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wouldn’t say. AIEG is not interested in becoming a top-tier systems supplier. Rather, the focus is on electronics and the company believes it is among the best in the world when it comes to electronic engine controls. Motorola AIEG is now focusing on selling to the tier-one suppliers as well as OEMs, who until recently controlled all aspects of product design. “Now I have a lot more freedom to walk into either OEMs or the tier-ones with new and creative designs that are our own development,” said Mr. M. Melka. He added that he expects AIEG sales will grow at the rate of 15% per year over the next five years. During the past five years, annual sales growth was 11.4%.

Recently, Motorola has AIEG been gaining share in its principal market, North America. Since Delphi and Visteon were spun off from GM and Ford, more electronics business has gone to outside suppliers, including Motorola. GM and Ford still have agreements with their trade unions that keep some of that business at Delphi and Visteon, but those agreements will expire in several years. “We’re seeing carmakers coming into the market and giving us a first shot at some business. That wasn’t happening before,” revealed Mr. M. Melka. Despite vigorous efforts in the past, Motorola AIEG does almost no business in Japan.

New Products

Among its most promising new products are 4x4 transfer case controllers and electronics for electric power steering. AIEG is promoting tools that allow customers to take M otorola’s architectures and quickly apply them to engines. Motorola is developing more economical engine controls, including modular approaches to linking the engine controls with transmission controls. While some carmakers are more interested in keeping engine and transmission controllers separate—for different engines and transmissions can be combined together—a number of carmakers have been developing sophisticated 32-bit powertrain controllers that integrate engine and transmission into one module.

Out beyond five years, Motorola sees good prospects for several new products. Motorola is developing powerful A C/DC converters that can handle the power output of 42-volt alternators. Electric braking is another promising new application for M otorola. Helping carmakers handle driver distraction by incorporating body electronics so that the driver will not be overwhelmed with inputs when driving—braking when a cell phone call comes in, for instance—will inspire products in the next five years.

AIEG Alliances

- Amerigon (Irwindale, California) and M otorola have entered into a non-binding memorandum of understanding to jointly develop electronic control modules for Amerigon’s Climate Control Seat system, in which heating and cooling are controlled at each seat. Climate Control Seat systems are an option on Ford’s 2000 model year Lincoln Navigator SUV.
- Eaton (Cleveland, Ohio) and M otorola have a strategic alliance to design, develop, market and supply automotive component assemblies focusing on electronics control modules for automotive transmissions. The alliance’s first contract is from G M to provide transmission modules for a M Y 2003 vehicle.
- Both AIEG and TCG have signed agreements with Lear (Southfield, Michigan) to jointly design and develop electrical/electronic products and systems exclusively for Ford’s integrated interiors. The joint venture will be based in Dearborn, Michigan. M otorola will integrate electronic, electrical and telematics products with Lear interiors.
- Motorola AIEG and TCG will outsource some of their electronics manufacturing to minority supplier Saturn Electronics and Engineering (Auburn Hills, Michigan), which is Q S 9000 certified and has manufacturing facilities in five countries. M otorola will take a minor equity stake in Saturn. A u to companies in Detroit struggle to find sufficient minority content in the products they manufacture.

continued on the following page
Motorola AIEG & TCG

New Telematics Business

Telematics involvement stems from Motorola’s very early days, notably its manufacture of the world’s first car radio in 1930 and first world’s first handheld radio in 1940.

Today the company is a worldwide leader in wireless technology. Marios Zenios, corporate vice president and general manager of the Telematics Communications Group, suggested, “We have a lot of competitors that bring individual pieces, but none that can provide so many of the elements of telematics [as we can].”

According to Motorola TCG, the company has booked $200 million in new business in the first half of 2000, due to new product introductions like integrated digital phones and telematics communications units (TCUs). TCUs include the GPS receiver, the cellular transceiver and all accompanying automotive-grade software. Our sources tell us that most of that new business has come from GM OnStar, a satellite-based subscriber emergency system begun in 1996. GM expects to have a million OnStar-equipped vehicles by the end of 2000. By 2003, more advanced OnStar systems based on Motorola’s next generation telematics platform, iRadio, will be available on some GM vehicles.

In 1996, Motorola and Ford pioneered together in telematics with Lincoln RESCU (Remote Emergency Cellular Unit). Ford, however, just announced that it will team up with digital-wireless communications provider Qualcomm (San Diego, California) to form a joint venture, Wingcast, to deliver telematics services to Ford customers. Ford expects a million Wingcast-equipped vehicles by 2002.

European Market Will Be Bigger

TCG focuses mainly on carmakers and telematics service providers in Europe and the U. Uited States. TCG currently does no business with domestic Japanese companies but sees business opportunities in Asia and South America. While today most of Motorola TCG’s sales is in the U. Uited States, the majority of sales will shift to Europe within five years. TCG already has some business with European carmakers Renault, Mercedes, Jaguar, BMW, and Opel.

The telematics market is developing faster in Europe than in the U. Uited States for several reasons. A according to TCG, if you include Eastern Europe in the European telematics market, it is a larger market than the U. Uited States in terms of population and number of vehicles. The wireless communications infrastructure is farther along in Europe, where digital cell-phone technology is well-organized around GSM. Already deployed in Europe, GPS (General Packet Radio Service) allows data transmission rates of over 128 kilobaud.

Moreover, the market for real-time information and services is currently greater in Europe, where more bandwidth allows for delivery of more real-time and on-demand services, not just safety, security and telephony but also navigation, traffic information, points-of-interest and e-commerce.

Strategy: From Black Boxes to Content

Like AIEG’s, TSG’s business strategy is an outgrowth of the corporate strategy to provide end-to-end customer solutions, which to TCG suggests not only equipment and software onboard the vehicle, but also content and software at a remote server. Motorola would work with service providers to develop programs that work with Motorola’s onboard equipment. Mr. Zenios is optimistic: “We have the strategy, resources and funding in place to grow both pieces of business [onboard equipment and server-based products] in parallel.” Although Mr. Zenios believes the demand for both will grow fast, he would not say how fast, nor would he venture which piece might end up larger.

While auto electronics suppliers in Japan have set up consortia like VICS to develop traffic information content, Motorola TCG is the first Western automotive electronics company to make content part of its core telematics business. According to considerable consumer research done by TCG, people want telematics to deliver entertainment, navigation, information and safety/security programming. Mr. Zenios speculated that telematics product success will depend on two major factors, ease of use in the car and cost.

Today, the TCG products that account for the most sales are GPS receivers and cell-phone transceivers installed aboard the vehicle. Motorola would like to move from those black boxes that perform a specific function to more sophisticated hardware— inexpensive computers with telecommunications capability and access to the Internet. The company is developing products based at the server including content software designed to work with Motorola’s wireless equipment aboard the vehicle.

Navigation and Other Server-Based Content Applications

Server-based navigation is one important content application. Motorola TCG has already demonstrated such a navigation system and shipping will start by the end of 2000. A big advantage of server-based navigation is its low price compared with conventional hardware: a few hundred dollars for the basic onboard TCG telematics unit (GPS receiver and cell-phone transceiver), plus a small user fee to...
the service provider. A conventional navigation system that uses CD-ROM or hard drive to store map data typically costs the consumer about $2,000.

A notable advantage of server-based navigation is that the service provider can update the map database much more frequently. Today’s navigation equipment uses digital maps stored aboard the vehicle—either on CD-ROMs or on hard drives—but because roadway and traffic attributes change often, poor route-guidance is the result, unless the data is updated frequently. With server-based navigation, the content provider continuously updates map data centrally and delivers turn-by-turn route-guidance instructions to the vehicle as requested over a wireless communications link.

Another example of content would be location-based services/marketing: The server provides location-specific information as requested by a driver. That situation presents a marketing opportunity. The service provider can sell a product or service specific to the location of the vehicle at the time of the request. For example, a request for a fast-food restaurant within the driver’s local area might be an opportunity to pass along an electronic coupon from M McDonald’s. Motorola TCG would develop such location-based services in conjunction with commercial businesses and sell them to the service provider.

Other examples of content applications that Motorola thinks consumers are interested in are wireless emails sent to and received from remote servers as well as text-to-speech products.

**Next-Generation Telematics: iRadio**

In January 2000 at the Consumer Electronics Show in Las Vegas, Motorola presented prototypes of its next-generation telematics platform, known as iRadio. In addition to the car radio, iRadio merges Motorola’s first-generation telematics voice and data platform—consisting of GPS receiver and cellular transceiver—with a scalable computing and communications platform. The iRadio platform, based on the PowerPC chip from Motorola SPS and the Linux operating system, can be set up according to different customer needs at varying prices. iRadio can handle voice recognition and text-to-speech. It is compatible with various keypad/display formulations; it can access the Internet, handle e-commerce, play digital files, run server-based navigation and traffic information applications, and it can handle onboard diagnostics.

Small enough to fit into a 1-DIN slot in the dashboard, iRadio, will connect to palm computers, laptops or portable cellular phones via the Bluetooth wireless protocol. Motorola would not comment on whose speech engine will be part of iRadio. Based on Java, iRadio is an open platform, which will make it easy for third-party speech recognition suppliers and others to develop programs for it.

**Speech Recognition**

TCG’s end-to-end solutions will make use of speech recognition both onboard the vehicle and at the server. “The advantage the server has [in voice recognition] is almost unlimited computing power. By sending your voice to the server, you have the luxury to run more sophisticated algorithms faster,” explained Mr. Zenios. The server can then be more tolerant of noise and speaking variations. In terms of speech recognition onboard the vehicle, there is a definite need for a limited- vocabulary recognition engine for command and control purposes. Motorola believes it can get by with a very thin client, and keep costs down.

Extensive voice recognition engines at the server will be very important, as more motorists browse the Web, but in order to implement server-based speech recognition, the communications link will need to be reasonably priced and wideband. According to Motorola, wireless carriers in the United States will deploy next-generation cellular transmission technology, called packet switching by MY 2003 or 2004. Packet switching allows constant connection, like a cable modem on a PC. Payment is based on packets sent, not on time connected.

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**TCG Alliances and Acquisitions**

International Data Corporation has estimated that the worldwide telematics market will grow to $42 billion by 2010 from $1 billion in 1998—worth going after. Motorola’s corporate strategy involves supplementing with alliances and acquisitions those areas where it is not strong, and “we are not afraid of [acquiring] the big ones,” declared Mr. Zenios. By example, he cites Motorola’s purchase of General Instrument Corp. on January 5, 2000, in a deal worth $17 billion. General Instrument had the cable modem/TV set-top box business that will allow Motorola to deliver video, voice and data networking services to the home. TCG is forging partnerships with those who can help with end-to-end telematics solutions, like the following:

- **BCI Navigation** (Paris, France): Motorola has taken a minority equity position in this vehicle navigation and map-data management company.
- **Cellport Systems** (Boulder, Colorado): Motorola and Cellport will bring Cellport 3000, a universal hands-free docking system, to vehicles so that a variety of manufacturers’ portable handsets can be used with Motorola’s telematics products.
- **Command Audio** (Redwood City, California): Motorola bought part of Command Audio, a company that provides audio-on-demand information and entertainment, including hundreds of programs from broadcast to print media.
- **IBM Pervasive Computing**: Motorola TCG entered into a partnership with IBM’s e-business solutions unit, Pervasive Computing, to jointly develop and market iRadio architecture to carmakers and other telematics service providers. According to Motorola, IBM is good at basic servers and back-end infrastructure elements.
- **Likkuva Systems International** (Sacramento, California): Motorola purchased outright this developer of dynamic route guidance. Likkuva’s software is capable of sending route guidance and location data from remote servers over today’s narrow-band wireless networks.
- **Phone-Or** (Israel): TCG and Phone-Or are jointly developing optical-microphones for automotive applications, and TCG has an exclusive contract to sell Phone-Or microphones to the auto industry in the West.
- **TrafficMaster** (Milton Keynes, U.K.), and Bosch division Blaupunkt (Hildesheim, Germany): Motorola has agreed to form a joint venture with TrafficMaster Europe to provide real-time traffic information to local service providers in Europe. Beginning in Germany, Blaupunkt navigation systems will receive TrafficMaster data via Motorola’s GSM mobile communications system.
Roundup...

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were up 6.2%.

Net Profit: ¥61.9 billion ( $572.5 million), 3.3% of sales, vs. 3.4% in FY 1998

FY 2000 Estimates: Sales are estimated at ¥1,900 billion, an increase of less than 1%. Denso says net profits will decline to 2.9% of sales.

Matsushita Electric Industrial

FY 1999 Worldwide Automotive Sales: ¥277.4 billion ($2.6 billion). Sales of automotive parts account for 3.8% of the company's total consolidated sales.

Change from FY 1998: up 7.5%

Nippon Seiki

FY 1999 Consolidated Sales: ¥115.0 billion ($1.06 billion)

Change from FY 1998: up 7.4%

Net Profit: Net profit dropped 72% in fiscal 1999, to ¥825 million ($7.6 million) or 0.7% of sales.

FY 2000 Estimates: Sales will grow 2.6% next fiscal year, to ¥118 billion ($1.09 billion).

Omron Automotive Electronics

FY 1999 Sales: ¥40.3 billion ($373 million); automotive electronics accounts for 7.3% of total sales.

Convergence Is Bigger Than Ever

Convergence 2000, the International Conference on Transportation Electronics—the world’s most important automotive electronics conference—will be held October 16-18, 2000. While the conference has been held in Dearborn, Mich., for the past 26 years, this year there was so much interest that planners moved the conference to the Cobo Center in downtown Detroit, Mich.

In 1998 Convergence had 71 exhibitors compared with 166 exhibitors this year. A mong the new exhibitors are Microsoft, Lear, JCI, Sun Microsystems and Sirius Satellite Radio. A ISO of interest this year will be the Automotive Multimedia Interface Collaboration (AMIC), with a display of up to ten vehicles equipped with plug-and-play electronics.

The conference chairman, J.T. Battenberg III, also the chairman, CEO and president of Delphi Automotive Systems, has gathered top executives from five of the world’s most dynamic companies to fill the five keynote-speaker positions: Scott McNealy, chairman and CEO of Sun Microsystems; Shoichiro Irimajiri, president of Sega Enterprises; Carly Fiorina, president and CEO of Hewlett-Packard; C. Michael Armstrong, chairman and CEO of Ford Motor Co.; and William Ford, Jr., chairman of the board at Ford Motor Co.

In the conference brochure, Mr. Battenberg writes: “The theme for Convergence 2000 is Automotive Electronics: Delivering on Technology’s Promise. In my opinion, we have yet to deliver that promise. This conference will provide us the forum to answer ‘What must we do as an industry to deliver?’” Some of the technical sessions that promise to deliver on the conference’s theme include:

Subject
Safety: The Electronic Cocoon
Infotronics: Dynamic Route Guidance
Future Design Process for Electronic Systems
Power Generation and Management
Safety: Occupant Protection
Infotronics: Mobile Information
Electronics for PNGV’s Fuel Efficient HEVs
Infotronics Part II: Mobile Entertainment Environment
Robust Smart Sensing
E/E Architecture
Distractions-Minimum; Attractions-Maximum
Electronics and the Evolving Driving Experience

Technical Chair
Christopher Borroni-Bird, GM
Mitsuharu Kabo, Denso
Peter Thoma, BMW
Joh Kassakian, MIT
Ian Lai GM
Robert Schumacher, Delphi
Christine Sloan, GM
John Slosar, Visteon
Hironobu Ono, Toyota
Reine Emig, Bosch
Cary Wilson, Ford
Norimasa Kashi, Nissan
Gian Luigi Longinotti Bultoni, Ferrari

Credit should be given to Convergence conference manager Denny Freitag, who is organizing the many volunteers who make the conference a success. For information, log on to the Web site www.convergence2000.org.