

RENESAS

EDGE

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THE CAR INFORMATION SYSTEM (CIS) IS RAPIDLY becoming widespread as an interface that connects cars, people and a networked society. A CIS typically offers a wide variety of features, from navigational functions such as timely traffic information, to in-car entertainment functions such as music and movies. Beginning with the integration of driving functions such as automatic distance control and anti-collision features, the CIS is evolving into a core, cohesive system for enhancing the comfort, convenience and safety of drivers and passengers. It's a major step toward the ubiquitous-computing car society, enabled mainly by advanced semiconductors.

SPECIAL FEATURE:

In-vehicle CIS Products Are Driving the Trend to the Ubiquitous-computing Car Society

Renesas has long been a leading supplier of products for in-vehicle navigation, CIS and telematics systems, among others. Our cutting-edge solutions include high-performance microcomputers, many types of IP, SoC and SIP technologies, middleware products from technology partners, and more. We apply expertise gained not only in the automotive industry, but also in fields such as mobile systems, to give customers major advantages in their CIS products.

This Special Feature explores the future of the CIS. It highlights ways that Renesas is facilitating progress in technology and applications for automotive electronic products.

RENESAS
Everywhere you imagine

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Interview:

Information-intensive Automobiles, Today and Tomorrow

Many Factors Are Shaping the Evolution and Adoption of Car Navigation and Telematics Systems around the World

Leading-edge information technology (IT) is already used throughout motor vehicles, from digital engine controllers to car information system (CIS) products. In the future, how will the story unfold for the information-intensive automobile? What obstacles await the evolution of in-vehicle information and entertainment electronics, which have much shorter life cycles than cars?

For this article, Mr. Tadao Saito, Honorary Professor of Tokyo University and CTO of Toyota's IT Development Center, was interviewed by Hisashi Kamio, Communications and ITS journalist. Mr. Saito advocates the aggressive incorporation of leading-edge IT into cars as a means of revitalizing the automotive industry. Mr. Kamio asked him about ways to promote the evolution of information-intensive automobiles.

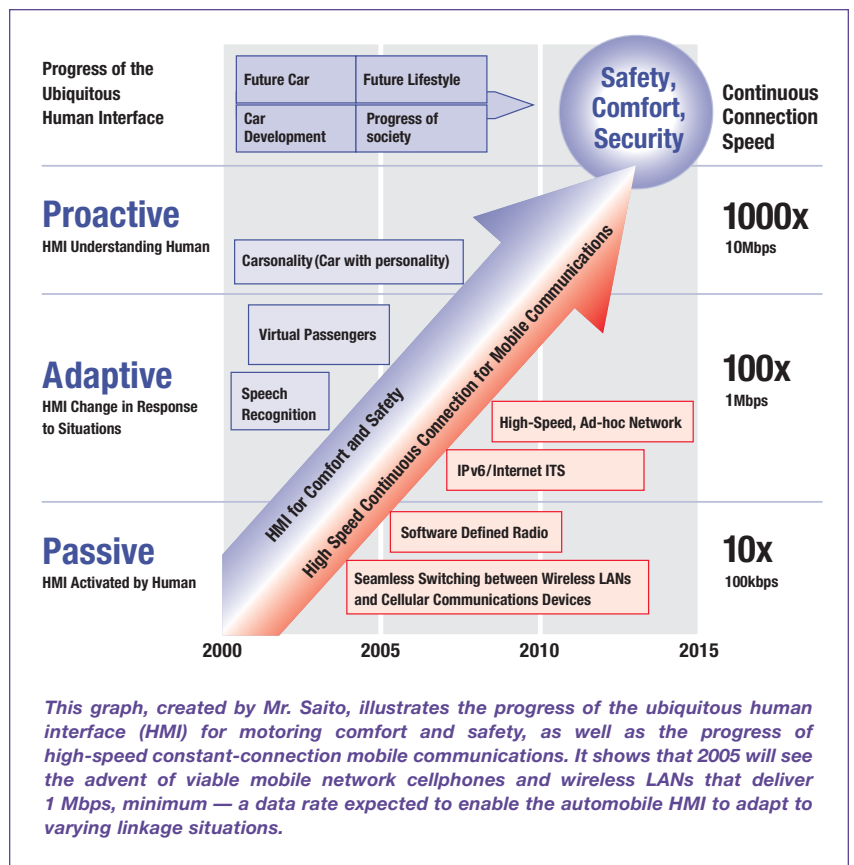
Working to link motor vehicles to the outside using telematics and ITS

Kamio: When we talk about making motor vehicles information-intensive, we immediately think of the recent car navigation systems (or Car Navi for short) and Intelligent Transport Systems (ITS). Actually, though, this topic covers many other aspects, doesn't it?

Saito: The shift towards information-intensive motor vehicles started with the control of "cruising, turning and stopping." A typical example would be the engine's injection control technology. This was an essential technology of the 1970s, when Toyota moved into the digital technology field. The early evolution of digital electronics intensified the dependence of vehicles on information, but this fact remained hidden under the hood. The advent of telematics and ITS brought the growing dependence on information into view in the passenger compartment, and we are now seeing all sorts of linked developments.

Kamio: The information-intensive technologies under the hood and inside the vehicle are now connecting to services on the outside for increased convenience and safety.

Saito: Yes. In the 1990s, the vision drawn up in Japan for ITS was mainly three formats for connecting road vehicles to the outside: dedicated short-range



communication (DSRC), wideband wireless and vehicle-to-vehicle communications. Even today, this vision is more or less the same.

Kamio: ETC, the forerunner of DSRC, is now in full stride on Japanese roads, and wideband wireless is expanding worldwide in the form of mobile phone networks. The only part of the vision yet to take off is vehicle-to-vehicle communications.

Saito: Wideband wireless includes the use of TV and radio broadcasting waves. These are also switching to digital technologies. However, even though DSRC and similar technologies were considered from the outset of ITS, they face a fundamental problem. Users cannot be increased until the infrastructure is built, yet that infrastructure cannot be built without users to pay for it. When we move beyond the vehicle's interior and try to connect occupants with the outside world, we are faced with the "chicken-and-the-egg" quandary of the number of users and the construction of the infrastructure. This problem must be solved to set the stage for the spread and utilization of ITS.

Elsewhere, the GPS and real-time traffic information system — Vehicle Information and Communication System (VICS) — was set up. This enabled Car Navi to avoid the problem I just mentioned. Thus, VICS is now the ITS trendsetter, seeing enormous growth over the past decade, to the extent that it's the principal force behind the shift toward information-intensive automobiles in Japan.

Kamio: When you look at the Japanese market, the spread of Car Navi is truly epoch-making, isn't it? In 1987 the Toyota Crown was fitted with a standalone Car Navi device that displayed map and vehicle position information. Then in the 1990s the GPS Car Navi came on the scene, with VICS being used for the first time in 1994. In a mere 15 years, the amount of information drivers had at their fingertips shot up dramatically. Today, large LCDs show high-resolution digital maps and can display real-time information. And now we are about to offer telematics information. Automotive manufacturers and the semiconductor industry are keenly watching just how far Japan's Car Navi can pursue high added value and high performance.

However, this raises an extremely interesting question in terms of the global market. Can the Japanese Car Navi become the global standard? Will it be a hit overseas, or end up as an automotive feature unique to Japan? What are your thoughts?

Saito: There are two issues here. First, the Japanese Car Navi is expensive. This might be a major stumbling block for average consumers in the United States and elsewhere. If we plan to expand overseas, we will have to reduce the price by 50 percent, at least.

The other issue is the very diverse ways in which people in different areas use and relate to their motor vehicles. In America, automobiles are necessities — like legs for getting around on a daily basis — and most owners tend to be satisfied

Profile:

Mr. Saito completed his doctorate studies at Tokyo University in 1968, becoming a Doctor of Engineering. After holding tenures as Assistant Professor at Tokyo University, Researcher at California Institute of Technology, and Professor at Tokyo University, he is now a Professor of Chuo University and an Honorary Professor of Tokyo University. His research encompasses digital communication formats, computer networking and distributed processing. Formerly, Mr. Saito headed the technical subcommittee of the Telecommunications Technology Council under the auspices of the Ministry of Internal Affairs. Currently, he is the Chairman of the Next-generation IP Network Research Committee, President of the Ubiquitous Networking Forum, Chief Advisor of the NICT R&D for Next-generation Super-high-speed Large-scale Networks, and a member of the Council for Science and Technology Basic Planning under the auspices of the Ministry of Education, Culture, Sports, Science and Technology.



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as long as their vehicles are inexpensive and reliable. In Japan, motor cars are often viewed as important status symbols or lifestyle statements, rather than transportation essentials. By contrast, in Europe, cars are rated for their high-tech image and sales there are affected by reputations in Formula 1 races and so forth. In fact, European sales rise for a car model just because it offers a telematics option, even if that option is not actually installed.

Currently, Car Navi is starting to become popular in the United States and Europe, mainly for deluxe cars. The prevailing opinion in the automotive industry is that Car Navi will spread out from Japan. I think it has good prospects to steadily expand in popularity to become a mainstream car feature. Its growth rate will vary in different countries, depending on various factors.

Kamio: Looking at the European telematics products, they use the simple OnStar configuration rather than the Car Navi format we have here in Japan.

Saito: In Japan, Car Navi became popular before telematics, so it was natural that in our country telematics was enabled via Car Navi equipment.

Kamio: Here I think we need to be clear about the positioning of Japan's Car Navi. The G-BOOK and similar services launched telematics technology in Japan beginning in 2002. Now that those services are well established, we can focus on how they can be integrated in the vehicle. Car Navi functions will be combined with the user interface and this will develop

(interview continued on page 4)

to include telematics capabilities. Then there will be an information service using the Japanese Car Navi platform. Overseas, there has been no need for a sophisticated device like the Japanese Car Navi. Instead, the OnStar format I mentioned earlier is the main form of telematics. Which one will dominate the field in the future?

Saito: Before that question can be addressed, we must clearly understand the fact that Japan has an extremely advanced traffic control system because our roads are very congested. Our trunk expressways and other expressways are outfitted with a huge number of roadside sensors, and the enormous task of installing them began way back in the 1970s. Now sensors are being installed along our ordinary roads. Nowhere else in the world is there a traffic information-collecting system of this magnitude. The data gathered from the pervasive network of sensors provides the basis for the information disseminated via VICS. And, as we mentioned, VICS is the key to the popularity of Car Navi in Japan because it gives drivers a lot of very useful information about traffic congestion, and does so in a timely manner.

Kamio: Certainly when I interview Car Navi users, they seem to benefit more from the VICS data display function than from the route guidance function. Also, the introduction of large color LCDs, displays that can show maps big enough to see real-time traffic congestion information, has helped raise the utility of Car Navi. Another factor that has facilitated the evolution of Car Navi — and telematics, too — is the political element. Politicians have used funds from expressway tolls, as well as road taxes and other taxes, to set up the sensor infrastructure in Japan. The more sensors there are, the more data that can be collected, and the more helpful that data can be to drivers.

Saito: The first step was collecting traffic information for highway administration. Later, that data became the output for Car Navi terminals in vehicles. I think this relationship is important. Even if we tried to apply this model to overseas countries to globalize the format, it would be impossible to do so because the cost of building the infrastructure would be prohibitively high. The circumstances for Car Navi in Japan differ vastly from those in other countries. Thus, currently the trend overseas is an evolution from telematics to Car Navi equipment that employs simple maps.



Automobile replacement-purchase cycle is also the new Car Navi cycle

Kamio: Today in Japan the popularity of Car Navi is growing steadily, and we are already seeing glimmerings of the next step: telematics. Among the automobile manufacturers, Toyota Motor Corp. has brought out G-BOOK, and Nissan Motor Co. and Honda Giken Co., Ltd. aren't far behind. Now we are directly facing the issue of how to popularize telematics.

Saito: This issue isn't limited just to Japan. I think the principal factor affecting the adoption of telematics is its level of dependence on cellphone networks. In this country, our third-generation mobile phone services have largely shifted to broadband, and we are seeing more and more fixed-fee services that enable constant connections. However, when you consider the fact that the average Japanese person spends very little time in a motor vehicle, it seems to me that the connection fees are a little steep. If we are going to bring about the ubiquitous networking society that includes automobiles, we must set up the wireless infrastructure to enable affordable, constant connections for high-speed mobile communications with capabilities exceeding 10 Mbps.

Recent developments indicate that the much-fanfaired fourth-generation cellphones will be viable here by about 2012, and I'm looking forward to the advent of an infrastructure that allows communications between devices other than mobile phones. There are plenty of wireless technologies to choose from, such as DSRC and WiMAX (Worldwide Interoperability for Microwave Access), but all of these will take time to gain support.

Kamio: Then we can't expect a very rapid shift to those enhanced capabilities.

Saito: We must remember that replacement purchases of motor vehicles play a large role in the evolution of in-vehicle



Interviewer: Hisashi Kamio

*Communications and ITS journalist
Guest Researcher for IRI Commerce
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Profile:

A communications and ITS journalist, Mr. Kamio is a special reporter for the "Response" Web site. He worked as a special correspondent for IT magazines and as a communications business consultant, then became a freelance journalist in 1999, specializing in communications business and ITS. He authored "Automobile ITS Revolution" (Diamond Publishing), writes regular articles for the automobile Web site "Response" and the IT magazine "ITMedia Mobile," and contributes articles to many business and specialist magazines. Mr. Kamio is also Guest Researcher for IRI Commerce and Technology Inc. and Technical Adviser for the New Energy and Industrial Technology Development Organization (NEDO), an incorporated administrative agency.



systems technology. Whereas mobile phones have a replacement purchase cycle of one to two years, motor vehicles are often kept for seven to ten years. Even more frequent purchasers of new cars tend to own them for around four or five years. Hence, the life cycle of automobiles is fundamentally different from the life cycle of general information devices. What's more, automobiles are essentially all-in-one products. Thus, if Car Navi becomes standard equipment, then that system will remain installed in used cars, so it will be quite normal for it to have to provide more than 10 years of service.

Kamio: According to data announced by one of the Car Navi manufacturers, sales of pre-installed Car Navi systems in Japan in 2003 were up by 159 percent over the previous year, but sales of Car Navi products purchased separately were up by just 112 percent. Recently, more than 90 percent of the motor vehicles in our country have been sold with pre-installed Car Navi, although this figure varies by model. This clearly indicates that Car Navi is rapidly becoming a standard automobile component.

Saito: That may be true, but the trend toward pre-installed Car Navi equipment is actually extending the life cycle of Car Navi. That may not be desirable if it makes it more difficult to add and sell telematics capabilities or generally forge ahead with other advances for the information-intensive automobile. The life cycle of Car Navi will be extended because it is linked to the life cycle of the vehicle. In turn, that will extend the time it takes for products with new technologies to permeate the automotive market. Another thing: even if the communications service infrastructure is readied for Car Navi and telematics, the number of users will not rise sharply unless replacement purchases of cars speed up. I expect that it would take at least 10 years for the mass of consumers to switch from a popular communications format to a new one.

Given this situation, perhaps any future pre-installed Car Navi should be designed for introduction no sooner than five years in the future. That is a long time to wait in the electronics industry. Many things can change during that time period. One way to avoid such a delay would be to include in the initial system design

sufficient CPU and memory capabilities to handle the inevitable future functional improvements and expansions, then distribute software updates over the Internet. This approach for evolving the in-vehicle system might overcome the wide disparity that exists between the life cycles of cars and information devices.

Also, I think it will be important for the automobile industry and other industries to combine their strengths and promote the information-intensive automobile. This would boost the rate at which vehicle owners adopt and use new services.

Kamio: What directions do you see for the relationship between information-intensive automobiles and electronics such as semiconductors?

Saito: Recent advances in automobiles such as improved safety and cleaner exhausts have all been based on electronics. The latest air bags offer occupants more protection because they use microchips that can vary the way the bag deploys, depending on several factors at the instant an accident occurs. In this sense, electronics are contributing to a rapidly widening area of driver and passenger safety and convenience.

Nevertheless, automobiles remain virgin territory for the IT industry. There is almost no sign of IT businesses fighting it out for this market. Take communications technologies, for example. Automobiles have so much space and battery power that both cellphone networks and wireless LAN networks like WiMAX can coexist within a vehicle. This capability, among others, has not yet been exploited to any significant degree.

Kamio: Are there difficulties ahead for expanding the role of electronics in motor vehicles, or any other points that should be noted?

Saito: Comparing the markets for automobiles and cellphones, both have similar dissemination rates. However, before a new branch of the electronics industry can be established, we must overcome the major dilemma mentioned previously. The initial market is small and the rate of market expansion is slow because the pattern of "replacement purchase demand" translates into a long life cycle. This causes great difficulty for IT companies seeking opportunities for fast growth.

Another matter to be considered is the high priority given to stability in the automobile industry compared with the IT field. When creating hardware and software for motor vehicles, you need to have a sound understanding of the process automobile manufacturers use to develop, build and service their products. If the electronics industry gains this insight and joins forces with the automotive industry in this country, Japan could well become the world leader in information-intensive vehicles.

Kamio: Clearly, to enable information-intensive motor vehicles, it would be very beneficial if the issues raised by the differences between the cultures of the automotive and electronics industries can be overcome. Thank you very much for sharing your thoughts with us, Mr. Saito.

Renesas' CIS Strategy

Aiding the Design of Sophisticated CIS Products with Semiconductors that Deliver Media Processing Capabilities and Much More



Naoki Yamauchi

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By offering a wide array of advanced semiconductor solutions that cover the full spectrum of in-vehicle systems, Renesas has earned a significant share of the automotive market in Japan and worldwide. In particular, we estimate that our share of the total market for microcomputers for car navigation systems now exceeds 80 percent. We strive vigorously and continuously to meet evolving customer needs. One measure of our progress is the SH7770 microprocessor, which incorporates the latest features required by car navigation systems, including a 3D graphics accelerator. In the process of writing this article, we asked Naoki Yamauchi of the Automotive Semiconductor Division to add his comments on the present status and future strategy of Renesas' CIS solutions.

The electronics content of automobiles is substantial and rising, and information systems are becoming better and more capable

Just a few decades ago, the electronics in vehicles were confined to radios and ignition systems. Today, semiconductor devices are pervasive in all types of cars and the dominant feature enabler in high-end models. They are the driving forces behind the many changes that occur between successive platform generations and even between year-to-year rollouts. Car information system (CIS) products, represented by car navigation systems and telematics, exemplify industry trends. They demonstrate continued improvements and will become a standard automotive feature for many more car models in the future. Furthermore, the typical CIS will likely develop into an entertainment system when it is combined with car audio and other in-vehicle systems.

Car navigation systems have become better, more capable and faster through the use of CD-ROMs, DVD-ROMs and then HDDs for data storage. As navigation features have improved, audio-visual (AV) features have been included, creating products that are properly termed "AV navigation systems." A similar evolution in features and performance has seen some car audio systems bolstered by HDD, merged with AV navigation systems, and combined with rear-cabin entertainment systems. Clearly, such enhanced systems are developing into in-vehicle AV content servers. System complexity is rising dramatically, although that complexity is well hidden behind user-friendly interfaces.

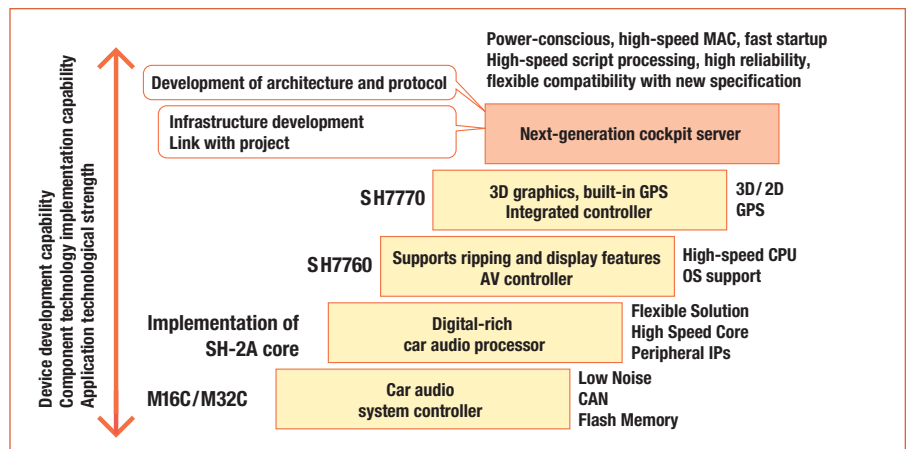


Figure 1: Car information systems are evolving rapidly and Renesas offers solutions for current and next-generation CIS products

Information and cabin-environment systems and are becoming integrated with safety systems

With the incorporation of advanced features in car navigation systems, the display screen is becoming larger and offering higher definition. That, in turn, is opening opportunities for car makers to offer new functions. Mr. Yamauchi pointed out that "in addition to the integration of information and cabin environment systems, which are conventional features of car navigation and car audio systems, the integration of vehicle and safety systems is taking place." For instance, besides showing car navigation functions, high-performance displays can show the picture from a back-up monitor camera, helping the driver to avoid hitting things. It can also present other types of vehicle safety information generated by sensors on both the inside and outside of the vehicle.

Figure 1 (above) depicts various CIS trends, as indicated by technology and Renesas products. We will offer a full lineup of solutions for CIS implementations as they evolve into AV navigation systems and become intimately related to car audio systems. Our products encompass car audio system controllers from the M16C family, digital-rich car audio processors that have an SH-2A CPU core, the SH7760 processor that supports ripping and display features, and the SH7770 integrated controller that implements 3D graphics and GPS functions. To facilitate future advances in CIS products, our R&D engineers are undertaking seamless development programs and proposing flexible solutions.

"Using the products now in our lineup or planned, Renesas solutions can cover integrated control of DVD and HDD mechanical units, as well as navigation features,

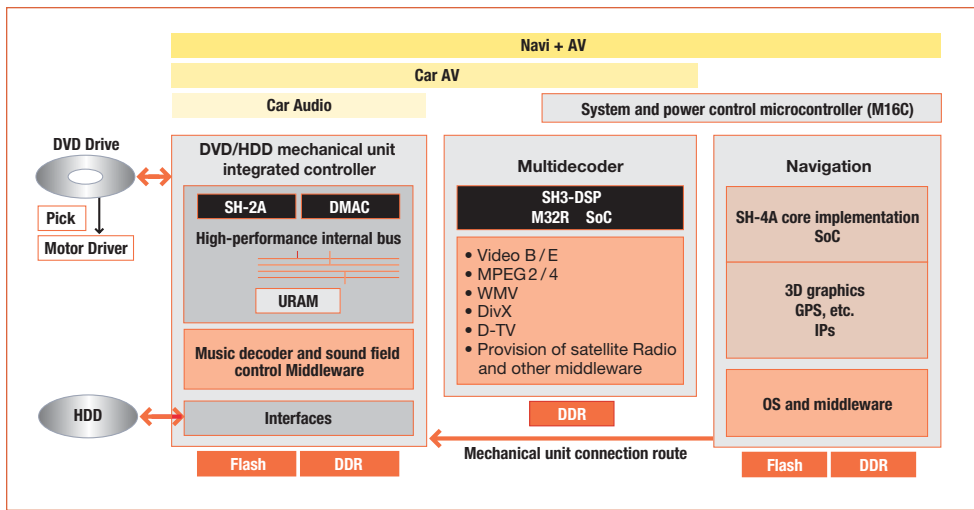


Figure 2: This future CIS configuration implements the many functions and enhanced capabilities that in-vehicle systems may soon provide for driver and passengers

including high-definition 3D graphics displays and various media processing functions. Furthermore, we can offer sub-microcomputers that handle the basic control and power control functions of systems,” explained Yamauchi. Figure 2 (above) illustrates what the design for a future CIS system might look like.

One Renesas aim is to incorporate more decoder capabilities into future CIS solutions. According to Mr. Yamauchi, “For digital home electronics, it is sufficient that DVD and HDD recorders support a MPEG2 codec. However, a CIS product must be compatible with a wider variety of content formats. It must handle MPEG2/4 video, data encoded with Microsoft’s Windows media audio (.wma) and Windows media video (.wmv) formats, digital broadcasts, satellite radio transmissions, and more. To implement solutions that can flexibly carry out such processing, we currently utilize middleware and/or provide hardware IP, depending on the requirements of the application. The best choices for CIS designs are likely to change as we move into the future.”

A trio of solutions addresses different market needs

Three strong product pillars form the basis for Renesas’ strategy for maintaining and expanding leadership in semiconductors for CIS technology and applications: the powerful SH7770 processor for CIS applications in Japan; the SH7760, which is already popular for telematics applications mainly in Europe and the United States; and the SH7780, which is under development.

“For the remainder of this article, I would like to focus on the SH7770, which received the prize for excellence in its category of the 11th ‘LSI of the Year’ competition, sponsored by Semiconductor Industry News,” said Mr. Yamauchi. “This device has been well received in the Japanese market. It has already been incorporated into the flagship AV navigation systems of several leading car navigation manufacturers.” Indications are that the SH7770 will

be adopted in all types of car navigation systems, including factory-installed equipment, dealer-installed options and aftermarket products.

“In a single chip, the SH7770 incorporates many IPs and provides a set of functions that previously required several chips. To achieve a significant gain in system performance, we mainly channeled our development energies into boosting the throughput of the CPU core, as well as improving bus performance,” Mr. Yamauchi stated.

The 400MHz SH-4A CPU core can deliver very high performance: up to 720 MIPS or 2.8 GFLOPS. However, the chip contains a lot of embedded memory (that previously had to be external), so system performance would be degraded by a conventional bus structure because bus power would be shared excessively. The design of the SH7770 solves this problem by using the bus at high, medium and low speed.

Additionally, to achieve high performance with low power consumption, our development team implemented a distributed processing scheme. Processing is performed by both the CPU core and by the on-chip graphics accelerator (hardware IP). “The technologies we developed for mobile products proved highly effective in the SH7770 chip,” explained Yamauchi. The hardware IP, carefully selected to meet the requirements of CIS applications, reduces the load of the CPU core and improves the overall power efficiency of the device.

Grasping the latest, detailed needs with an overwhelming share

“I must mention that solutions built into the SH7770 processor are the end results of three main factors: the talent and hard work of Renesas engineers, the insights and suggestions offered by car navigation manufacturers, and the ideas and insights provided by the research centers of Hitachi and Mitsubishi Electric,” Mr. Yamauchi commented. “Our large share of the

microcomputer market for car navigation systems has allowed us to forge close ties with customers. In turn, that enables us to quickly understand the latest needs of the market, in detail.”

SIP technology and multicore techniques may be used to raise the level of integration

Planning for advanced processors is ongoing to attain the ever-higher levels of performance that semiconductors will have to deliver in future generations of CIS products. Among the design strategies being considered are the use of solution-integrated-product (SIP) technology, a Renesas strength, and multicore architectures. “The SH7770 is a powerful, well executed SoC device. The next step may be to connect other LSI chips externally the SH7770, such as peripheral media processing chips and larger amounts of memory, in a device built with SIP technology that keeps the same footprint and pinout. This would allow easy system upgrades,” said Mr. Yamauchi.

Adding functionality and distributing processing tasks using multicore methods holds great promise. “Multicore is a good way to obtain greater performance while limiting the amount of power dissipated,” Mr. Yamauchi explained.

The research centers of Hitachi and Mitsubishi Electric will continue to help Renesas acquire key component technologies for producing enhanced solutions for CIS. For software components, we will sustain our active cooperation with our technology partners and sustain our to support for an open system architecture that accommodates a wide range of solution elements. Having launched the COMET consortium in the United States for supporting system development, we will establish similar consortiums in Japan and Europe.

The articles on the following pages of this magazine describe in greater detail the CIS solutions Renesas provides and other aspects of this dynamic automotive electronics market.



The SH7770 processor received a prize for excellence in the “LSI of the Year” contest sponsored by Semiconductor Industry News

Renesas CIS Solutions

Extending the SuperH® Architecture to Include Multi-CPU Versions Using SIP Technology and Multi-Core Configurations

The SuperH processor core has already become a de facto standard for car information system (CIS) products and Renesas is further developing this microprocessor architecture. We are considering a range of solutions that focuses on both types of CIS products: the navigation terminals with full graphics functions that are rapidly growing in popularity in Japan, and the telematics terminals now being used increasingly in Europe and America. This article looks at specific CIS solutions in the context of our product strategy, technology roadmap, and available IP options.

Providing optimum solutions for both navigation- and telematics-type CIS products

The Renesas SuperH family of 32-bit RISC microprocessors enjoys overwhelming support in the CIS sector, having gained approximately an 80 percent share of the market for car navigation microprocessors. SuperH devices are the true de facto standard and we have established a clear roadmap for continuing to enhance and extend the CIS solutions that use this RISC architecture (figure 1). That market can be broadly divided into car navigation systems, which are becoming pervasive in Japan, and telematics systems, which are popular in Europe and America.

Significantly, the trend for CIS products in Japan is to start adding telematics functions to complement the existing navigation functions. System capabilities required for telematics include high-speed/high-resolution 2D and 3G graphics, high-volume data storage using

HDDs, video playback from DVDs and similar media, and music playback from CDs, MP3 files and other formats. As graphics functions are enhanced, car audio and other audio-visual (AV) functions will be incorporated, as well, thereby creating a new type of product: “AV navigation” systems.

Given these trends, the ideal solution for the CIS market in Japan is a range of full graphics navigation products. Renesas meets this need with the SH7770, a powerful ASSP-like microprocessor that uses a 400MHz SH-4A CPU core and offers enhanced graphics processing capabilities. The growth and importance of the CIS market has prompted Renesas to plan to supplement the SH7770 with the SH7780 now under development. The SH7780 will be a standard product with many potential applications.

In Europe and America, consumers are more interested in emergency assistance, traffic warnings and similar services than in

navigation capabilities with advanced graphics. Thus, products in the CIS sector consist primarily of telematics systems that use speech and arrows to provide simple route guidance, etc. The functions required for telematics include synthesized voice output, speech recognition, emergency warnings, and personal assistants.

To implement telematics applications, Renesas has released the SH7760 microprocessor. This device, a standard product, has a reduced function set compared to the SH7770 and uses the slower SH-4 CPU core, which operates at speeds up to 200MHz. The SH7760 is also a good choice for HDD-based car audio systems.

Improved bus operation boosts overall system performance

The newly developed SH-4A CPU core delivers 720MIPS of processing power when operating at 400MHz, and faster versions are planned with clock speeds of 600MHz or more. Other Renesas development efforts aim to increase

Faster core with redesigned bus delivers 720MIPS at 400MHz; achieves both high performance and low power consumption

The SH-4A CPU core, operating at its maximum frequency of 400MHz, provides 720MIPS of processing performance, a 1.7 times increase in speed over the previous 240MHz/430MIPS SH-4 core. The SH-4A instruction set is upwardly compatible, allowing the reuse of existing programs written for SH-4 processors.

In the SH-4A core, the number of pipeline stages has been increased to seven in order to increase the operating frequency. Hardware optimization mitigates the deterioration in performance caused by branch penalty and increased road-use. Thus, functional performance remains at a level equivalent to that of the five-stage pipeline of the SH-4. As a result, throughput has been increased by more than just the increase in operating frequency. Middleware performance has

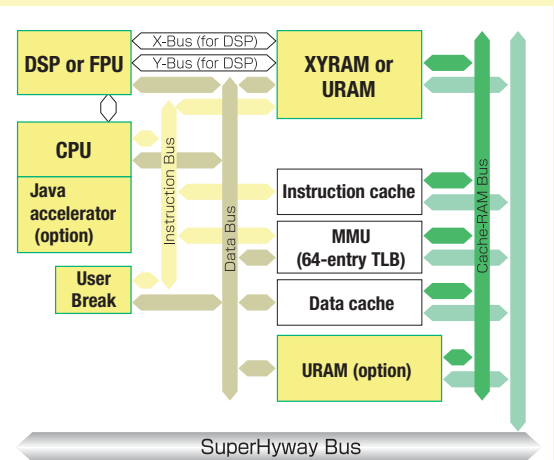
been improved by 20 to 60 percent by making the pipeline two-way superscalar. Additionally, a four-way cache memory improves the cache hit rate.

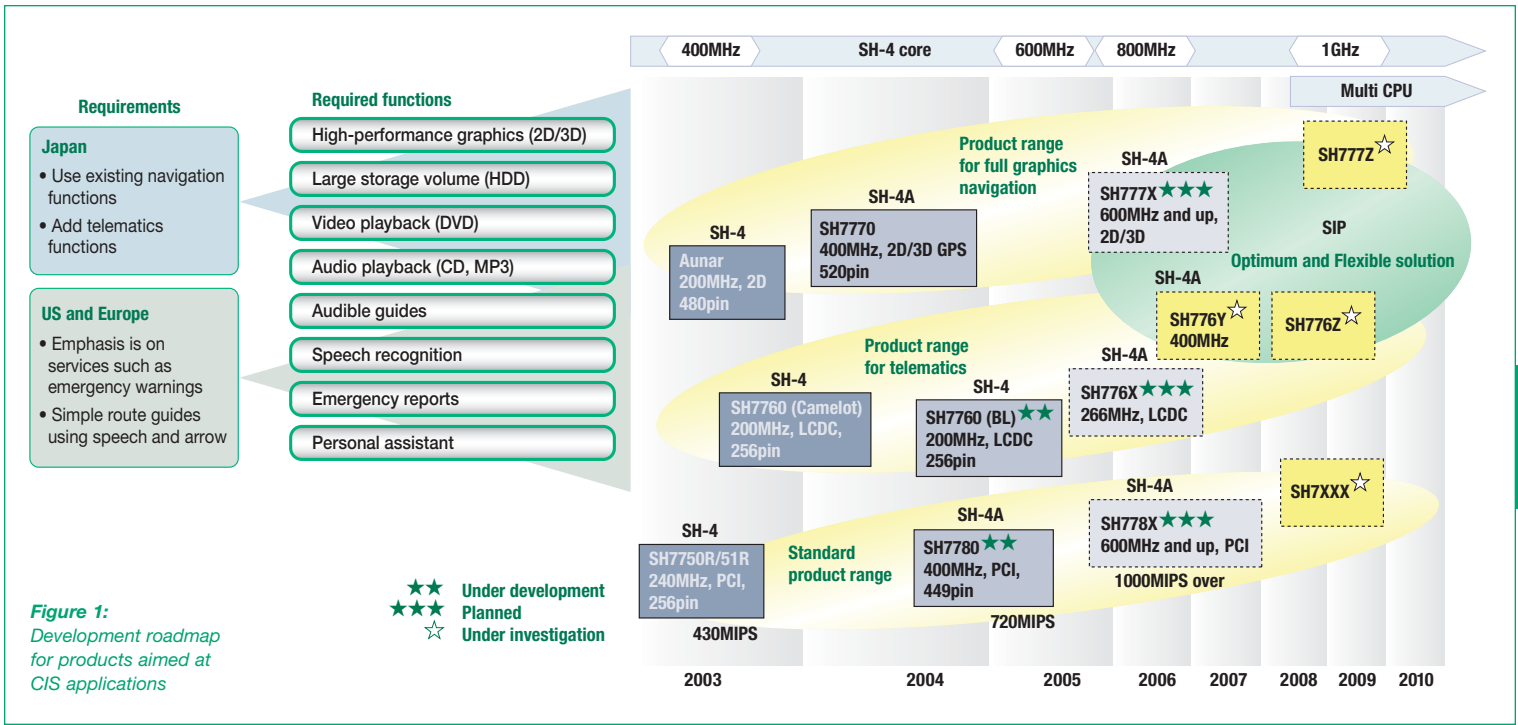
A 64-bit SuperHyway bus is used as the on-chip bus. This is a split-transaction design with separate request and response buses. Therefore, transactions cannot monopolize the bus for long periods and bus utilization efficiency is improved.

Reductions in operating power, leakage current, and similar characteristics make the SH-4A core relatively power efficient. The lower power consumption is achieved by various methods, including finer step sizes for clock-driver activation limits and a decrease in

the memory-bank activation ratio. To minimize the leakage current, the power supply is turned off wherever possible.

Internal Block Diagram of the SH-4A Core





device integration using SIP (Solution Integrated Product) technology. Media processing functions, large memory sizes, various I/O, and other functions previously provided by separate devices can be combined in a single package that also includes an SH-4A based processor.

Multi-core products are also under consideration. Using multiple CPUs to share the load is an effective way to boost performance, given a limited power supply capacity. Besides symmetric-multi-processor (SMP) load sharing, Renesas is investigating using multiple cores to distribute functions. In the latter approach, other cores can be used besides SuperH types:

cores with enhanced DSP, media processing, or other functions, for example. Our aim is to provide multi-core products that form part of efficient solutions. We view multi-core technology as a useful approach for pursuing lower power consumption.

Improving bus performance is just as important for boosting overall system performance as increasing the operating frequency or adopting multi-core architectures. For this reason, the data transmission paths in SuperH chips have been separated into high-speed (200MHz), medium-speed (100MHz) and low-speed (50MHz) buses. This design approach raises system performance because, for example, the

data input from the ATAPI can be passed directly to DDR SDRAM without going through the CPU.

Dealing with electromagnetic interference (EMI) is an important issue in vehicle data systems, and SIPs can deliver significant improvements in EMI. For instance, using a SIP to combine the processor and DDR SDRAM in a single device reduces switching noise. SIPs provide cost savings by allowing reductions in the number of components or circuit board layers. Also, because they put all the high-frequency circuits inside the package, SIPs eliminate the need for high-frequency circuit board design.

(continued on page 10)

Product Solution: SH7770

Package: 520-pin BGA (33mm x 33mm)

Maximum operating frequency: 400MHz

Performance: 720MIPS, 2.8GFLOPS (at 400MHz)

CPU core: SH-4A core

Cache memory/internal memory

- Instruction cache: 32Kbytes
- Data cache: 32Kbytes
- RAM: 16Kbytes

External memory

Memory controller supports direct connection of DDR-SDRAM

Bus-status controller supports direct connection of SRAM and ROM

Peripheral functions:

- 2D/3D graphics engine
- Display control
- Video input interface
- DMAC: 36ch
- SCIF: 10ch
- GPS baseband processing module
- USB host/function interface & more

Low power consumption modes

- Sleep mode
- RTC power supply backup mode
- DDR-SDRAM power supply backup mode

SH7770 chip package

SH7770 internal block diagram

Product Solution: SH7780

Package: 449-pin BGA (21mm x 21mm)

Power Supply Voltage: 1.25V (internal) / 3.3V (external)

Maximum operating frequency: 400MHz

Performance: 720MIPS, 2.8GFLOPS (at 400MHz)

CPU core: SH-4A core

External bus interface (3-bus configuration):

Voltage	Bus width	Op. freq.
DDR I/F 2.5V	32-bit	160MHz
Local bus 3.3V	32-bit	100MHz
PCI 3.3V	32-bit	33/66MHz

Cache memory/internal memory

- Instruction cache: 32Kbytes (4-way set associative)
- Data cache: 32Kbytes (4-way set associative)

LRAM (high-speed): 16Kbytes

Medium-speed RAM: 32Kbytes

Internal functions:

- DMAC: 12ch
- SCIF: 2ch
- SIOF/SSI/HAC
- NAND Flash controller
- MCMCIF

Low power consumption modes: Module standby function

SH7780 chip package

SH7780 die photo

SuperH architecture will be extended to handle future CIS solutions

A common issue for many embedded systems is the growing volume of software that must be developed. The amount of code used by advanced applications is expanding so rapidly that the term “software explosion” is no exaggeration. Systems for the car navigation and other CIS markets reflect this trend. It is not uncommon for the latest car navigation systems to have a code size in excess of 2 million steps. The cost of creating this software typically represents one quarter or more of the total system development cost.

Whether or not this trend increases in the future, software complexity is unlikely to decrease. Therefore, developers of car navigation systems must find ways to minimize the cost of writing software while still

maintaining product competitiveness. A good tactic for doing this is to use a platform. Software development efficiency improves if resources such as various applications, middleware, and common drivers and protocol stacks can be accumulated, then reused in the development of new CIS products. A key factor in establishing and maintaining suitable platforms is selecting the optimum CPU architecture, one that has capabilities that are adequate now and can — and will — be extended to remain sufficient in the future.

It’s inefficient to design a CIS product line using a different CPU architecture in each model or product series. The processor disparities make it difficult to develop standardized drivers, low-level middleware and similar software, even if some CPU differences can be hidden by the operating system (OS). The adoption of a popular, well-supported standard CPU

architecture enhances the longevity of the platform. Moreover, using the same platform over a long period of time allows a valuable library of software assets to be assembled.

The many benefits that standard platforms provide explain why all car navigation microprocessors from Renesas belong to the SuperH family and will continue to do so. Our consistent architecture policy is the reason we currently supply SuperH family products that use the SH-4 core and upwardly compatible SH-4A core for CIS applications. Compatibility is essential as we develop new CPU cores that utilize the latest technology. It also drives our development of platforms that implement efficient software development environments. The need to maintain a consistent processor architecture is a primary tenant of Renesas’ product strategy.

IP Solution: 2D/3D Graphics IP

By conserving resources in car navigation systems, graphics IP aids international trend from 2D to 3D graphics

British company Imagination Technologies (IMG) has been successful around the world with its “Power VR MBX” 2D/3D graphics IP, used in SoCs for multimedia applications. The company was quick to recognize car navigation as the application in which the display of realistic images using 3D graphics could best demonstrate the power of its graphics IP product.

Renesas has the highest share of the market for semiconductors used in car navigation systems, and IMG has worked with Renesas for the past three years to jointly develop a version of Power VR MBX for SH-4 series processors. Commenting on this technology partnership, Mr. Yassaie said, “Renesas was the only realistic partner with whom to collaborate on a version of MBX for car navigation. Even if we deal with other manufacturers of car navigation semiconductors in the future, Renesas already has a two-year head start and is likely to remain a very important and strategic partner for us in the future. There is a high degree of affinity between the SuperH family and MBX, and this can be considered the best combination at the current time. 3D graphics will have a big impact on the car navigation market and we are working to provide an environment that gives our customers maximum support for car navigation development.”

A key feature of Power VR MBX is a technology called “tile-based rendering,” which was developed using a “deferred texturing” architecture. This technology lightens the load that generating graphics places on the 3D graphics engine, enabling true 3D playback, even on systems where CPU power, memory, and other resources are limited.

In simple terms, using tile-based rendering, the 3D body-generation process doesn’t process regions of the image that are hidden (not displayed) in the shadow of other objects when generating the screen display. It only generates the solid body images for visible regions. This rendering technique significantly reduces the volume of processing and associated memory requirements for generating 3D images. Thus, the technology has attracted attention as a graphics IP suitable for car navigation and mobile phone applications where resources are limited.



Hossein Yassaie
CEO, Imagination Technologies Group plc.



“Although simply ‘skipping the regions that are not visible’ sounds simple, there are a number of problems that must be overcome to achieve this in practice. For example, if glass and other transparent materials are to be represented realistically, the background must be visible through the glass. The solutions for dealing with such situations are already built into our IP, and this feature is something our competitors cannot duplicate,” Mr. Yassaie emphasized.

IMG expects 3D graphics functions increasingly to become a standard feature in pure car navigation products and the company is working hard together with Renesas to have the technology adopted, even in low-cost car navigation systems. The aftermarket, which offers systems that are installed after the car is purchased, currently remains the mainstay of the market for high-end car navigation systems featuring 3D graphics, even in Japan. Nevertheless, prices are expected to fall over the next one or two years, so car navigation is likely to soon become a standard factory-supplied feature, just like air conditioning. The markets in Europe and America are expected to follow the same trend with a delay of about one year.

“Internationally, the importance of the car as a place where we spend our time is increasing. As consumers place more importance on the environment inside their vehicles, I believe it is important for the car navigation system to evolve into a more user-friendly product that goes beyond giving directions and instead acts as a navigator toward a better in-car experience. The adoption of 3D display functions is a natural part of this change, and I am confident that use of this technology will not be limited just to Japan,” said Mr. Yassaie.

IMG sees its current 3D graphics IP for car navigation as a first-generation technology and has set a goal to have the technology used in one million vehicles. The company has already started work alongside Renesas to develop the next-generation 3D graphics IP, which will provide higher quality, more realistic 3D graphics.

The CIS product development roadmap (figure 1) shows that in the spring of 2004 we began supplying the SH7770 device for full graphics navigation applications. At that time we also released the SH7760 for telematics and HDD audio products, and began developing the SH7780 as a standard product. To put that activity into perspective, let's briefly review those devices.

SH7770 processor enables CIS products with full graphics navigation

The powerful SH7770 ASSP-like microprocessor combines a CPU core, 2D/3D graphics accelerator, GPS baseband processing module, and various I/O and other modules in a single chip SoC using the latest process technology. The CPU core is the 400MHz SH-4A version, which is upwardly compatible with the older SH-4 core, allowing the reuse of existing application code.

The SH7770's 2D graphics engine provides the optimum functions for map drawing, enabling high-quality maps to be drawn at high speed. Its 3D graphics engine is the PowerVR MBX 3D graphics IP from Imagination Technologies (IMG, a British company). This engine provides 3D drawing functions for advanced and high-

speed multimedia applications, as well as 3D drawing for navigation.

The SH7770 is the first microprocessor in the world that includes an internal GPS baseband-processing module. This built-in functionality reduces system cost by eliminating the need for an external dedicated baseband LSI. Besides the baseband processing module, the SH7770 includes more than 50 different internal peripheral modules required for next-generation in-vehicle information terminals, including various sound interfaces and serial interfaces. An internal bus arbitration circuit uses defined priorities to maximize the effectiveness of the process by which the many on-chip peripheral functions obtain access to external memory.

SH7760 is optimized for telematics and HDD audio systems

The SH7760 processor has an SH-4 core with a maximum operating speed of 200MHz and uses a unified memory architecture (UMA). The device's IP modules include an LCD controller for use with the turn-by-turn displays that give route information to drivers. That controller also makes the chip suitable for car audio and other applications that must include sophisticated display functions.

Standard voice and audio interfaces are built into the SH7760, as are an AC97 codec interface and an I²C interface. The device also has a USB host, MMC interface, memory card interface and vehicle network support (HSPI, I²C bus, HCAN 2.0), among other on-chip functions.

Renesas has developed an SH7760-based solution for HDD-based car audio systems. The design implements AAC compression and decompression and high-speed leaping (four times normal speed) via middleware. It adopts encryption technology (MISTY) to ensure full protection for the music data on the disk drive and runs on the SH-Linux OS to deliver improved portability for software resources.

SH7780: fast general-purpose processor with extra CIS functions

The SH7780 now in development will be a general-purpose microprocessor with additional CIS functions, whereas the SH7770 chip is specifically optimized for CIS applications. In the Renesas product roadmap, the SH7780 is the replacement for the SH7750R and SH7751R.

(continued on page 12)

Infrastructure Solution: Quasi-Zenith Satellite Systems

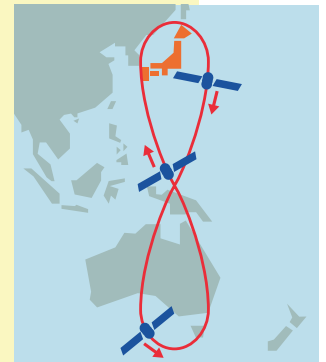
Positioning system developed in and for Japan refines GPS to help bring world of ubiquitous technology to automobiles

The spread of car navigation systems has created a demand for more precise positioning information. The main method used up until now to determine the position and direction of a moving vehicle has been the USA's global positioning system (GPS). At least four GPS signals must be received to determine a position by GPS. However, often the position cannot be determined if the signals are blocked by buildings, mountains and other obstructions. The best chance for obtaining good position data occurs when one satellite is high in the sky above the location, for just three other satellites are needed.

There is a growing need for a new positioning infrastructure so that accurate positioning information can be obtained at anytime, anywhere in the Japanese islands. In response, progress is being made on the Quasi-Zenith Satellite System (QZSS), a positioning infrastructure developed in Japan that complements GPS and provides highly accurate positioning information. QZSS is expected to be Japan's first positioning satellite system. The Advanced Space Business Corporation (ASBC) based in Chiyoda-ku, Tokyo and headed by President and CEO, Takeo Iinuma, is pursuing the project with investments from 59 different companies, including Mitsubishi Electric, Hitachi, and various trading companies, as well as vehicle manufacturers and broadcasters. The service is scheduled to start in 2010.

The Quasi-Zenith Satellite System already has plans underway to launch around three satellites that will cover a narrow service area extending north-to-south from Japan to Australia. Whereas about 24 GPS satellites cover the entire world, QZSS will be a regional navigation satellite system (RNSS) that provides positioning information for East Asia-Oceania Region.

The Quasi-Zenith satellites will probably trace out a figure-eight orbit pattern over the surface of the earth, although teardrop-shaped and other orbits are also being considered. If three satellites are spaced equally along such an orbit, one will always be passing over Japan, enabling precise positioning information.



As indicated by its name, the Quasi-Zenith Satellite System will always have one satellite in the sky above Japan, close to the zenith, at a high angle of elevation. This will greatly improve reception in locations where GPS would be obstructed by buildings or mountains. Another advantage of having a high angle of elevation is that the geometric dilution of precision (GDOP, which represents a geometrical distribution of satellite related to the positioning error) is small. Therefore, much better positioning accuracy is anticipated.

Another project to develop a high-precision positioning system that complements GPS is the "Galileo" program being pursued by the European Union (EU). The company undertaking this project has already been established in Germany, and it plans to launch 30 positioning satellites for global use by 2010.

One result of both positioning approaches is likely to be an acceleration of the integration of telematics and other information technology into automobiles. QZSS and Galileo will provide new infrastructure to help establish an environment of ubiquitous networks, including broadcast communication functions aimed at mobile devices.

Like the SH7770, the SH7780 has a 400MHz maximum operating speed and achieves 720MIPS performance. The chip's internal PCI bridge has enhanced performance in POI mode and its memory interface supports DDR SDRAM (160MHz, both edges). Because the SH7780 will be a standard product, it will be able to use the many middleware products available from Renesas and its technology partners.

IP jump-starts chip designs, facilitates customizations

When designing chips for the CIS market, the availability of IP is just as important as architectural features such as the CPU core and bus structure. A wide range of IP that can be quickly incorporated into chips customized for specific applications must be created or otherwise obtained. Often, the best solution is to use what is already available, since developing an IP from scratch requires considerable time, can be expensive and might

divert resources from the overall device development process.

For an available IP to be useful, though, it must be suitable for volume production. The amount of work required to incorporate a particular IP module into a chip is significantly reduced if that IP has already been implemented in silicon. Renesas has many such proven IP assets. They range from basic IP for the I²C bus and I²S, through to IP for CAN, ATAP, USB, PCI and IEEE-1394 interfaces, 2D and 3D graphics, GPS baseband, unified memory controller, and much more.

We use these assets in many LSI devices for general-purpose applications. Some are also applied in devices optimized for one or more specific markets, such as the mobile, PC peripheral, digital consumer electronics, office automation and factory automation sectors, as well as the automotive industry. For instance, the PowerVR MBX 3D graphics engine integrated into the SH7770 CIS chip had

previously been designed into the SH-Mobile3 application processor for mobile phones.

Renesas also offers a wide range of middleware, which is software IP. One example is our audio-related middleware, which encompasses encoders and/or decoders for AMR-NB, AMR-WB, AAC, MP3, WMA (v8/v9), ATRAC3, aacPlus, ATRAC3plus, RealAudio, and G.723.1/G.723/G.723A formats, as well as an echo canceller and noise splitter. All of the middleware developed for the SuperH family will be usable well into the future. We can make this statement because, even as upcoming Renesas microprocessors for CIS applications move to multi-core configurations, one of those cores will always be a SuperH type, based on an architecture that remains consistent over time.

For more information on the SH7760, please visit: http://america.renesas.com/fmwk.jsp?cnt=sh7760_root.jsp&fp=/products/mpumcu/superh_family/sh7750_series/sh7760_group/

Renesas Microprocessor User Profile: Pioneer Corporation

SH7770 delivers realistic 3D maps on the CYBERNAVI and the chip's compact mounting enables a small case size

In June 2004, Pioneer released four new models in its Carrozzeria-HDD [CYBERNAVI] series, including the AVIC-ZH900MD. The Renesas SH7770 has been adopted as the core of these products, which currently are Pioneer's flagship car navigation models. These systems provide a high-level combination of both advanced car navigation and sophisticated AV functions in a 2DIN integrated AV navigation auto-server.

The AVIC-ZH900MD, the high-end model in the series, has further developed the "agent" concept as a new direction for car navigation systems that can "remember and learn from the preferences and behavior patterns of each driver to operate in place of the driver." This model represents a new generation of car navigation systems that not only provide navigation functions, but also feature AV (audio-visual) functions. It has a "congestion prediction function" that statistically analyzes past congestion data, a "drive planner" that produces a detailed drive plan based on knowledge of the driver's preferences and current circumstances, and a "feeling play" function that automatically selects music to suit the driver's mood.



Carrozzeria-HDD [CYBERNAVI] AVIC-ZH900MD

Pioneer

The car computer and HDD used to implement these functions are contained in a "brain unit" small enough to hold in your hand. Mr. Ando explained that "we selected the SH7770, which combines graphics and many other peripheral functions in a single chip, in order to house the computer and HDD in the brain unit." Similarly, Mr. Nagaki commented that "whereas the previous three-chip system had separate microprocessor, graphics, and ASIC chips, the SH7770 replaces this with a single chip. That enabled us to solve a serious packaging problem because space was very limited."

A key feature of the AVIC-ZH900MD is the "solid city map," which displays very realistic 3D maps. "Although we wanted to provide true 3D map displays in the past, there were no chips able to achieve this. We have only been able to do it now thanks to the SH7770, with its powerful 3D engine. The SH7770 also includes a powerful 2D engine for drawing high-resolution maps," said Mr. Nagaki.

The SH7770 includes a DDR interface as a standard feature. The ability of the Renesas device to perform fast accesses to external memory using unified memory is another important factor in high-speed drawing. The SH7770 played a major role in enabling Pioneer to develop the AVIC-ZH900MD to be its top-of-the-range car navigation system.



Hitoshi Ando
General Manager
Engineering
Development 1
Engineering
Development Division
Mobile Entertainment
Company



Kouichi Nagaki
Manager
Development Section 1
Mobile Systems
Development Center
Research &
Development Group

Renesas Microprocessor User Profile: Alpine Electronics, Inc.

Joint-development with Renesas of the "Chimera" custom SoC for car navigation coincided with adoption of the Windows CE OS

Alpine is the OEM supplier of the car navigation system fitted as a standard feature in the 2005 high-end Japanese Legend sedan (the Acura RL in the United States) from Honda Motor Company (referred to below as Honda). The "Honda Inter-Navigation System," which replaces the previous navigation-only version, combines navigation, AV, vehicle information, and similar functions in a single unit.

The main processor used in this new car navigation system is the "Chimera" SoC, a custom car navigation chip jointly developed by Alpine and Renesas using the SH-4 core. The SH-4 runs at 200MHz and has features that include a 2D graphics accelerator and unified memory architecture (UMA), so this SoC can be seen as a predecessor of the SH7770. It has been applied both in pure navigation systems and in car navigation systems that are dealer installed options. "Having decided to adopt the Windows CE operating system, we jointly developed the Chimera SoC using the latest SH-4 core because the SuperH core supports Windows CE and also because we wanted to improve the processing speed," said Mr. Soma.

A car navigation system must pack all its primary functions into a unit no larger than the 2DIN size. According to Mr. Yazawa, "The Chimera was a big help because it uses a single-chip SoC configuration that combines not only the processor, but also other functions that were previously performed by separate chips. That decreased the system component count."



Carrozzeria-HDD [CYBERNAVI]
AVIC-ZH900MD

ALPINE

Development of the Chimera brought together the car navigation know-how of both companies, utilizing IP and other resources already held by Alpine, as well as the wide range of IP available from Renesas. "Renesas responded well to the somewhat unrealistic requests that flowed from the demanding user requirements," Mr. Yazawa said.

The code size of the car navigation software for the Legend, including the user interface, was in the order of 3 million steps. A software development platform is essential for writing software this complex, and Alpine is creating one in-house. A common ongoing processor architecture forms the basis for this platform. "We plan to use the SH7770 for all of our car navigation products from 2007 models onwards, including versions aimed at the aftermarket, pure car navigation, and dealer option markets. We are also considering using the next-generation SH7770 chip for subsequent models. We expect to use the development platform that we have put together for Chimera to support our car navigation development into the future," Mr. Yazawa stated.

Car navigation solutions provided by Renesas are making a major contribution to maintaining Alpine's competitiveness in the car navigation market.



Satoshi Soma
General Manager
AVNC Development



Takeshi Yazawa
Senior Manager
AVNC PF
Engineering Dept.
Assistant Director,
AVNC New Function
Development,
AVNC Development

Renesas Microprocessor User Profile: Mitsubishi Electric Corp.

Early adopter of the SH7770 for its "H9000" HDD navigation system estab- lishes development platform for SuperH

Since adopting the SH-3 series in 1997, Mitsubishi Electric Corporation has been a consistent user of SuperH family processors in the car navigation systems it has developed and marketed. "We have had a long relationship with the SuperH family and have accumulated a large volume of associated resources. We are establishing a software development platform based on the SuperH family to provide an environment that can go some way to improving the efficiency of software development for car navigation, an area that cries out for ways to cope with the software explosion," said Mr. Ideno.

All car navigation systems from Mitsubishi Electric use devices in the SuperH family, including models aimed at the pure navigation market and aftermarket. The company was an early adopter of the SH7770 in its latest aftermarket car navigation system and flagship product, the H9000 HDD Car Navigation System.

Perhaps the most significant feature of the H9000 is the stress-free high-speed processing and high-resolution graphics provided by the SH7770, which is called the navigation core. "The core functions of navigation systems have matured, and the requirements now are for features such as high-speed 3D graphics, real-time information acquisition, and integration with audio-visual functions. The processors we used in the past lacked the performance to handle these functions, so special-purpose processors customized for car navigation had been required," explained Mr. Ideno.



HDD Navigation H9000

MITSUBISHI

Three noteworthy examples demonstrate the H9000's high-speed processing capabilities. Its "instantaneous route search" function can search out the route from Sapporo to Kagoshima, Japan in 0.2 seconds. Its "smooth ten times-per-second display" has increased the refresh rate for the vehicle position display from two to ten times per second. Also, its "high-speed scaling function" offers a total of 14 gradations. Mr. Ideno stated that "it is clearly thanks to the SH7770 that we are able to provide such a fast route search. Also, functions such as the 'smooth ten times-per-second display,' which were impossible in the past due to performance restrictions, have now become a reality because we use the SH7770."

In April 2002, Mitsubishi Electric became the first in the industry to adopt Java technology for real-time information acquisition in the vehicle. They are now further enhancing this technology to provide even more comprehensive telematics support by adding a "places to visit guide" in addition to the "seasonal information distribution service." AV navigation features have also been enhanced, including a "timeslip playback function" that can play a CD while simultaneously recording at x4 speed.

Because the functions provided by the previous chipset have been combined on a single SH7770 chip, the circuit pattern around the chip can be fixed. This makes it much easier to implement anti-noise measures. Thus, the SH7770 has not just helped improve the functions of Mitsubishi Electric's car navigation systems, it has also made a major contribution to making the system development process more efficient.



Hiroaki Ideno
Car Infotainment
Production Manager
Mita Plant
Mitsubishi Electric
Corporation

Renesas CIS Solutions

COMET Consortium Promotes CIS by Assembling Technology Partners that Offer Proven System Development Support

CIS is in the midst of a software explosion. The size of car navigation software, for example, is already in the order of several million steps. Often, the efficiency of the software development process can be improved by utilizing middleware — the proven software components various suppliers offer for key areas. The COMET Consortium, a Renesas-sponsored organization now operating in the USA, brings together companies that cooperate to promote CIS applications and support developers of automotive systems that use Renesas processors. This organization will expand to Japan and Europe, tailoring its activities to the needs of customers in those regions.

Providing CIS solutions in conjunction with partner companies

The use of software components is an important issue in the efficient development of large-scale systems like CIS products. For automotive applications, Renesas offers

to customers using SuperH processors a wide range of proven middleware products — some that we have developed, but most of which come from various third-party expert suppliers. This middleware lets system developers substantially reduce the workload associated with CIS development, which

typically involves large-scale software development. It also shortens the time it takes to get new systems into production.

Numerous and diverse software components have been made available through Renesas' close collaborations with its technology

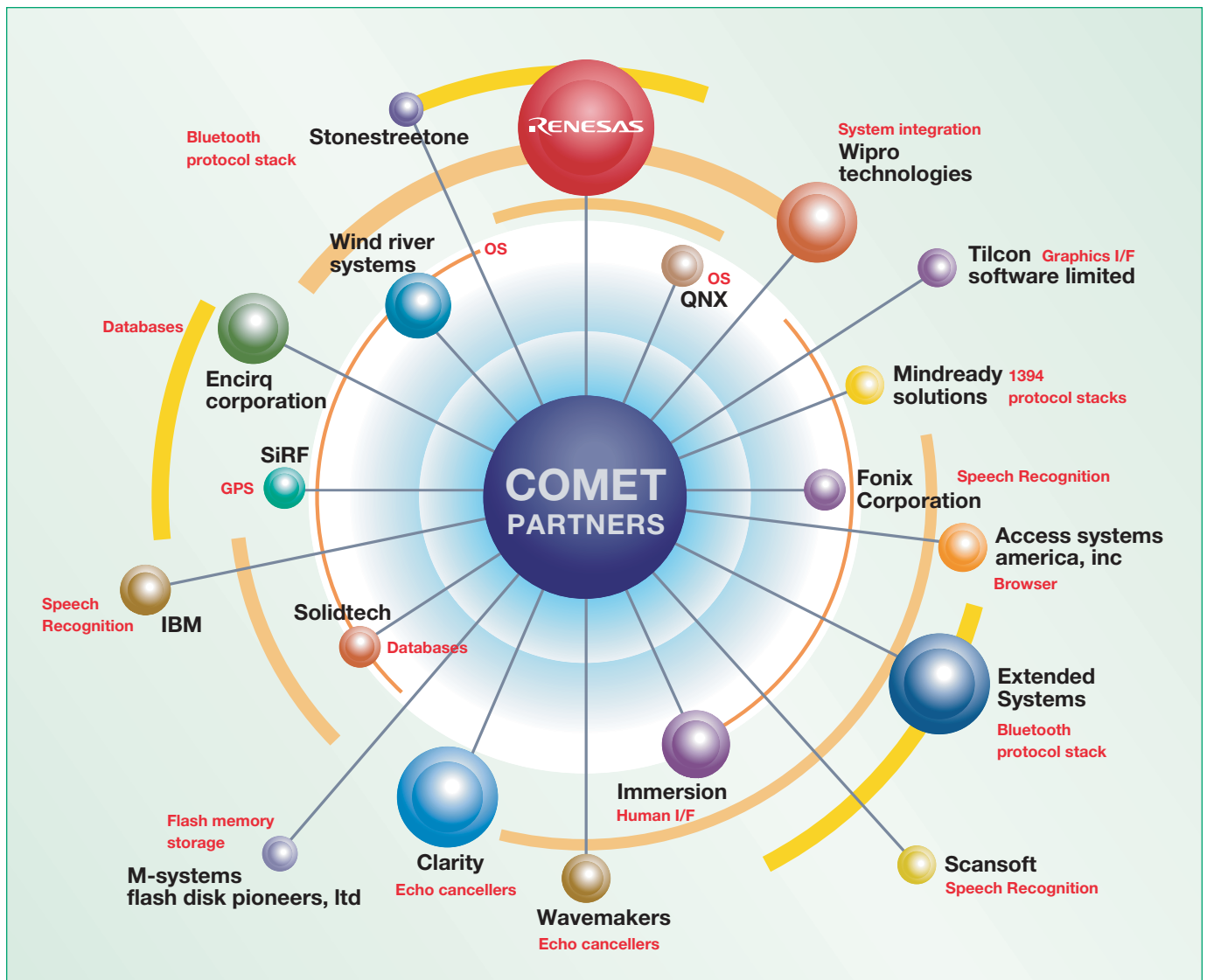


Figure 1: These are some of the COMET partners now participating in the development support program in America.

partners. We have expended a great deal of effort over many years establishing the network of third-party experts that now supports our processors. The size of this support community is unmatched, an important competitive advantage and one that greatly benefits our customers.

In the automotive field, Renesas has actively built close business relationships with many different companies to encourage the proliferation of products and services that support our SH7770 and SH7760 processors and other devices for CIS applications. We sponsored and launched the successful COMET™ (Community enabling telematics) Consortium in the United States in 2002, an organization that addresses key issues hindering telematics growth. To facilitate solutions, this cooperative group has assembled 24 essential software and middleware technologies and ported/optimized them to the SuperH RISC architecture incorporated in a flexible system platform developed by Renesas. The primary processor powering the platform for applications in North America is the SH7760 telematics chip.

The products offered by the current roster of COMET member companies cover a wide range: operating systems, databases, protocol

stacks, interfaces, speech-recognition software, echo cancellers, storage-related products, and more. (See figure 1, opposite.)

Establishing a support structure in Japan that includes SI vendors

Because the automotive industry and CIS applications differ regionally, Renesas will start a Japanese version of the COMET Consortium in mid 2005, inviting both technology partners and system integrators (SIs) to join (see figure 2 below). Rather than focus on the SH7760,

as was the case in the USA, the consortium in Japan will emphasize system solutions based mainly on the SH7770 processor.

The system integrators planning to join the Japanese consortium are mainly companies that have extensive experience in automotive systems. These firms include Akita Electronics Systems, Hitachi Advanced Digital, Hitachi Engineering, Hitachi Software Engineering, Hitachi ULSI Systems, and Hitachi Systems & Services.

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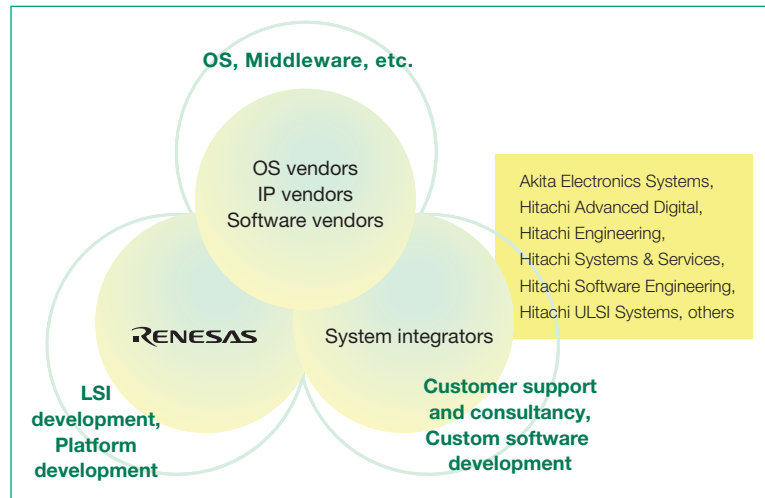


Figure 2: The establishment of a COMET consortium for Japan will strengthen the support structure for SuperH processors for +CIS applications

COMET Consortium member Clarity Technologies, Inc.

Maximizing the Performance and Quality of Voice-based Communications

The ubiquity of wireless and mobile devices has created an increased demand for more robust voice technology to maintain the same quality and performance expected in traditional voice-based communications. Clarity Technologies designs, develops and delivers software and services that improve voice-based CIS communication systems and products. “We’re the leading independent provider with the technology, expertise, focus and services needed to deliver superior solutions for enhancing voice-based communications. Using our expertise and voice extraction technology, we solve CIS voice quality and performance degradation issues for complex audio environments, regardless of the hardware, audio interface, operating system or speech-recognition application,” said Mr. Doney.

Accelerating the development of CIS applications

“Today’s vehicle buyers want more robust voice technology in CIS applications. They pressure manufacturers to provide the same quality and performance they expect from traditional voice-based communications,” Mr. Doney explained. “As a result, we believe it’s critical that our customers—the automotive suppliers producing advanced telematics systems—be better able to serve car and truck buyers by having access to a complete set of system solution elements.”



Dave Doney
Director, Worldwide Automotive Sales
Clarity Technologies, Inc.

The COMET Consortium has assembled a vibrant support community of expert vendors offering an end-to-end array of products, including CPU processors, operating systems, and other software and middleware, in addition to the Clarity software. This support community simplifies and accelerates the development of CIS applications by making multiple choices of interoperable software and middleware available on a single, proven Renesas hardware platform—one that’s flexible, upgradeable and driven by a solid technology roadmap.

Benefits of being a COMET Consortium member

Clarity appreciates the many benefits of working closely with Renesas as part of the COMET program. “Most importantly, we value the fact that the consortium is dedicated to ensuring product interoperability, maximizing system performance, and helping our customers apply one of the best possible application platforms,” Mr. Doney said. “Also, we recognize the importance of the early insight we gain into Renesas’ advanced technology and product plans. This knowledge lets us include the latest microcontrollers in our automotive-focused engineering and marketing activities.”



High-performance SoC for Mobile Hard Disk Drives Previews Solutions Optimized for HDDs in Digital Appliances

Hard Disc Drives (HDDs) have many applications: 3.5-inch HDDs are used mainly for storing data in personal computers and servers, 2.5-inch HDDs are built into notebook PCs, and 1.8- and 1.0-inch drives are used for small information appliances and mobile audio devices. Renesas has gained a significant market share supplying semiconductor devices for these HDDs. Among the products we have supplied are microcomputers with built-in flash memory, preamplifiers, motor drivers and buffer memory for HDD heads.

Until 1996 we offered these components as individual parts. In 1997, however, we incorporated a microcomputer and a hard disk controller (HDC) into a single-chip SoC device. In 2003 we increased the integration level by combining a microcomputer, HDC and read channel all onto one chip. That SoC now is a popular space-saving component in many 2.5-inch mobile HDDs.

High-speed read-channel IP boosts HDD performance

Figure 1 shows a block diagram of the SoC for a 2.5-inch mobile HDD. The chip, built with 0.15µm process technology, integrates a microcomputer, read-channel IP, HDC and ATA interface.

The high-speed read-channel IP is one of Renesas' strongest assets. We developed this powerful analog/digital circuit jointly with a major HDD manufacturer. It has outstanding readout and servo controllers, two key elements that allow HDDs to perform better and be more efficient.

Currently, Renesas is developing a SoC for 1.0-inch HDDs that will not use external DRAM as buffer memory. Instead the device will provide everything, including the buffer memory, on a single chip by using TCAM, a highly integrated on-chip memory compatible with the SoC process. This future solution will consume less energy and enable disk drives to become even smaller.

Precise manufacturing, accurate testing and exact control are essential

HDDs undergo extremely difficult system performance evaluations. Accurate data readout is essential, and drives must achieve very low corrected error rates, on the order of 10⁻⁷. Extremely precise design and

manufacture of the discs and read/write heads are required, as are excellent integration with—and close control by—the associated electronic circuits. Accurate testing is essential, too.

Supported by a research laboratory of Hitachi, Ltd. that develops disks and heads, Renesas has developed a system evaluation environment for read channels. We also have established an effective evaluation technology for HDD SoCs (figure 2).

Applying expertise to create advanced solutions

Because Renesas is an integrated technology device manufacturer (ITDM), we possess the all the resources needed to quickly develop and deliver the SoC prototypes essential for implementing improved HDDs. Applied technologies are a foundation of our design creativity.

To facilitate one important industry trend, we are taking advantage of the considerable application expertise we have acquired in the process of supplying various semiconductors for DVD recorders, digital video cameras and mobile telephones. Specifically, we're using this expertise to develop SoC solutions tailored for the HDDs needed to implement innovative digital appliance features.

For example, many products in the next generation of digital appliances will have to be able to handle streaming data such as video images. As a result, the HDDs in them will require capabilities different from the capabilities of the

(continued on page 24)

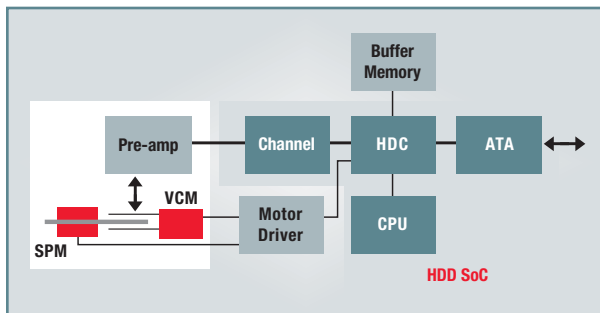


Figure 1: Renesas is a major supplier of the SoC used in 2.5-inch HDDs for mobile products.

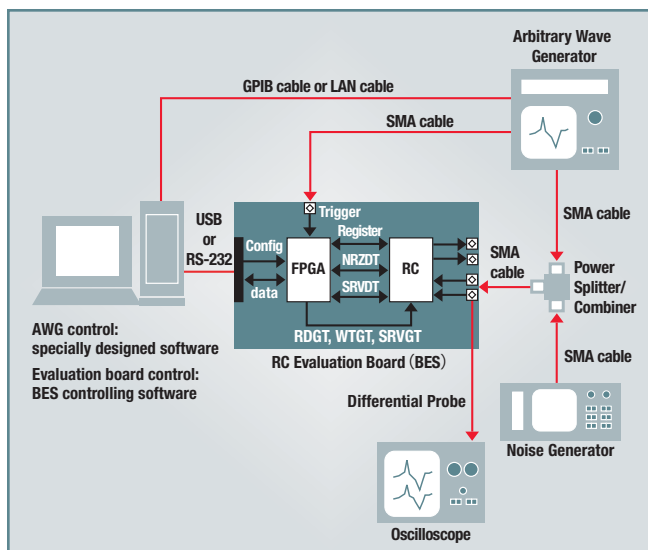


Figure 2: This test system was designed by Renesas to accurately evaluate HDD SoC devices.

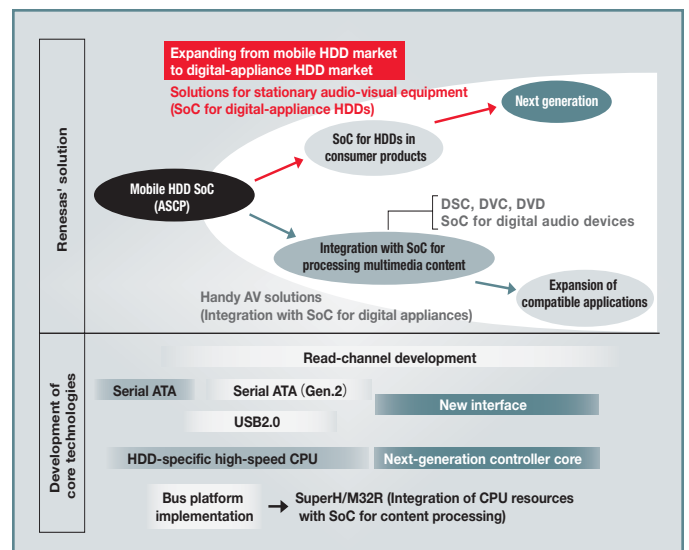


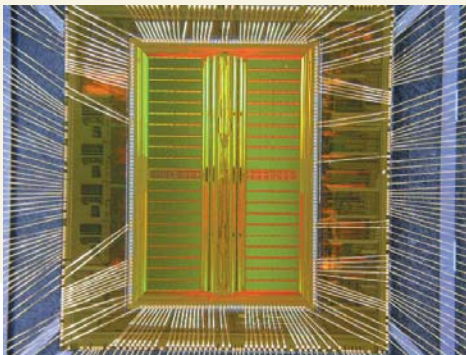
Figure 3: Development of Renesas solutions for HDD SoCs proactively anticipates market needs, while also responding to specific customer requests.



Masaki Yamakawa
Group Manager,
Image Processing Group,
Image Engine
Technology Department
Advanced Technology
Research Laboratory
Mitsubishi Electric
Corporation

DVP-M Series Devices Implement All Main Signal Processing Functions for Latest LCD TVs on a Single Chip — an Industry First

The image quality of LCD TVs continues to improve despite falling prices and broader product ranges. One reason for this is the rapid progress being made in the signal processing technology incorporated into LSI devices like the “digital video processor-multi” (DVP-M) series of video signal processing ICs jointly developed by Mitsubishi Electric and Renesas. These LSIs are the first to successfully combine all of the main



In the DVP-M series LSI device, 64MB of DRAM is layered using Renesas SIP technology.

signal processing functions for an LCD TV in a single chip. Their enhanced capabilities eliminate or greatly reduce the problems of blurred color and after-images previously associated with LCD screens.

One chip integrates the functions of up to six ICs

Flat-screen LCD TVs are an area of high consumer interest and the focus of intense competition among electronics manufacturers. Product lines are expanding and prices are falling, even as the picture quality and performance of these TV sets is improving. A tremendous amount of research and development effort is being expended to find ways to deliver more viewer satisfaction for less money. And that R&D effort is paying important dividends.

For example, five signal-processing functions are required for the LCD TVs currently being

developed at Mitsubishi Electric Corporation. Technologies for Y/C separation, noise reduction, and IP conversion are essential. Additionally, compression feed-forward driving (cFFD) techniques improve video responsiveness, while natural Color Matrix (NCM) technology provides natural color reproduction with vivid colors. The new TVs also incorporate other functions, two are which being developed by Renesas: support for text broadcasting systems from different countries and an LCD-panel timing controller (TCON).

Previously, it took from two to six separate LSI devices to implement these seven functions. To simplify TV designs and cut costs, Mitsubishi Electric and Renesas have collaborated to develop the “digital video processor-multi” (DVP-M) series of video signal processing ICs. These complex devices are the first in the world to provide all of the previously

mentioned technologies in single-chip solutions that deliver outstanding functionality and enhanced capabilities.

The DVP-M series LSIs eliminate or greatly reduce the problems of blurred color and after-images previously associated with LCD screens. Additionally, they save circuit-board space, cut power consumption, reduce parts counts and decrease overall cost. Figure 1 (below) compares the old design with the new one.

Applying the latest image processing technology

Technology for achieving a high-quality image is a key to gaining a competitive edge in TV manufacture. Mitsubishi Electric has acquired strong expertise in image reproduction and has applied its extensive LCD TV know-how throughout the DVP-M series.

One example relates to the depiction of diagonal lines, which has been a weak point for LCD TVs. Contour correction technology that analyzes the characteristics of diagonal lines is used to improve the sharpness of contours. Generally, the signal processing of diagonal lines has consisted only of comparing vertically adjacent pixels and checking along the time axis. The new video signal-processing ICs do much more. To improve the image, they apply technology that reduces edge widths by checking edge regions three-dimensionally,

(continued on page 25)

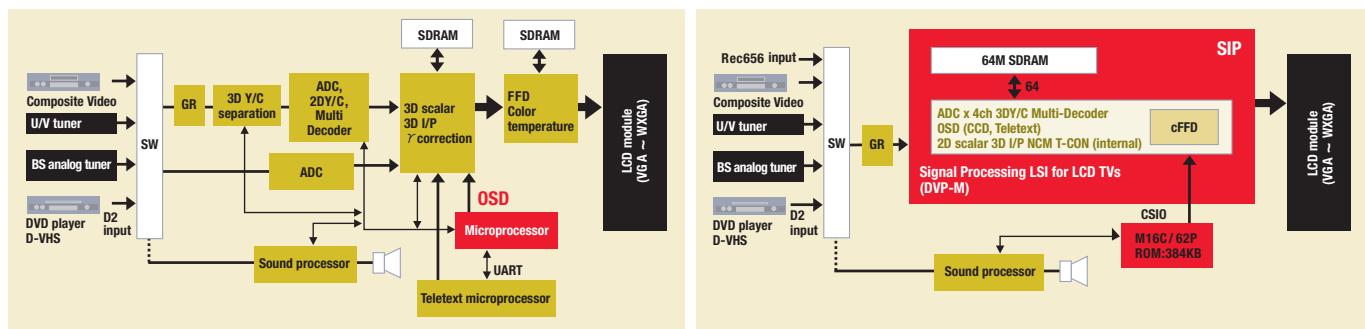


Figure 1: The diagram on the left shows the complex circuit used by previous LCD signal processing techniques. The simplified, performance enhanced implementation with a DVP-M device is on the right.

64MHz M32C/95 Group Microcontrollers for Automotive and Industrial Applications Launch Top-end M32C/90 Series in M16C Family

Offering twice the speed of chips in the M32C/80 group, these 32-bit devices have up to 768KB of flash, a three-channel CAN interface and many other peripherals

The M32C/90 series, the top of the range in the M16C family, comprise 32-bit CISC microcontrollers for automotive and industrial applications. The first product release consists of four 64MHz models in the M32C/95 group, which deliver twice the speed and more functionality than chips in the current M32C/80 series.

The new devices maintain the key advantages of the M16C family: highly efficient C language

support, strong noise immunity, low noise emissions, and low power consumption. To improve processing performance, their high-performance M32C/90 CPU core has new features, including a 32-bit arithmetic circuit, transfer instructions, and a barrel shifter for shift instructions.

The microcontrollers provide a three-channel CAN controller. One channel of this controller supports 32 message slots; the other two support 16 message slots. An on-chip non-stop debugging interface connects to an external debugger via a single unused pin. The devices' many other peripheral functions include 16-bit timers, DMAC, and A/D and D/A converters.



Left: 144-pin LQFP **Right:** 100-pin LQFP

Seven serial I/O channels provide LIN master support for systems equipped with communication functions. Two flash memory options are available: 768KB and 512KB. Development support includes the single-line non-stop debugger. The devices have 100-pin LQFP or 144-pin LQFP packages.

For more on M32C/90 series MCUs, visit:
http://www.renesas.com/fmwk.jsp?cnt=m32c95_root.jsp&fp=/products/mpumcu/m16c_family/m32c90_series/m32c95_group

Microprocessor with Internal Ethernet LAN Connection Function Simplifies Audio-Visual, Office Automation and Factory Automation Equipment

The SH7619, first single-chip device to include a MAC and PHY transceiver, is ideal for systems that offer 10/100Mbps Ethernet LAN connectivity

The SH7619, which expands the SuperH family, is a 32-bit microprocessor with an internal Ethernet PHY (physical layer) transceiver and Ethernet controller. It is an excellent choice for digital AV products, OA machines, and FA equipment that require a network connection function.

The new chip is the first Renesas microprocessor to incorporate both a media access controller (MAC) that complies with

the IEEE-802.3 standard and a PHY transceiver on a single chip. (Previously the PHY was a separate component.) Thus, the SH7619 simplifies the development of 10/100Mbps Ethernet LAN connection functions and reduces the system component count. The chip's SH-2 CPU core has a maximum operating frequency of 125MHz and is suitable for the high-speed processing of TCP/IP and other protocols.

The microprocessor also includes a host interface function (HIF) for connecting to other microprocessors. An on-chip debug function supports real-time debugging at the

chip's maximum operating frequency. Development tools include the E10A-USB emulator. The SH7619 is packaged in a small (13mm x 13mm) 176-pin BGA.

For more information on the SH7619 processor, please visit:
http://www.renesas.com/fmwk.jsp?cnt=press_release20041108.htm&fp=/company_info/news_and_events/press_releases



Power MOSFET Device Reduces Number of Components Needed in High-current DC/DC Converters

The HAT2210WP combines two MOSFETs in a low-thermal-resistance, WPAK-profile package; it can control 1.5x the output current of the HAT2210R device

The HAT2210WP power MOSFET enables the design of smaller DC/DC converters for notebook PCs, communication equipment, and many other types of products. The device contains two MOSFETs in a 5.3mm x 6.1mm package with a slim (0.8mm, max.) WPAK housing (Renesas profile code) that achieves high heat dissipation.

Heat generated by the power MOSFETs is transferred very efficiently to the circuit board from the heat-dissipating die pad on

the underside of the device. In fact, the thermal resistance of the WPAK profile package is half that of the SOP-8 profile package used by the previous HAT2210R MOSFET device. As a result, the new HAT2210WP device can safely control one-and-a-half times as much output current. System engineers can take advantage of this performance to reduce the number of MOSFETs in DC/DC converters that handle higher currents.

Also, because the HAT2210WP includes separate high-side and low-side transistors, it has separate drain connections. Both of the power MOSFETs are eighth-generation designs built with Renesas' latest industry-



Left: top **Right:** bottom

leading 0.35mm process. The optimized design of this power device emphasizes switching speed for the high-side transistor and low on-resistance for the low-side transistor. This makes it possible to obtain higher efficiency for the low-voltage side of the DC/DC converter.

For more information on the HAT2210WP power MOSFET, please visit:
http://www.renesas.com/fmwk.jsp?cnt=press_release20050421.htm&fp=/company_info/news_and_events/press_releases

4Gigabit AG-AND Flash Memories Can Record Large Volumes of Data at High Speed

The high-capacity flash devices attain a programming speed of 10 Megabytes/second, fast enough to record a two-hour movie in about two minutes using MPEG-4 coding

The R1FV04G13R (512Mbit x 8bit) and R1FV04G14R (256Mbit x 16bit) AG-AND flash memories achieve the world's fastest write speed: 10Megabytes/sec. Thus, the 4Gigabit devices enable high-speed recording of large volumes of data such as movies, motion video and similar multimedia content, as well as computer data files. For example, in approximately two minutes, one of these flash chips can store an entire two-hour movie formatted with MPEG-4 coding.

Beyond being the ideal large-capacity storage media for high-end digital still cameras and

silicon movie devices, the R1FV04G13R and R1FV04G14R will greatly expand the range of products that employ flash memory. They make it possible to use mobile terminals and digital home appliances for applications that previously had to be performed on PCs. They can store several Gigabytes in silicon audio recorders/players, for instance, and that capacity can be accessed conveniently via a high-speed USB2.0 interface.

Manufactured with a 90nm process and incorporating an improved AG-AND flash memory cell, the new products have the smallest chip size of any commercially-available 4Gigabit flash memory device. Despite having four times the capacity, the new chips are only 1.3 times the size of a 1Gigabit AG-AND memory.



They offer a 2Kilobyte power-on read function and provide a cache-program function during writing and a write-data-input function during erasing. The R1FV04G13R and R1FV04G14R use a NAND interface, so they are compatible with NAND flash memory at the command level.

For more information on these 4Gigabit flash devices, please visit:
http://www.renesas.com/media/products/memory/product_summary/flashe.pdf

New Users: SH-Mobile Application Processor Is Used in Handset and Latest FOMA Models from LG Electronics

Besides being adopted for successive LG Electronics' mobile phones for international markets, the SH-Mobile processor has been chosen for three manufacturers' 901i Series-3 handsets for the Japanese market

The SH-Mobile application processor has been selected for use in a GSM/EDGE handset produced by LG Electronics Corporation now on sale in the United States. (EDGE = Enhanced Data Rates for GSM Evolution, an enhanced data transfer technology based on GSM). Thus, there are now six different mobile phone models made by LG Electronics that use SH-

Mobile devices, including a CDMA handset and a GSM/GPRS handset released since July 2004.

In the Japanese market, Renesas SH-Mobile chips have also been selected for the SH901iC (made by Sharp Corporation), the F901iC (made by Fujitsu Corporation), and the D901i (made by Mitsubishi Electric Corporation) — three 901i Series-3 handsets for the NTT DoCoMo third-generation FOMA mobile phone service. These new handsets have been released progressively since December 2004. They provide long battery life: up to 570 hours of continuous standby opera-

tion (static) and 160 minutes of continuous communication time. Other features include a 260,000-color QVGA main color display, a 204Megapixel (max.) auto-focus digital camera function, and a seamless TV telephone function.

For more information on SH-Mobile application processors, please visit:
http://www.renesas.com/fmwk.jsp?cnt=press_release20041220a.htm&fp=/company_info/news_and_events/press_releases

New Company: Renesas Design Corporation (RDC) Has Been Established

In April 2005, two Renesas organizations — RLD, which focused on microprocessor design, and RDD, which focused on SoCs and mixed-signal design — merged, forming RDC

On April 1, 2005, Renesas combined two of its design businesses — Renesas LSI Design (RLD; head office in Itami, Hyogo Prefecture; President: Mamoru Iwatsuki) and Renesas Device Design (RDD; head office in Itami, Hyogo Prefecture; President: Kanichi Harima) — into a new company called Renesas Design (RDC;

head office in Itami, Hyogo Prefecture; President: Kanichi Harima). This reorganization strengthens our system solutions business and improves the efficiency of our semiconductor design activities.

Previously, RLD and RDD had operated as independent design companies. RLD had focused on microprocessor design, while RDD had concentrated on the design of SoCs, mixed-signal chips, and other devices. The merger of these operations into RDC aids personnel exchanges and facilitates the sharing of design expertise,

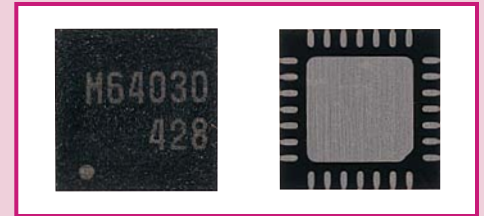
thereby enhancing Renesas' overall system solutions capabilities, improving quality, and shortening engineering cycle times.

The main areas of business for RDC include the design and development of microprocessors, SoCs, mixed-signal and similar technologies; the development of CAD technology; and the design and development of advanced semiconductor manufacturing and testing equipment. The new company has 800 employees.

FOCUS ON: Blue-Violet Laser Diode Driver

M64030FP Provides the Fast, Stable and Precise Writing Control Essential for Accurately Storing Content on Blu-Ray Disks

Optical disk drive manufacturers want new models to read and write at higher speeds and densities, so they require a driver IC for the laser diode that delivers both a fast through-rate and great precision. To meet this need, Renesas has introduced the M64030FP, a laser diode driver for use in optical pickups for Blu-ray Disks (BDs). The IC drives a blue-violet laser diode and has a new waveform-correction function that enables a high through-rate: 0.8ns or less. Using an internal write-strategy circuit, it achieves high-precision writing.



M64030FP: Top (left) and bottom (right)

Through-rate is about 50 percent better than previous Renesas drivers, for stable writing performance

Blu-ray Disks (BDs) illustrate the trend to optical disk drives that can read and write at higher speeds while storing more data. The BD standard specifies a storage capacity of 25GB on single-layer disks, or 50GB on dual-layer disks. The characteristics of the 405nm wavelength blue-violet lasers used in such high-density disks make it more difficult to achieve the required through-rate (the time required for the waveform to rise or fall) than is the case for infrared lasers and red lasers with a wavelength of 780nm. This makes it very hard to increase the speed and precision of the drive.

To solve this problem, Renesas has applied the high withstand voltage technology and high-speed circuit capability accumulated over many years to produce the M64030FP. This laser diode driver for BD drives significantly improves the through-rate of blue-violet laser diodes and has a high drive capacity for

handling future double-speed and double-layer disks. The driver incorporates a newly developed waveform-correction function that improves the through-rate to 0.8ns or less, based on Renesas test results. Compared to the performance of previous Renesas models without a waveform-correction function, this through-rate is about 50 percent better, for stable writing performance.

A feature of the waveform-correction function is that it permits the through-rate to be controlled flexibly via a serial interface. This makes it relatively easy for engineers to implement methods for suppressing two optical-waveform problems that previously have challenged the development of optical pickups for BD drives:

- Waveform overshoot—the waveform temporarily goes past the target level on the rising or falling edge of a pulse. Overshoot causes excessive heating to occur in a specific region. That, in turn, causes a loss of writing precision and deterioration of the write endurance for rewritable disks.

- Ringing—a short-duration oscillation in a region of the waveform where a sharp change occurs, such as on the rising or falling edge of a pulse. Like overshoot, ringing causes a loss of write precision.

Multiple functions contribute to high-precision operation

The M64030FP supports a 132MHz data clock and delivers a maximum output current of 350mA. Moreover, it is designed to enable the use of higher speeds and densities in the future. This sophisticated device provides the following function elements for reading and writing:

- A high-frequency current-superposition circuit that reduces laser noise during reading in the optical pickups used with single-mode lasers that read BD, DVD, MD, and CD-RW media. This circuit can generate a current output with a frequency of 250MHz to 500MHz for writing.
- An automatic power control (APC) driver that compensates for variations in the relationship between the drive current and output power of the laser diode caused by factors such as temperature and time. The APC driver uses feedback to adjust for these changes, ensuring that the output power remains constant. It supplies a stable laser drive current based on the signal from the analog-front-end IC.
- A 32-phase write-strategy function that supports double-speed 132MHz operation for high-precision writing. Because heat is used for recording, this function improves the ability to store a signal on the disk by using multi-pulse modulation of the laser output. Specifically, five drive signals are generated within the M64030FP, based on a single input signal. This eliminates need to synchronize input signal delays during system design and saves design time.

M64030FP Specifications

Parameter	Specification	Remarks
Name	M64030FP	
Power supply voltage	2.5V ± 0.25V, 5V ± 0.5V, 7V to 9V	The 7V to 9V power supply is for the anode voltage of the laser diode and also for the withstand-voltage protection circuit for the laser diode connection terminal.
Supported laser types	Floating type	Connect the laser's cathode to the driver and the anode to the power supply.
Maximum write strategies		
• Operating freq.	150MHz	
• Through-rate	0.8ns or less	(based on Renesas testing)
Laser diode drive current	Write: 200mA, max. Servo: 150mA, max.	
Package	28-pin QFN, 5mm x 5mm	

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Partner Visits

QNX Software Systems

Supporting the Ongoing Progress of CIS, QNX Neutrino Is a Microkernel Architecture Real-time Operating System

QNX Software Systems (hereafter abbreviated as QNX) is a real-time operating system (RTOS) vendor based in Ottawa, Canada. The company has been supplying the QNX RTOS, with its microkernel architecture, since 1980, mainly to the North American market. Its Japanese subsidiary, QNX Software Systems Kabushiki Kaisha, is the company's first base in the Asian region and was established in June 2000.

The headquarters organization has had a partnership relationship with Hitachi America Ltd. since 2001, and that relationship has continued with Renesas. In fact, it is being strengthened by a QNX support team at Renesas, whose activities include conducting regular meetings covering car information system (CIS) designs.

QNX delivers POSIX compliance, microkernel architecture, RTOS, and universal process model

According to Mr. Harashima, "For CIS applications and a myriad of others, the QNX

Neutrino RTOS has many desirable features, including POSIX (Portable Operating System Interface for UNIX) compliance, a microkernel architecture, real-time OS, and universal process model." Currently, the Renesas SH7750, SH7751, and SH7760 processors are supported and QNX plans to add support for more processors on the Renesas technology roadmap.

POSIX, defined in the IEEE-1003.1 standard, is a UNIX system interface that increases the portability of application software. The microkernel architecture, the bedrock RTOS design concept QNX has maintained for 24 years, "keeps the core part of the operating system as small as possible and provides the many other OS services separately from the core. Thus, functions can easily be enhanced and OS can evolve continuously while the same architecture is retained," Mr. Harashima explained.

The universal process model dictates that each process run in a full memory management unit (MMU) environment. The memory for each process is protected and processes cannot interfere with each other. Accordingly, the RTOS is sufficiently robust that modules can be added or replaced while the system is running. There is no risk of the overall system

PARTNER PROFILE:**Location:**

4F, KB-6
Building
6-banchi, Sanbancho, Chiyoda, Tokyo
102-0075

Established: June 2000

No. of Employees:

6 (as of Dec. 2004)

URL:

<http://www.qnx.co.jp>

Harashima Takeshi

Sales Manager,
QNX Software Systems
Kabushiki Kaisha



crashing, even if a specific module hangs up.

Mr. Harashima believes the QNX Neutrino RTOS is suitable for CIS applications for future cars. "Currently, car navigation systems are installed as standalone systems. In the future, however, they are likely to be integrated into the central console of the

(continued on page 26)

Microsoft Corporation

Offering High Development Productivity in Screen Design, Windows Automotive v.4.2 Is OS Choice for an Increasing Number of CIS Products

Microsoft supplies the Windows CE and Windows CE Embedded operating system (OS) products for use in embedded devices and has long supported the SuperH family of processors. One element in its product range is Windows Automotive v.4.2, a special-purpose OS based on Windows CE. Announced in 2003 to facilitate the rapid progress in car navigation systems typified by the adoption of high speed graphics, it has been successfully implemented in a growing number of systems.

The high development productivity that is a feature of Windows has been recognized as a big advantage for CIS and car navigation system development. The latest Windows Automotive v.4.2 includes communications drivers and multimedia middleware such as user-interface design tools and map-drawing functions that utilize high speed graphics. These ease application development projects, particularly those that require considerable reworking of screen designs.

Takatoshi Shimizu, who has been responsible for Windows Automotive v.4.2 in Japan since 2000, said that "once the use of 3D graphics for map drawing appeared, customers (manufacturers of car navigation systems) started to realize how much Windows Automotive v.4.2 could reduce development costs while maintaining real-time performance. Windows Automotive v.4.2 is well recognized as a general-purpose OS with the functions required for the

PARTNER PROFILE:
Headquarters:

Odakyu Southern Tower
2-2-1, Yoyogi, Shibuya, Tokyo
151-8583

Established: 1986

Capital: 495.5 Million Yen

Employees:

1,560 (As of July 12, 2004)

URL:

<http://www.microsoft.com/japan/>

Takatoshi Shimizu

Senior Account Manager
Automotive Business Unit
Device Solutions Sales
Microsoft Co., Ltd.



next generation of car navigation systems. Five different car navigation products that use the OS were demonstrated at the 11th World Congress on ITS held in Aichi, Japan in October 2004."

AUITK tool makes screen design more efficient; design guidelines help engineers obtain best system speed

One reason for the increased development productivity of Windows Automotive v.4.2 is the Automotive User Interface Toolkit (AUITK), which enables the flexible design of user interfaces. It consists of an API and development tools for creating user interfaces and screen designs.

(continued on page 27)

International Network: Part 6. Design Center in Vietnam

Renesas Design Viet Nam Co., Ltd.

Renesas Design Viet Nam Co., Ltd. (RVC) was established in Vietnam in October 2004. It operates as one of our global design centers, designing core system LSI products. With a focus on strengthening system solutions, it plans to secure more than 1000 technical employees by 2010. For this article we interviewed RVC's President, Mr. Sato, who said that his company will implement a 3-year plan to create a "zero defective design" environment from an international perspective.



Sato Tsuneo
President and CEO
Renesas Design
Viet Nam Co., Ltd.

Why did you establish a semiconductor design company in Vietnam?

Sato: One of the core operations of Renesas is a system solution business focused on three markets: automobiles, mobile products and PC/AV devices. To be successful in this business we need a development staff that can integrate LSI hardware design with suitable software design. Japan's working population has started to decline and will continue to do so. That will make it very difficult to hire enough talented engineers within the country.

Recognizing this situation and being committed to expanding our system solution business, Renesas management determined that it was necessary to find ways to address three challenges:

1. Respond to a predicted absolute shortage of talented human resources
2. Become more efficient at developing system LSI devices, even as the chips grow increasingly complex
3. Invent improved techniques for creating system LSI chips.

Our solution was to establish the new company, Renesas Design Viet Nam Co., Ltd.

(RVC). RVC recognizes that resolving these challenges is its major commitment.

Why did you choose Vietnam for the design center?

Sato: The major reason for choosing Vietnam is the people. Generally speaking, the Vietnamese people are as earnest and hard working as the Japanese. We believe that RVC's engineers should be "assertive, ambitious and attentive" and Vietnam can provide personnel with these traits. In addition, the nation offers the following advantages:

1. A high level of education, as evidenced by the country's high literacy rate, over 90 percent
2. A labor population with many younger people
3. A stable social foundation supported since the 1990s by the Doi Moi policy
4. A government-led core investment policy for the high-tech industry

Considering these factors, we concluded that Vietnam has enormous potential to develop its intellectual industry in the future.

What are RVC's corporate policy and strategies, and what specific role is the company taking within the overall operations of Renesas?

Sato: With "Accuracy, Quality and Innovation" as our corporate policy, we will expand our businesses by engaging principally in logical design and verification, based on the latest design tools and the accurate design techniques demonstrated by our Vietnamese engineers. We believe that RVC will be able to support the overall development of Renesas' system solutions in the future and will take on a major role in the expansion of our global design operations.

Which fields are RVC focused on? And what is the organizational structure of the new company?

Sato: We are primarily focused on the design of SoC products for three markets: digital consumer goods, mobile telephones and vehicles. However, we are also considering partially including the design and development of product lines such as microcomputers and mixed-signal (MSIG) semiconductor devices.

RVC's design department is the core of our organization and we will assign many workers to both hardware and software design activities. Additionally, we want to set up both a business planning group and an IT infrastructure development group that will prepare us for future technological innovations.

As for our organizational structure, we want to develop a human resource training plan so that our design operations can be performed as soon as possible, primarily by Vietnamese employees rather than by Japanese loan employees. Consequently, we will be able to establish a corporate culture that reflects the local culture.

What are your ambitions and your goal for RVC?

Sato: RVC is the first company specializing in semiconductor design in Vietnam. To recruit many talented Vietnamese engineers, we are working with major colleges and universities in Ho Chi Minh City and Hanoi to open courses that will be sponsored by Renesas. We are also proposing training programs that are focused on the future. For example, we collaborated with the Ho Chi Minh City University of Technology in Ho Chi Minh City to establish a special design course for the SuperH product family. Through these and other activities, RVC aims to go beyond the boundaries of Renesas and nurture semiconductor design as one of Vietnam's core industries.

As for our goal, RVC is aiming for zero-defect design. Based on the three-year plan formulated to achieve this goal, we want to build a comprehensive structure for system LSI design from a global perspective.

“Japan Micom Car Rally 2005” — Grand Prix for Self-running Model Cars

“Japan Micom Car Rally 2005 – Grand Prix” was held on a specially set-up race course at NTT Hokkaido Seminar Center (Chuo Ward, Sapporo City) on January 8 and 9. In the rally, handmade self-running model cars equipped with individually programmed microcomputers ran on a 60-meter racecourse, competing for the best time. Race outcomes were determined not only by the cars’ hardware, such as their shapes and balance, but also by their software, which had to generate fast and accurate steering movements. Renesas supports this activity and the other events leading up to it by giving key system components to schools: controller boards that contain an H8/3048F, a 16-bit microcomputer with F-ZTAT flash memory.

The Grand Prix was divided into two groups: adults and high-school students. This is the final battlefield for extremely strong opponents who have devoted themselves to perfecting their microcomputer-controlled cars and who have won preliminary races in various locations.

This year celebrated the tenth anniversary of the rally. To mark this significant milestone, two new races and a special event augmented the regular races.

In the “New Regulation Race,” only one car out of 37 competitors finished the entire distance. The winning autonomous vehicle had to successfully overcome the T-junction, Y-junction and lane-change challenges that were added to the regular racecourse, thereby demonstrating extremely high navigation skills and good control techniques.

In the “Drag Car Race,” the model cars had to win speed contests as they roared down a 25-meter straight course. Here the main difficulties were controlling the accelerating microcomputer cars and also starting and stopping the cars while maintaining good maneuverability.

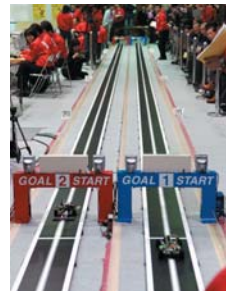
The “Mini Micom Car Race,” the special event added to the rally, was a fun activity in which 26 elementary and junior-high-school students

from all over Japan gathered with their parents and spent a whole day building microcomputer controlled cars. High-school students guided the construction efforts. The following day, the newly constructed cars competed on the standard rally racecourse. It was rewarding to see the young students work together with their parents to build cars, and pleasant to see them looking so pleased after the rally.

Through the Japan Micom Car Rally and other similar events, Renesas continues to offer the younger generations enjoyable opportunities to experience embedded systems. These activities help young people become familiar with and excited about the basics of the electronics that will enable the forthcoming ubiquitous networked society.

See page 26 for a complete list of race winners, or review the race results and details at:

<http://www.renesas.com/jpn/society/carrally/index.html>



Semi-annual European Trade Show: “electronica 2004” Exhibition

The “electronica 2004” exhibition, a biennial exhibition of electronic components and the largest of its kind in Europe, was held November 9-12, attracting about 75,000 visitors to the Trade Fair Center in Munich, Germany. A special semiconductor section was set up in Hall A5, where Renesas had a product display. Our main focus for the European market was on microcomputers and solutions for mobile phone and automotive applications.

Specifically, in the field of mobile telephones, we highlighted total solutions based on key elements from our wide range of advanced semiconductor products. These included the SH-Mobile application processor, which addresses the needs of the multimedia applications driving the spread of 3G mobile phones; our LCD driver/controller devices, which support color LCDs; and our RF devices, which are the most popular choices for GSM phones.

In the field of automobiles, our solutions for in-car communications systems received much attention because Renesas had just joined the AUTOSAR (Automotive Open System Architecture) alliance and adopted FlexRay. At the exhibition, we showcased advanced automobile solutions and technologies via demonstrations for FlexRay, CAN/LIN and Safe-by-wire.

Visitors to electronica 2004 were clearly interested and satisfied with the show. According to a questionnaire distributed to visitors and participants, 85 percent of respondents indicated that they benefited from the event.

Generally speaking, the primary objective of industrial exhibitions in Europe is to have business meetings in booths on the exhibit floor. We believe that the marketing campaign we launched in Munich will further expand our successful international business operations.



Renesas CIS Solutions: COMET Consortium

(continued from page 15)

Like COMET in the USA, members of the consortium in Japan will provide operating systems, middleware, and similar solutions, while Renesas focuses on chip development and platform development. However, rather than treating operating systems and middleware as separate components, the consortium will supply them as part of a platform to deliver a system solution. Customers will be able to acquire from the Japanese COMET consortium an efficient development environment without having to produce their own, saving time and expense.

The system integrators in the consortium will provide support, consultations, custom software development, and similar services. In some cases, Renesas customers they may ask them to help set up a platform. There are significant advantages to this. In particular, an integrator can optimize the platform to suit the exact requirements of a specific application. Also, it can apply experience from previous CIS projects to aid the development of custom software. Moreover, customers that work with a system integrator can obtain end-to-end support, from initial consultations when the system is being conceived, right through to support for development of the production system.

COMET Consortium will be set up in Europe, too

Because Europe is another important region of the automotive industry, Renesas logically has begun to set up a COMET consortium there, as well. By sponsoring a support structure that covers America, Japan and Europe, the three main CIS markets, we are enhancing our global support network. Our customers can take advantage of this seamless worldwide coverage when they expand overseas. Additionally, the multi-national, multi-faceted COMET group will provide a distribution and support structure that transcends regions for products offered by members of the consortiums.

CIS: Overview and Renesas perspective

A car information system can be thought of as a representative device for a society based on ubiquitous networks. A CIS product can incorporate advanced functions from a range of fields, including mobile and other communication functions; digital consumer electronic functions such as DVD, music and TV; and, in the future, various functions affecting vehicle operation.

The expectations for the semiconductors used in CIS products continue to grow, not just in terms of device improvements but also in relation to collaboration with other fields. Clearly, semiconductors are carving out an ever more important role in the automotive industry.

The many advanced solutions Renesas provides for the CIS sector are based on the latest technology and incorporate the considerable in-depth knowledge we have accumulated serving many different markets. We will continue to utilize our strengths to contribute to the march of progress in CIS applications. Our chips will help bring increased levels of safety and convenience to drivers and passengers, wherever they may be.

System Solutions: High-performance SOC for Mobile Hard Disk Drives

(continued from page 16)

drives in personal computers. Using our accumulated application knowledge, we are working to optimize HDD SoCs and promote their integration with other semiconductor chips in ways that ensure the fast processing of multimedia content.

One goal of the Renesas system solutions team is to proactively offer innovative and enhanced devices that support customers' product development projects. Figure 3 on page 16 highlights our current development programs. Our fast response gives customers a big advantage in markets that change rapidly.

For more information on HDD SoCs, please visit:

http://www.renesas.com/fmwk.jsp?cnt=digital_home_category_landing.jsp&fp=/applications/digital_home/&site=i

R&D: DVP-M Series Devices for Latest LCD TVs

(continued from page 17)

including diagonally adjacent pixels. The image comparison below shows the resulting gain in image quality.

Another example of Mitsubishi Electric's expertise is the use of cFFD technology to improve responsiveness and deal with the problem of after-images caused by the display screen's slow response speed. According to Masaki Yamakawa of Mitsubishi Electric's Advanced Technology Research Laboratory, "The cFFD technology optimizes the voltage applied to the LCD to boost response speed by comparing the 'before' and 'after' images when a change in image content means that a quick response is required. The result is a response speed of 12 to 14ms, which improves after-image performance to a realistic level. The cFFD technology also uses image compression techniques to reduce the required memory size to a level that makes it possible to integrate the circuitry on a single chip."

Another feature of DVP-M series is that the devices provide video interfaces for three different broadcast standards: NTSC, PAL and

SECAM. This simplifies the process of developing LCD TVs for different regions of the world.

Three device types — all single-chip implementations

To enable a wide range of end uses, from standard to high-end TV models, the LSI product range is split into three separate types of signal-processing devices:

- DVP-M devices are high-end chips that support W-XGA panels. They deliver maximum image quality because they use 3D processing for the Y/C separation, employ cFFD technology and have noise-reduction and IP-conversion functions. The DVP-M devices have 64Mbit of DRAM and are built with the proven Renesas solution integration product (SIP) technology.
- DVP-MT versions support XGA panels, so they have fewer features and only 16Mbit of DRAM. They're also built with Renesas SIP technology.
- DVP-ML versions offer the most basic set of features.

All devices in this product line have the same pinouts for complete mechanical compatibility. Mr. Yamakawa commented that "because the chips are pin-compatible, a common platform (circuit board) can accommodate all three models in the DVP-M series. This reduces the cost and shortens the time required to develop a wide range of LCD TVs, from standard models to premium products."

The Renesas SIP technology that makes the pin compatibility possible has the added benefit of reducing the amount of wiring on the circuit board. In turn, this reduces issues related to electro-magnetic interference (EMI), easing system design.

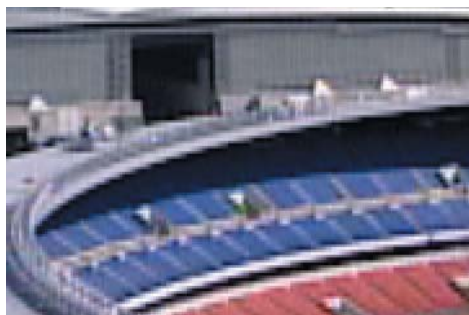
Successful product launch spurs additional development

The DVP-M series has enjoyed an encouraging start, having already been selected for use by a number of customers. A new DVP-MW device that supports dual display screens is currently under development. Additional research and development is progressing on an LSI for the large, high-quality LCD TVs that will become customers' flagship models.

Having established a successful collaboration, Renesas and Mitsubishi Electric will continue to work to facilitate the evolution of LCD TVs. Both firms are contributing their expertise for tuning the parameters of advanced DVP-M chip implementations.

For more information on DVP-M series devices, please visit:

<http://www.renesas.com>



There is a substantial improvement between the image on the left, produced by the previous vertical interpolation processing technique, and the one on the right, produced with the contour correction technology provided by the DVP-M series signal processor. IP conversion processing technology with diagonal line recognition smooths diagonal lines.

Focus On: Blue-Violet Laser Diode Driver

(continued from page 20)

(By contrast, a laser diode driver without a write-strategy function mandates that the five pulse currents be output by five drivers in the IC, each of which must be controlled by a signal external to the IC. This complicates system design, due to the need to allow for the delay that occurs in the circuit board for each signal.)

- The high-speed laser driver circuit required for accurate writing using the high-precision/high-speed write-strategy waveform. The improved write precision the device achieves is another benefit that helps shorten the development time of optical disk drives.

- Other functions that simplify system design, including an input data-compensation function and a superposition amplitude-compensation circuit.

Small package offers good heat dissipation capability

To aid mechanical design and ease system packaging tasks, the M64030FP blue-violet laser diode driver is supplied in a small (5mm x 5mm) 28-pin leadless QFN package with good heat dissipation efficiency. Renesas plans to continue to respond to market needs by developing advanced

products that deliver even higher precision and can control yet faster laser diodes.

For more information on this laser diode driver, please contact sales personnel at Renesas. Note that the datasheet and other specification documents for the M64030FP include information from the BD Rewritable Standard, which is published by the Blu-ray Disc Association (BDA). Therefore, Renesas can only supply specifications to customers that have entered into the Blu-ray Disc Information Agreement and have obtained a Blu-ray Disc Rewritable License.

Partner Visits: QNX Software Systems

(continued from page 21)

vehicle. If our OS is used in various vehicle systems, individual systems can be merged more easily, taking advantage of existing resources. Although other OSs can be used in standalone systems, I believe that the QNX Neutrino RTOS is the only one that allows existing systems to be transferred without modification when separate systems are combined.”

Future CIS systems with a CAN interface will exchange data actively with the ECU and other vehicle systems. “One advantage we offer is that other OSs that incorporate a MMU typically take a number of seconds to boot. By contrast, the QNX Neutrino RTOS supports CAN using a mini-driver that executes before the OS boots,” Mr. Harashima said.

QNX Momentics Development Suite aids system development

The QNX Momentics Development Suite (figure 1, right) is a set of development tools developed at an early stage by Eclipse. “It is currently gaining popularity as an environment for the development of embedded applications,” said Mr. Harashima, “because the suite provides many advantages, including a common user interface for all supported development hosts.”

The IDE workbench is constructed from the Eclipse framework and runs on the OS. The various tools provided by QNX Momentics and other tools supplied by third-party vendors form a layer on top of this, where they can be used together in an integrated environment.

Tools available from QNX include C/C++ and Java code developers, target data, system builder, source debugger, profiler, memory analysis tool, Photon application builder, code coverage tool, and system analysis tool.

The target system is connected to a PC via Ethernet, serial, JTAG, ROM monitor, or other means. Then debugging is performed via a target agent that runs as a single QNX Neutrino process. A number of different Renesas processors are currently supported,

including those in the SuperH family. Reference boards for each supported processor are also available through the BSP (board support package). Operation can be tested on reference boards from a wide range of board vendors and other sources to select the product that best matches the development system.

Renesas’ partnership with QNX gives CIS manufacturers and other system developers yet another way to explore and expand the vast application possibilities for our microprocessors.

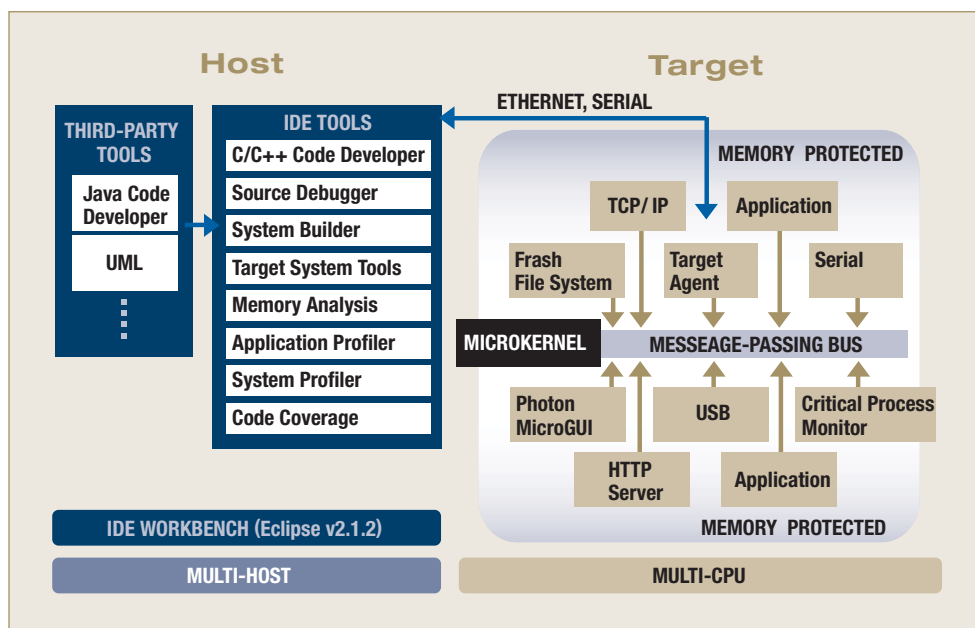


Figure 1: QNX Momentics Development Suite

TOPIX: Japan Micom Car Rally 2005

(continued from page 23)

Winners of the races:

Japan Micom Car Rally – High School Students

First place: Takumi Mizuno
(Isogo Technical High School, Kanagawa)

Japan Micom Car Rally – Adults

First place: Ichiro Nakao
(individual entry)

Drag Car Race

First place: Yoshihiro Takida
(Dept. of Computer Science, National Defense Academy)

New Regulation Race

First place: Junya Tanaka
(Gifu Technical High School, Gifu)

Mini Micom Car Race

First place: Kazutaka Kimura
(2nd grade at Hakuho Junior High School, Katsuragi, Nara)

To review the race results and details, please go to the following website:

<http://www.renesas.com/jpn/society/carrally/index.html>

Partner Visits: Microsoft Corporation

(continued from page 21)

AUITK allows the user interface to be modified easily by changing the SKIN portion (figure 2, right). Even if the screen design in factory installed car navigation systems doesn't have much effect on system performance, it can be thought of as part of the car's interior design. Using AUITK, engineers readily can alter screen designs in major ways, tailoring them for each model of car.

For example, changes such as "making border lines one dot thicker" or "making the font one size larger" would previously have required program modification work, raising development costs. Using AUITK, though, the user interface design created on a PC can be reproduced easily on the target car navigation system, and it takes little work to make skin modifications without program code change. Also, functions such as animation, alpha blending, rotation, and slide-in are already provided, so screens can be presented in a diverse ways.

Maintaining real-time performance in the end product is an important issue for car navigation, and Microsoft provides basic design guidelines that lift baseline performance. Those design guidelines show how to manage the Windows Automotive v.4.2 thread list, for example, and provide many other insights.

"The fact that the Windows Automotive v.4.2 code itself has adequate real-time performance has been proven by published figures. For optimum performance, the customer's applications, middleware, and other software must run in harmony with Windows Automotive v.4.2. The overall thread priority order within the system has to be tuned with consideration for processing latency, so multiple threads can

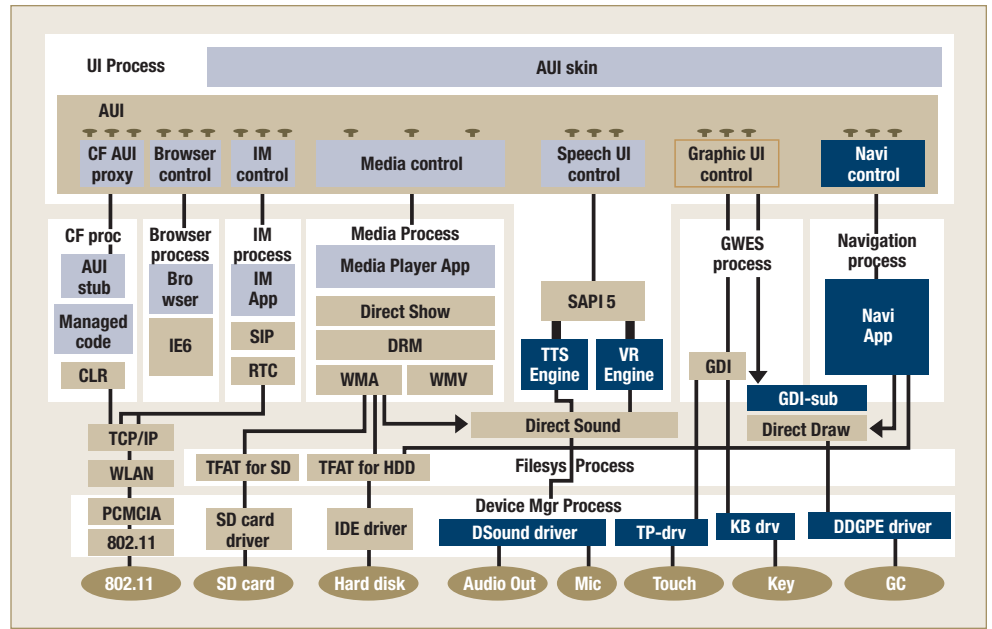


Figure 2: Typical software configuration using Windows Automotive v.4.2

execute as fast as possible. Development can proceed very smoothly if users refer to the recommended values in the design guidelines when performing this tuning," Mr. Shimizu explained.

Microsoft and Renesas cooperate to enable better graphics performance

To support the increasing use of high-speed map drawing, Microsoft has cooperated with Renesas to provide the GDI-Sub, sub-set interface of Windows GDI graphic library. This interface has been tuned to enable applications to access the graphics processor directly for even smoother playback.

"Our aim is to be recognized by customers as the OS that is easiest to use and the one that provides the most development flexibility for the next generation of car navigation systems. We are currently working to include support for the SH7770 in the next version of Windows Automotive," Mr. Shimizu said.

A reference platform that runs the complete Windows Automotive v.4.2 module efficiently on a reference board is available now. A development platform for the SH7770 will be provided to support the emergence of a new generation of car navigation products.



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