New Information Technologies to Achieve Next-generation Telematics Portals

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OVERVIEW: Telematics services have become increasingly popular recently, and various types of telematics systems are expected to rapidly integrate to increase the value of services and to reduce system operation costs. Also, telematics systems, that connect car manufacturers and car users directly, are going to be connected to sales systems and production systems to provide a pillar of information strategy to car manufacturers. Hitachi, Ltd. is considering telematics agent to integrate heterogeneous systems, an advanced HMI (human-machine interface) that is exclusive to cars, advanced navigation systems, the applications of car information, and an open interface between car terminals and telematics portals as key technologies for next-generation telematics services and terminals. It is currently engaged in the development of these technologies.

INTRODUCTION

TELEMATICS is providing services to car drivers through cell phone communication and second-generation telematics services are now starting to be used. Nissan Motor Co., Ltd. started to provide its integrated telematics services that greatly increased the convenience of drivers' operation and reduced membership fees. Other major car manufacturers are planning to start new services that are similar to this.

Hitachi is now developing a system for second-generation telematics services and has started developing information system technologies for third-generation telematics services. In the 3rd generation, end-users will require further high-value services and many telematics systems and ASPs (application service providers), that are now operating, may be integrated to reduce system operating costs. In addition, telematics systems that are directly connected to cars and that are an effective means of gathering end-user information will be connected with the sales and production systems of car manufacturers playing a pivotal role in the strategy for ITs for each car manufacturer. The information gathered from end-users will influence car design, car production, and

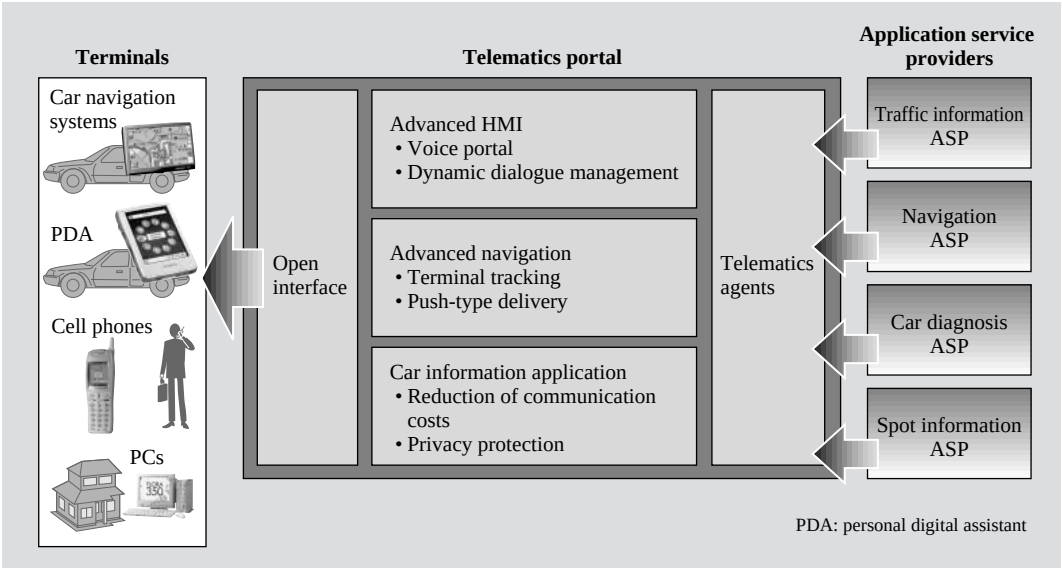

Fig. 1—Telematics System Architecture. Information content is gathered from various ASPs, appropriately edited and processed in accordance with car situations (e.g. driving conditions, road conditions and condition of car, etc.) and private information, and provided to users.

car sales promotions.

In this paper, we introduce various advanced core technologies that Hitachi is developing for the next-generation telematics systems (see Fig. 1). These are as follows:

(1) telematics agent technologies that can integrate different kinds of systems,

(2) highly advanced HMI (human-machine interface) that increases safety of drivers,

(3) highly advanced car navigation systems that predict traffic jams,

(4) applications of car-control information such as driving situations, and

(5) openness technologies that can connect various car terminals and telematics portals.

TELEMATICS SYSTEMS

Telematics portals that have been developed by different companies and different types of industries will be integrated in the next-generation telematics systems. In addition, a telematics portal will take root in the information system of each car manufacturer as a business strategy system to increase car sales. These two directions are explained in this section.

Integration of Various Telematics Portals

Hitachi has been developing service integration technologies, which integrate ASPs providing different kinds of services and high-value services to end-users, and we have defined the interface specifications to connect a telematics portal with ASPs[1]. We have also developed new technologies to expand services and introduce seamless technologies that provide services to different kinds of terminals. We have also evaluated the effectiveness of developed technologies[2].

Recently, most of Japanese car manufacturers started telematics services and are operating telematics systems. However, the expense involved in operating these systems is a serious problem for each company. New companies in different industries who are not car manufacturers are now also starting telematics services and the telematics systems for these companies will be integrated to reduce the costs of operating the systems and increase the value of services (see Fig. 2).

To provide high-value and low-cost services to end-users through connecting them to telematics portals, we need various kinds of ASPs, and each company's car terminals. We also need "telematics agent" technologies that gather and deliver appropriate services in accordance with each end-user's situation giving consideration to their safety.

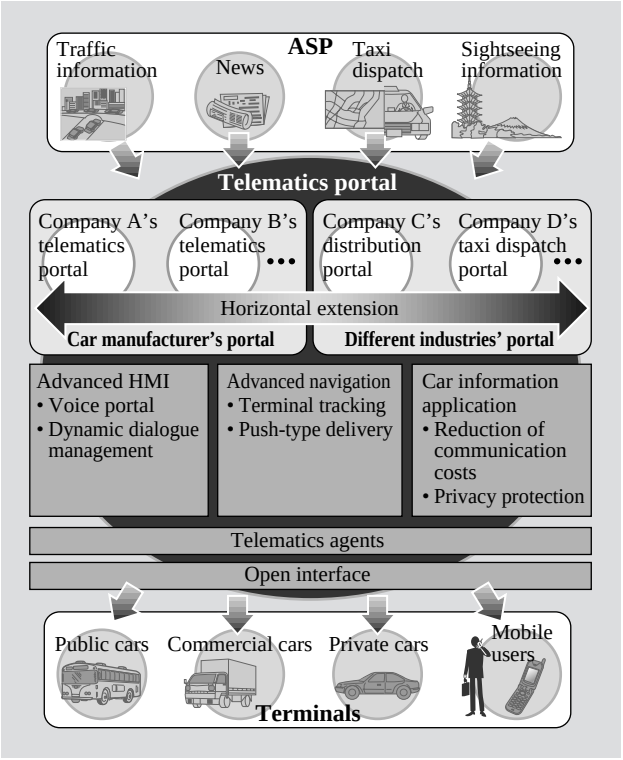

Fig. 2—Integration of Various Telematics Portals. Car manufacturers' telematics portals and the systems of different industries will be integrated.

Integration of Production, Sales, and Services

The efficiency of a whole system including product processing, sales, and distribution is increased through BPR (business process re-engineering) in manufacturing systems such as car manufacturing systems. However, each manufacturer struggles with CRM (customer relationship management) in understanding the requirements of end-users and how to reflect these requirements in sales promotions. Hitachi developed various kinds of technologies to achieve BPR and CRM, and to meet requirements of manufacturing companies[3].

Telematics services are started through the initiative of car manufacturers, and end-users are directly connected to a car manufacturer. Hereafter, we intend to start fully fledged CRM and new business strategies using these new ITs. For example, car condition information can be gathered from shipped cars and referred to the production field to provide feedback on the design of car parts. On the other hand, car manufacturers can deliver e-mails immediately from

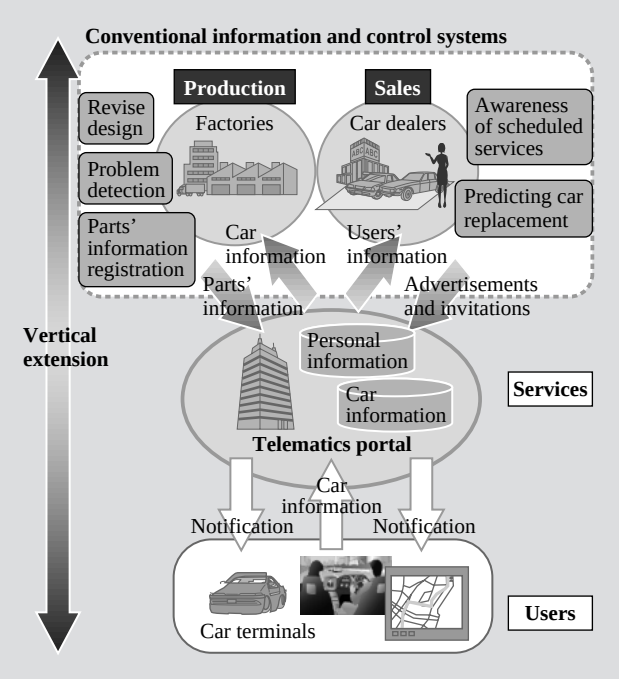

Fig. 3—Integration of Production, Sales, and Services. Users and factories (production), users and car dealers (sales) can directly exchange information through a telematics portal.

their production site to the end-users those uses particular automotive parts when a serious problem has occurred. Moreover, effective sales promotions can be done by predicting when the car of each end-user needs to be replaced or serviced by checking individual information and driving status by integrating sales systems and the telematics system as shown in Fig. 3.

To achieve system integration, we need to develop data gathering and management technologies for car condition information, including information filtering technologies among systems, and privacy protection technologies.

KEY TECHNOLOGIES FOR TELEMATICS SYSTEM

Telematics Agent Technology

System operating costs are reduced by connecting many telematics portals. However, security among portals must be guaranteed to protect customer information. Also, appropriate services must be gathered from many ASPs, processed, and provided to end-users based on the kinds of services that end-users require and where they require them such as driving location, driving route, traffic information, weather information, or their preference for high-value services.

To obtain appropriate car condition information to achieve CRM and to detect problems with the car, the kinds of information gathered and its timing must be easily set and able to be changed in accordance with the intended purpose. It is also important to protect data that influences the control of the car when gathering car information and to guarantee security between the telematics portal and the car.

Hitachi thinks the following technologies are necessary to satisfy these system requirements, and these are discussed below:

(1) Portal agent technologies

(a) Access control technologies: These protect confidential information between telematics portals and ASPs.

(b) Service integration technologies: These gather appropriate services from ASPs, process them, and provide them to end-users based on their service preferences and the situation of their service usage.

(2) Terminal agent technologies

These monitor car status and driving continuously by gathering and storing car information. They set and change the kinds and times for gathering car information based on the user's requests provided by telematics portal.

(3) Portal and car cooperation technology

Security technologies that prevent influences outside the car from controlling it. These include technologies that establish and change the content of information and the frequency and timing it is transmitted between telematics portals and cars.

Advanced HMI Technology

To provide safety and comfortable services to end-users when they are driving, the convenience of operation must be greatly increased by voice control. Recently, global standard language VXML (voice extensible markup language) that describes voice communication content easily has been developed. Voice communication content can be prepared and edited in accordance with the services end-users access in the car using this language and complex input can be achieved by voice communication. In addition, end-users can recognize that the intelligence of their cars has extensively increased by voice communications, and that the pattern of communication changes every time they speak with their cars. They may also recognize that their cars have increased in value (see Fig. 4).

Information content is continuously being renewed such as the names of new shops and interchanges or highways and these names need to be pronounced and

recognized. However, new names that are not in the dictionary cannot be recognized automatically if conventional technologies are used.

Hitachi is developing two technologies to solve these problems. These are:

(1) Dynamic communication content creation technology

This technology manages communication with an end-user over time and switches display patterns and content as driving conditions change. (e.g. complicated information cannot be displayed when warning the driver about dangerous road conditions, and service content must adapt to the current location.)

(2) Voice portal technology

This is a method of creating and recognizing voice data at telematics portals so that the latest information content can be read and recognized. It also involves a synchronization control method that provides voice and image information at the same time so as not to distract the driver. The end result is a smooth HMI in harmony with driving.

Advanced Navigation System

An exclusive receiver is currently needed to access traffic information providing services such as VICS (vehicle information and communication system), and this service is limited to the surroundings of the car being driven. Recently, commercial companies have been able to process and use traffic information because that provided by VICS has been deregulated.

Hitachi has developed a new ASP service that manages traffic information and solves contemporary problems. It allows traffic information to be transmitted from telematics portals to car terminals using mobile communication without the need for exclusive terminals. The driving route information, that takes traffic jams and sudden traffic accidents into consideration, can be transmitted to drivers because handling of traffic information was recently deregulated. In addition, not only real-time traffic information, which is provided by conventional technologies, but also best dynamic route guidance and prediction of arrival time, which is achieved predicting future traffic information based on historical and statistical traffic information, can be provided to end-users (see Fig. 5).

Hitachi is engaged in developing the following three technologies:

(1) Location presumption technology of terminals at navigation ASP

This is a method that effectively assesses the location of drivers using limited communication between the telematics portal and car terminals. The frequency of communication is reduced by presuming that the car has settled on an established driving route

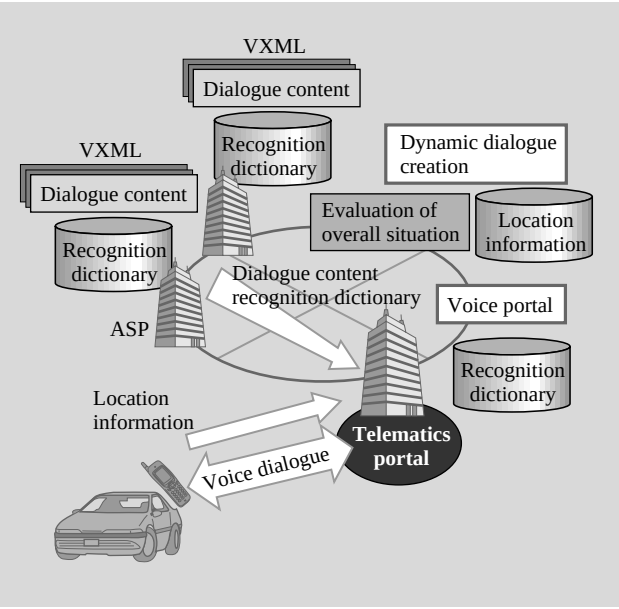

Fig. 4—Advanced HMI Technologies.
Provide appropriate content in dialogue with users based on car situations such as its location.

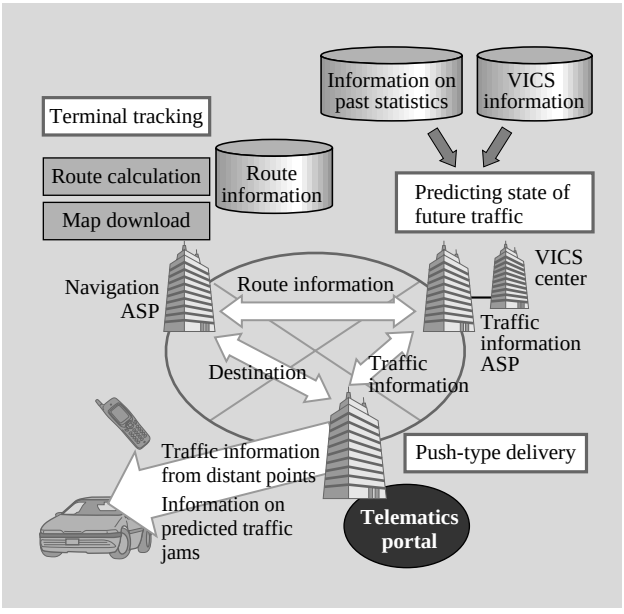

Fig. 5—Advanced Navigation Systems.
Prediction and provision of future traffic information using not only temporal traffic information but also historical traffic information through cooperation with navigation ASP and traffic information ASP. Also, provide traffic jam information taking driving route information.

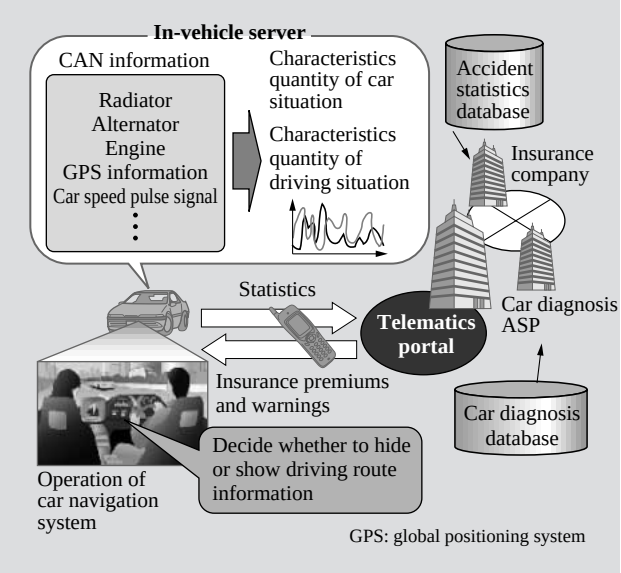

Fig. 6—Combination of Car Information Technologies. Provides new services by using various information on car gathered through CAN.

and this eliminates the need to trace its location frequently.

(2) Push type delivery technology at telematics portal

A delivery method to reduce the communication costs of the owner of the telematics portal when delivering live traffic information from the portal to drivers.

(3) Traffic information prediction technology at traffic information ASP

A method to predict traffic status at a particular time at a particular place based on historical and statistical traffic information and present VICS data.

Technology to Apply Car Information

Recently, CAN (controller area network) was developed to gather status information on cars and operation information on drivers. New services such as "achievement related insurance products" and a "car trouble diagnosis service" may be achieved using car information obtained through CAN. We are developing new technologies that contribute to providing these services (see Fig. 6).

As the driver pays insurance premiums based on his own driving record, he will be more conscious about driving safely. This leads a reduction in insurance premiums. Advice on unserviceable parts, warnings about theses, and how to repair them can be provided through this service and it is also possible to dispatch a service engineer.

Hitachi is developing the following technologies to provide these services:

(1) Technology to reduce communication costs

To calculate insurance premiums and diagnose trouble with cars, vehicle information gathered through CAN must be sent to the telematics portal. However, the communication costs to send the information is high if all information is transmitted. Therefore, we are developing new technology to reduce communication costs by statistically processing collated car information before transmitting it to the telematics portal thereby reducing the amount of information transmitted. In addition, we are developing new car diagnosis technology that uses statistics based on the physical deterioration and physical characteristics of each car part using information transmitted from the car.

(2) Privacy protection technology

Information such as car information and driving status is private information. However, to increase end-users' satisfaction on services, the information needs to be sent to a telematics portal and utilized by service providers. Hitachi is engaged in research on ways to conceal information and limit its publication without permission.

Openness Technology between Car Terminals and Telematics Portal

(1) Openness by HTTP and XML

Services must be provided to the car terminals of different companies if various new services are added and the number of members increased. To connect different kinds of car terminals to a telematics portal at low cost, requires openness in the communication protocol between the telematics portal and car terminals.

Recently, new car terminals that have a web browser installed and that adopt HTTP (hypertext transfer protocol) as the communication protocol have been introduced. There is also a trend toward standardizing the description of traffic information content and content related to telematics using XML (extensible markup language).

To satisfy this trend toward openness, Hitachi is developing an open interface using open platform technologies, car terminal technologies and its know-how.

(2) Openness using Java*

The life cycle of cars is 5 to 10 years and new

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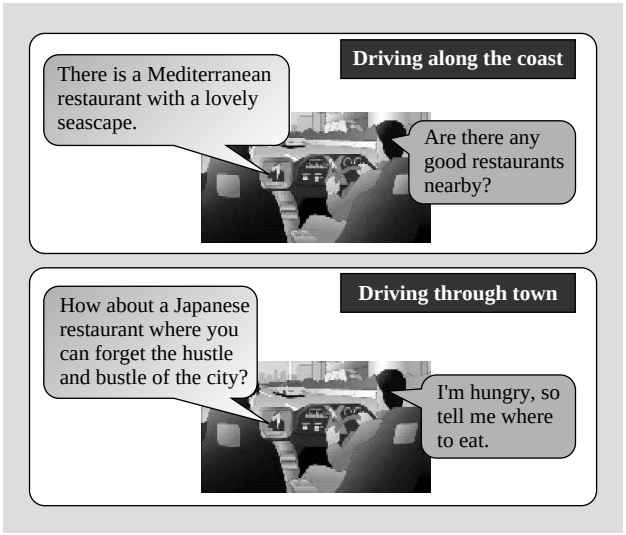

Fig. 7—Example of Situation-based Dialogue.
Switch dialogues automatically based on user's situation.

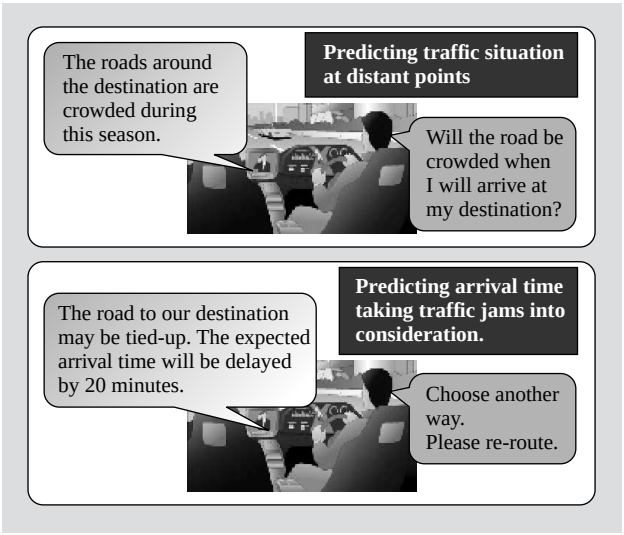

Fig. 8—Example of Future Navigation System to Predict Road Conditions.
Predict traffic jams around the destination at time of arrival and post to users.

services are added and replaced every month. If service menus displayed on car terminals and car information that is used to provide services cannot be changed, serviceability for end-users is limited. To solve problems caused by differences in the life cycle, we are planning to use the popular Java format used for cell phones.

The menus and layouts of pictures displayed on car terminals can be changed by downloading Java applets from a telematics portal to car terminals. Appropriate car information on services can be gathered by replacing programs for process car information installed in a car terminal.

EXAMPLES OF APPLICATIONS

Situation Considering Communication Type

Complex input operation is required when retrieving restaurant information near areas the car is driven, such as prices and the kinds of foods if one uses conventional voice communication services. However, this type of information can be retrieved automatically based on the place the car is driven and the end-users' preferences, through voice communication and information on recommended restaurants can be provided without complex operation of the car terminal. Driving safety increases and end-users feel that their vehicles become intelligent extensions of themselves as the information recommended by the car terminals changes according to the place. Fig. 7 shows the combination of car information technologies available.

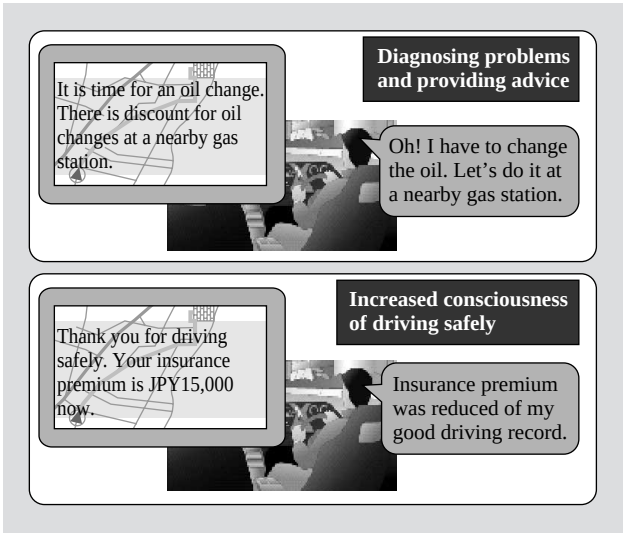

Fig. 9—Example of Support to Avoid Trouble.
Increase consciousness to safe driving by diagnosing car problems and predicting trouble with parts, and provide support to avoid difficulties.

Future Prediction Navigation System

Conventional navigation systems retrieve a route to the destination based on current traffic jam information and calculate a new route for drivers when it is overcrowded. However, future prediction navigation systems will predict changes in road conditions using present information on traffic jams, history statistics and the season, and when the road is overcrowded they will inform drivers and automatically calculate a new route. Conventional

navigation systems only provide traffic jam information from nearby, but future prediction navigation systems will provide traffic jam information based on distant destination, thus increasing convenience for the end-user. Fig. 8 is an example of a situation-based dialogue with this navigation service.

Support to Avoid Trouble

This support service continuously diagnoses the car and if it detects a part that seems to be broken, it informs of gas stations and service outlets when the car approaches these. Information on the time required to repair defective parts, the cost, and nearby facilities that can repair the damage can be provided to drivers who then contact mechanics to arrange repairs. A service whereby insurance premiums can be reduced by a record of safe driving can also be provided. Fig. 9 shows the support service for avoiding car trouble.

CONCLUSIONS

In this paper, we discussed the direction of the integration of telematics systems, application service providers and information systems based on business strategy of car manufacturers. Included in this discussion were important future core technologies such as telematics agent technologies, highly advanced human-machine interfaces, highly advanced car navigation systems, application technologies using car information, and openness technologies.

If IPv6 (Internet protocol version 6) becomes popular and each car terminal has an IP (Internet protocol) address, a "peer-to-peer system," that shares information content between cars and other equipment, will become widespread through communication technologies such as an ad hoc network. Copyright protection technologies and new accounting technologies for peer-to-peer systems will also become important.

Further, if new communication platforms such as wireless LAN (local area network) and DSRC (dedicated short-range communication) become popular, flexible use of the communication platform will be required. For example, end-users will need to use wireless LAN in urban areas because of the wide bandwidth and low communication costs, and they will need to use DSRC when settling accounts because it is very secure. They will also continue to use cell phone communications in the suburbs. To fulfill these requirements, we need to develop new roaming technologies that switch different kinds of communication platforms quickly. Hitachi is currently engaged in research and development on these key technical issues.

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