Special Article on Mobile Multimedia and ITS

Mobile Multimedia and ITS — Current Status and Future Prospects —

The Intelligent Transport Systems (ITS) is no longer an abstract idea: its introduction to the real world is just around the corner.

On the other hand, mobile communications have undergone dramatic change, as demonstrated by mobile phones and Personal Handyphone Systems (PHS). Their services, which have traditionally been voice-oriented, are increasingly adopting mobile multimedia technologies.

This article explains the progress of these two sectors, and provides an introduction to mobile multimedia services for ITS based on public mobile communications.

Seiichi Kurokawa

1. Introduction

Intelligent Transport Systems (ITS) refers to a system that exchanges information among people (including pedestrians), roads and vehicles, so as to ensure greater safety, increase transport efficiency and provide comfortable driving and walking environments (Figure 1).

Vehicles employing ITS are called "Smart Cars", roads are a "Smart Ways", and the information/communication system interconnecting the two is "Smart Gateway."

This article focuses on the concepts and examples of ITS services, which can be applied in the real world with the use of public mobile communications [1], [2].

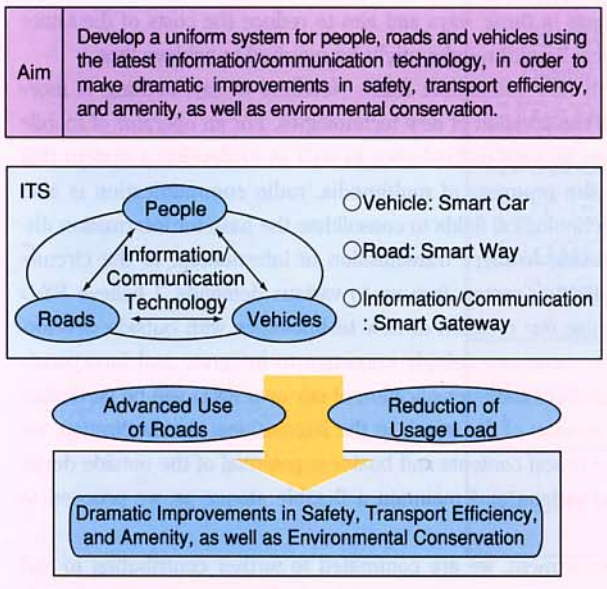

Figure 1 Conceptual Diagram of ITS

2. Overview of ITS

An overall illustration of Japan's ITS is shown in Figure 2, executive organizations in Figure 3, developments and services in Table 1, and the structure of ITS service media in Figure 4 [1], [2].

ITS service providers include national and local road authorities, bus and taxi businesses, police, hospitals and even private companies that provide traffic information.

Because ITS users include a wide range of drivers and pedestrians, the information/communication system provider's role is to interlink the different parties smoothly, through a highly functional pipe designed for information distribution.

Mobile communications play a significant role as one of the media for providing ITS services. Mobile communications consist of:

- ITS-dedicated communications: communication through ITS-dedicated waves, such as Dedicated Short Range Communication (DSRC);
- Private communications: communication through waves allocated to specific operations and businesses, such as police and taxi radios; and
- Public mobile communications: communication services provided by common carriers such as DoCoMo.

The Ministry of Posts and Telecommunications (MPT) predicts that the cumulative revenue generated by the ITS market will be about 60 trillion yen by 2015, out of which ITS

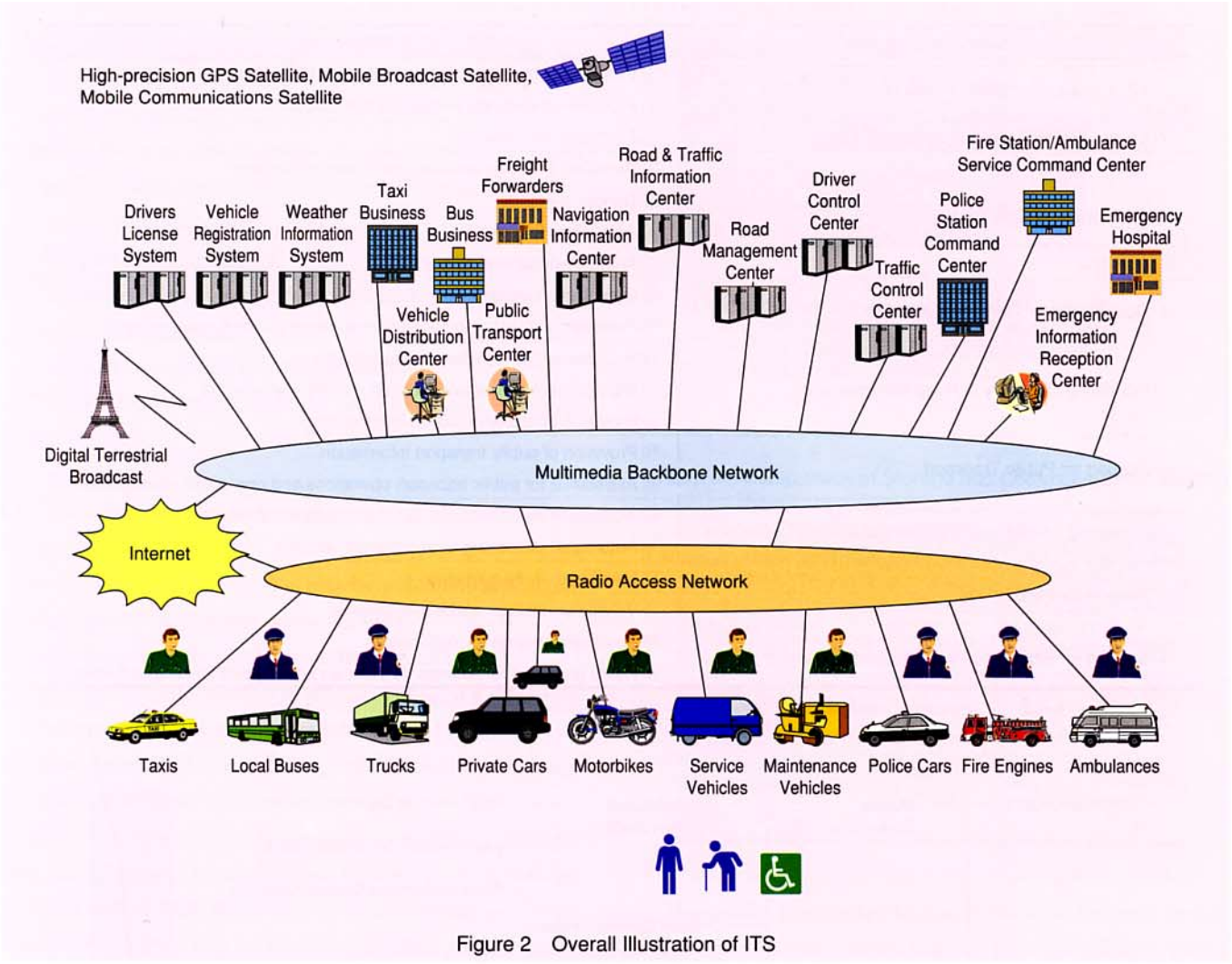

Figure 2 Overall Illustration of ITS

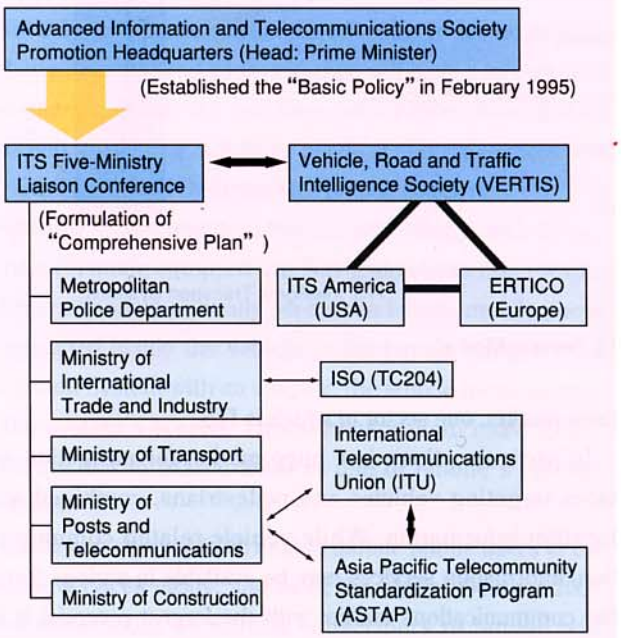

Figure 3 ITS Executive Organization in Japan

information/communication services will account for about 30 trillion yen, terminal equipment about 19 trillion yen, and ITS information/communication systems about 11 trillion yen [2].

Efforts to put ITS to practical use are making steady progress. While some have just entered the full examination stage as of April 2000, like the Electronic Toll Collection (ETC) System, others are already commercially available. The latter includes the operation and management of commercial vehicles using i-mode equipped Car Navigation Systems and packet communications, and services that locate pedestrians using PHS.

3. Evaluation of ITS within DoCoMo's 2010 Vision

DoCoMo Vision 2010 — Challenging the Mobile Frontier — [3] predicts that ITS-led navigation of vehicles and pedestrians will play a major role in mobile communications in the

Table 1 9 Development Areas and 20 User Services

Development Area	User Service
(1) Advances in Navigation Systems	① Provision of route guidance and traffic information ② Provision of destination-related information
(2) Electronic Toll Collection System (ETC)	③ Electronic toll collection
(3) Assistance for Safe Driving	④ Provision of driving and road conditions information ⑤ Danger warnings ⑥ Assistance for driving ⑦ Automated highway systems
(4) Optimization of Traffic Management	⑧ Optimization of traffic flow ⑨ Provision of traffic restriction information on accident management
(5) Increasing Efficiency in Road Management	⑩ Improvement of maintenance operations ⑪ Management of special permitted commercial vehicles ⑫ Provision of roadway hazard information
(6) Support for Public Transport	⑬ Provision of public transport information ⑭ Assistance for public transport operations and operations management
(7) Increasing Efficiency in Commercial Vehicle Operations	⑮ Assistance for commercial vehicle operation management ⑯ Automated platooning of commercial vehicles
(8) Support for Pedestrians	⑰ Pedestrian route guidance ⑱ Vehicle-pedestrian accident avoidance
(9) Support for Emergency Vehicle Operations	⑲ Automatic emergency notification ⑳ Route guidance for emergency vehicles and support for relief activities

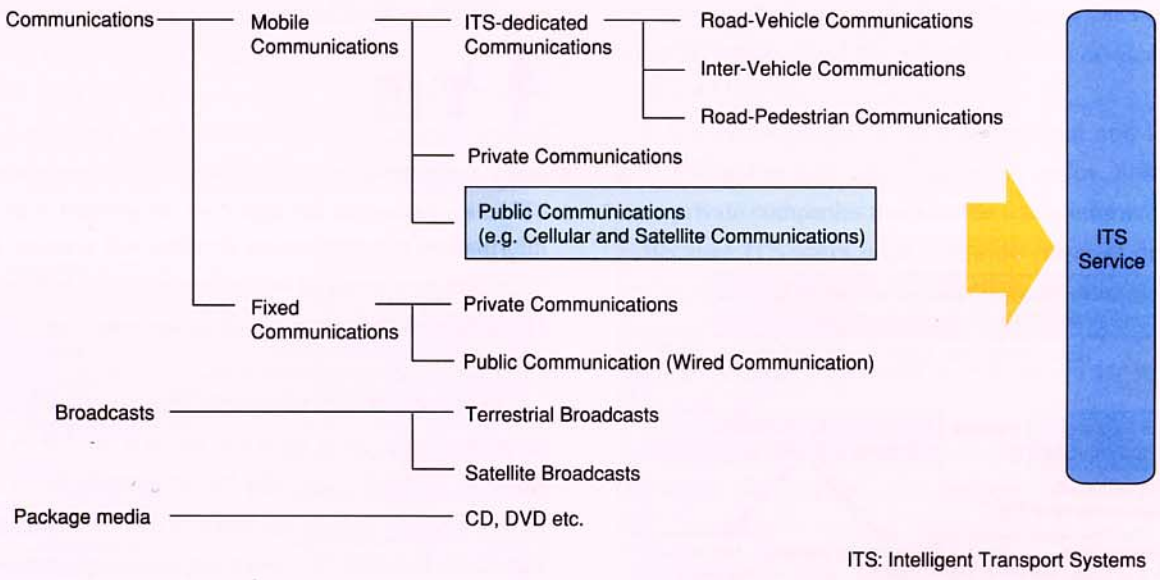

Figure 4 Structure of ITS Service Media

future.

Currently, there are some 60 million subscribers to mobile phones and PHS in total, and the market is expected to reach a saturation point at around 80 million (Table 2).

Under these circumstances, the main challenge is to sustain or accelerate the rate of increase in subscriber population. In that sense, there is much room left in data communications including the Internet, or the non-voice communications market, one sector of which is ITS.

In particular, there is a huge market for navigation services targeting vehicles and pedestrians, combined with location information. While vehicle-related communication/information services may be available in various forms, the communications market with the largest potential is for interactive Car-Navigation Systems, which are expected to top 40 million units (Table 2).

4. Examples of ITS Services Using Existing Public Communications

Among the nine development areas under the scope of ITS, public mobile communications can be heavily used to:

- Advance navigation systems
- Support public transport
- Increas efficiency in commercial vehicle operations
- Support pedestrians
- Support emergency vehicle operations

The following sections describe each of these cases with examples.

4.1 Advanced Navigation Systems

(1) Comparison of Media

Advanced navigation systems may be put into practical use through the following three types of media:

- Standalone-media (package media): e.g, CD, DVD;
- Broadcast-and-narrowcast: e.g, radio, TV, Vehicle Information and Communication System (VICS)
- Communications: e.g, public communications, private communications

Table 3 compares these three types of media. In practice, they will be applied in combination with each other, making the most out of their respective merits. For example, large information of map will be stored on DVDs, general traffic information will be given by broadcast/narrowcast, and real-time personal information will rely on communications media.

Notably, public communications due to its large subscriber population and wide coverage will have a tremendous advantage in delivering real-time information about distant areas and in meeting individual needs at affordable rates.

(2) Car Navigation Systems with i-mode Support

Figure 5 shows how Car Navigation Systems with i-mode support ("i-mode equipped Car Navigation Systems") work.

When a handset normally used as an i-mode mobile phone is connected inside the vehicle to the i-mode equipped Car Navigation System with an adaptor, the i-mode menu appears on the system's screen. This service, called "i-navi Link", was launched in March 2000 as one of i-mode's optional functions.

i-mode was developed to enable mobile phone users to use Internet services easily, and as of the end of October 2000, there were about 14 million subscribers to i-mode with approximately 28,000 websites dedicated to i-mode subscribers [4].

Table 2 Forecasts of Mobile Communications Service (2010)

Number of Subscribers to Mobile Phones	80
Number of Interactive Car Navigation Systems	40
Number of Internet Users (Wired)	50
Number of Internet Users (Mobile)	30
Number of Mobile Information Terminals with Interactive Communication Functions	30

(Unit: million)

★Extracted from DoCoMo 2010 Vision
★These figures are forecasted by NTT DoCoMo based on "Projections for Long-term Macro Trends of Mobile Communications/Mobile Multimedia" (July 1998, Nomura Research Institute)

Table 3 Comparison of Storage and Communications Media

Media Type	Capacity of data storage /transmission	Cost	Timeliness and Ease of Changing Information	Adaptability to Personal Use
Standalone (e.g, CD, DVD)	Large	Low	Somewhat difficult	Difficult
Broadcast & narrowcast	Medium	Medium	Easy	Somewhat difficult
Communication	Small	Relatively high	Very easy	Easy (Inc. acquisition of remote information)

Meanwhile, the market for Car Navigation Systems is also experiencing rapid growth. Sales of Car Navigation Systems are expected to exceed 1.5 million units per year in the near future.

DoCoMo has conducted a "1000-unit monitors" program and "Communication Car Navigation Forum" to survey services for i-mode equipped Car Navigation Systems.

These efforts revealed that:

- i-mode users want access to the same i-mode information inside the car as they can get outside the car
- Communication costs associated with car navigation must be minimal
- In-car users should be charged by data transfer volume (the packet transmission method), rather than by connection time (the circuit-switching method).

Based on these findings, it was decided to use the same content, networks and terminals as for the i-mode.

As Car Navigation Systems are designed to be installed in vehicles, they have fewer restrictions on power consumption and larger displays than mobile phones. In addition, they are equipped with a positioning function via the Global Positioning System (GPS). Due to these features, i-mode and

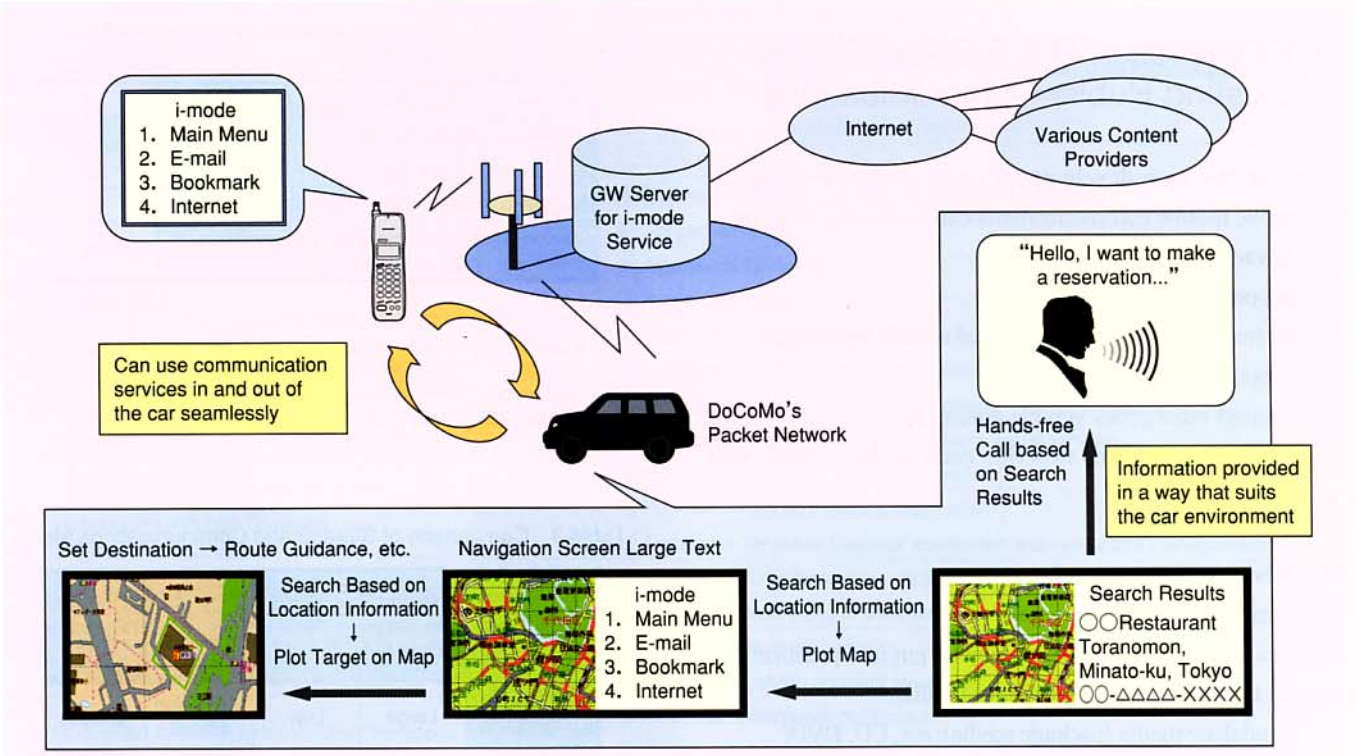

Figure 5 Advanced Navigation System (Service for i-mode Equipped Car Navigation Systems)

Car Navigation Systems complement each other. By using the Car Navigation System's large screen, with a connection to the Internet and other communication networks. The range of services can be expanded boosting the potential of ITS services. Further, the use of content and the framework developed primarily for i-mode (to which more than 14 million people already subscribe) diminishes the development risks, reduces the system load and ultimately benefits the user in terms of cost.

The basic functions of the i-mode equipped Car Navigation System are as follows:

- Displays i-mode content on the system's screen.
- Retrieves real-time location information and gives route guidance based on that information.
- Locate the vehicle via the exchange of e-mail carrying location information.

A variety of new applications are currently being considered, combined with new i-mode functions (such as agent functions with Java support).

Ideally, the i-mode equipped Car Navigation System should enable the seamless use of information. Traditionally, the means for accessing information depended on the environment e.g, in/out of the car, indoors/outdoors, office/home, private car/commercial vehicle. Now, we can develop an environment in which information a can be continually access through mobile phones, without changing the means. For example, information gathered at home could be displayed on the Car Navigation System, by simply bringing the mobile phone into the car. Hence, a wider range of information becomes accessible in a seamless fashion.

4.2 Support for Public Transport

Public transport may be assisted by facilitating the operation and management of buses and taxis, and by providing customers with information about their operating status.

Similar to the methods used to increase the operation and management efficiency of commercial vehicles, DoPa links and i-mode will be an effective means to gather location information, with i-mode handsets and other mobile phones being utilized to deliver information to customers, such as the arrival time of buses.

4.3 Increasing Efficiency in Commercial Vehicle Operations

Various systems have been introduced to increase efficiency in the operation and management of trucks and other commercial vehicles, using DoPa★ links (Figure 6). In these systems, trucks send information about their current location

★DoPa: NTT DoCoMo's packet communication service. The system interconnects data terminals with the network of the PDC Mobile Packet Data Communication System (PDC-P), and also with the Internet, corporate LANs and other networks via the Point-to-Point Protocol (PPP).

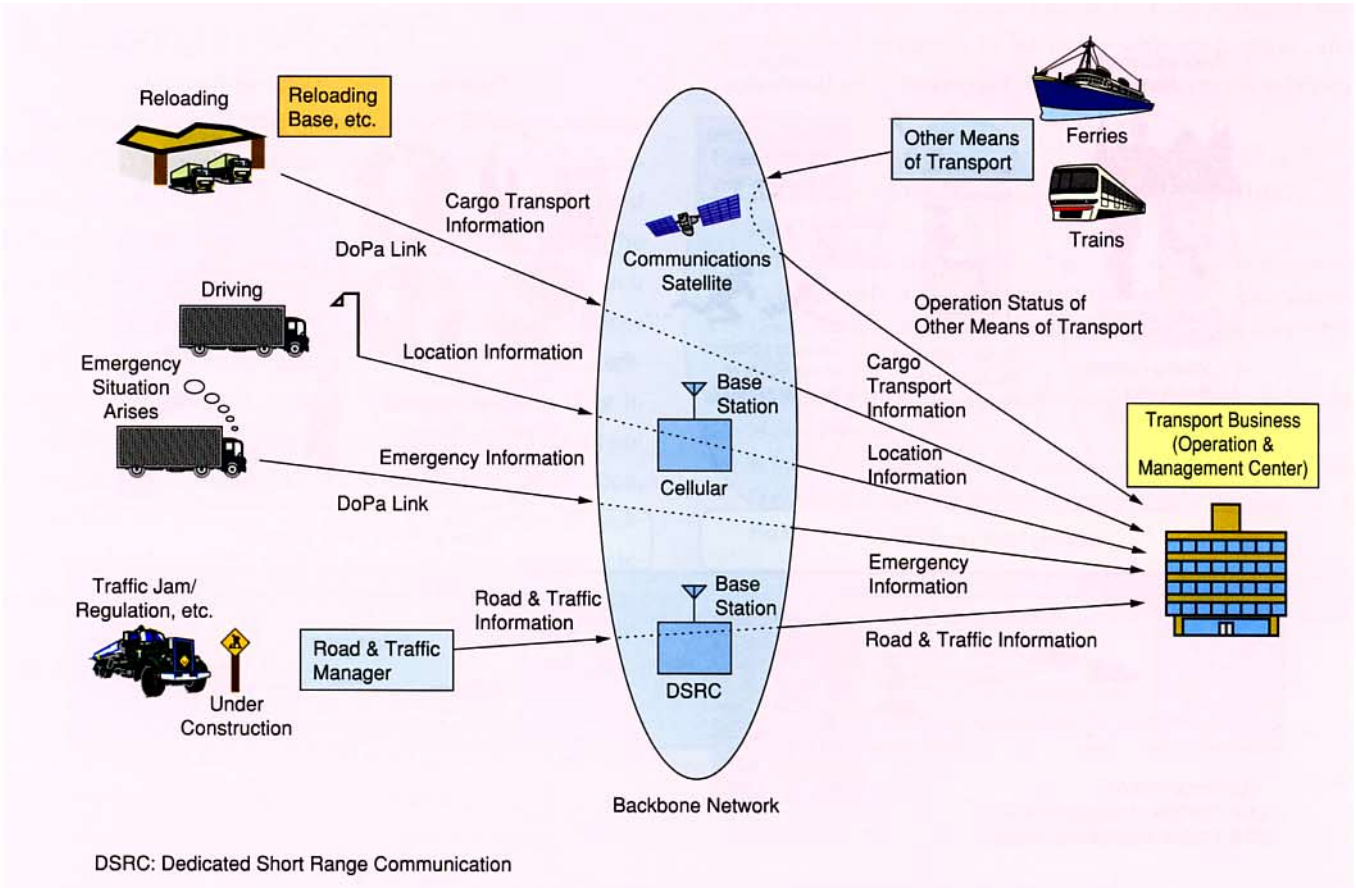

Figure 6 Increasing Efficiency in Commercial Vehicle Operations (Services for Operation and Management of Trucks, etc.)

and cargo status to the control center via the DoPa links. Based on the information, the center can grasp the general status of vehicles and cargo, send them information about traffic jams and guide them to their next destination. This ultimately raises the efficiency of vehicle usage, and helps relieve road congestion.

The operation and management of commercial vehicles can also be made more efficient by the application of i-mode Equipped Car Navigation Systems. For example an inexpensive system can be quickly configured by using i-mode mail.

4.4 Support for Pedestrians

One of the distinctive features of Japan's ITS service is the support it will provide to pedestrians, i.e, pedestrian navigation.

Although ITS is often regarded as an automobile-oriented service, it also offers important support for pedestrians. In the years to come, various navigation and danger-prevention services are expected for use by pedestrians, including but not limited to the elderly, children and physically handicapped persons (Figure 7).

In order to realize these services, it is essential to locate where the pedestrians are. This can be done by using information from mobile phone base stations together with GPS information.

PHS base stations are installed every few hundred meters, while those for mobile phones are set up in intervals of a kilometer or so. The advantages of using this infrastructure are low cost, and local-map downloading services and so on can be provided to users easily.

In parallel, GPS can be used to improve the accuracy of the information. Currently, GPS circuits are mounted in Personal Digital Assistants (PDA) and other similar terminals, from which the GPS center gathers information a variety of location and adjusts it to determine their actual locations. This technique makes pedestrian location possible on a scale of 20 to 30 meters, and even up to a few meters.

The infrastructure currently being considered for these services is called the DoCoMo Location Platform (DLP). The location information provided by the Platform will be used to deliver various types of local information to pedestrians, make emergency notifications, and locate elderly persons, children, and pets.

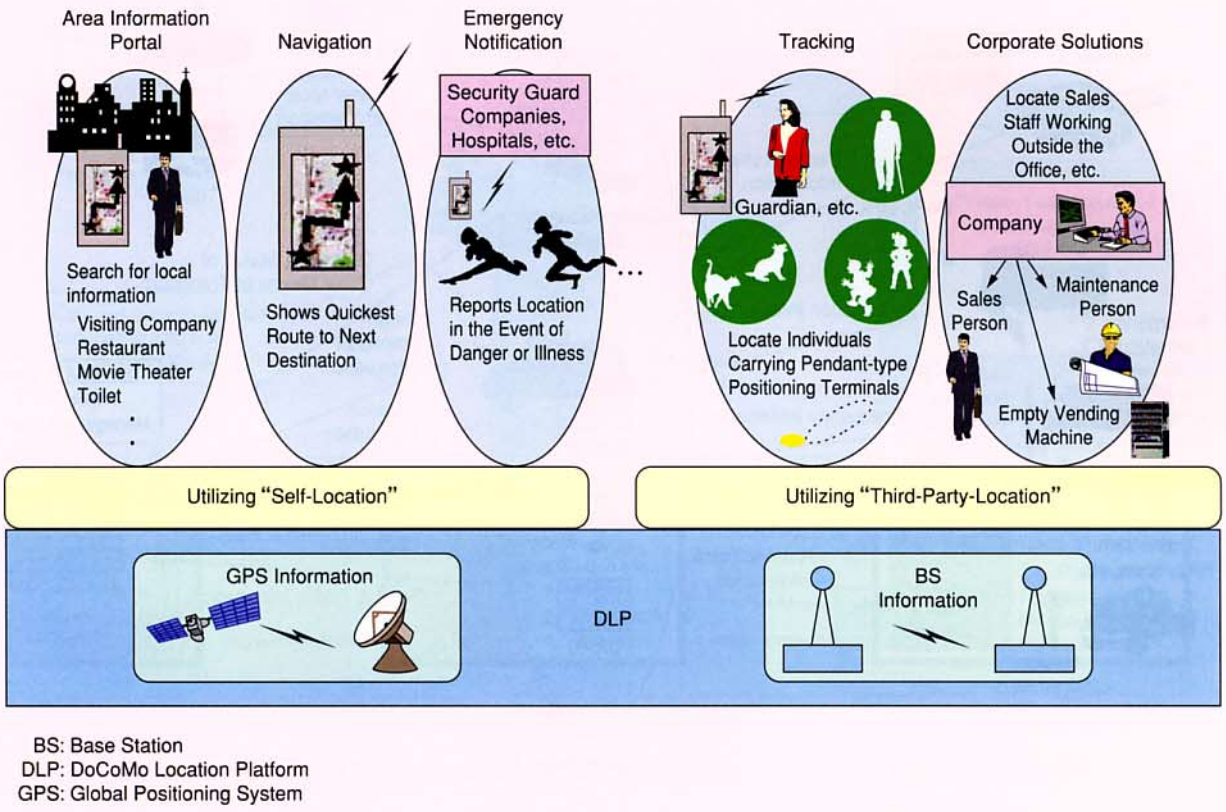

Figure 7 Support for Pedestrians (Location Information Service for Pedestrians, etc.)

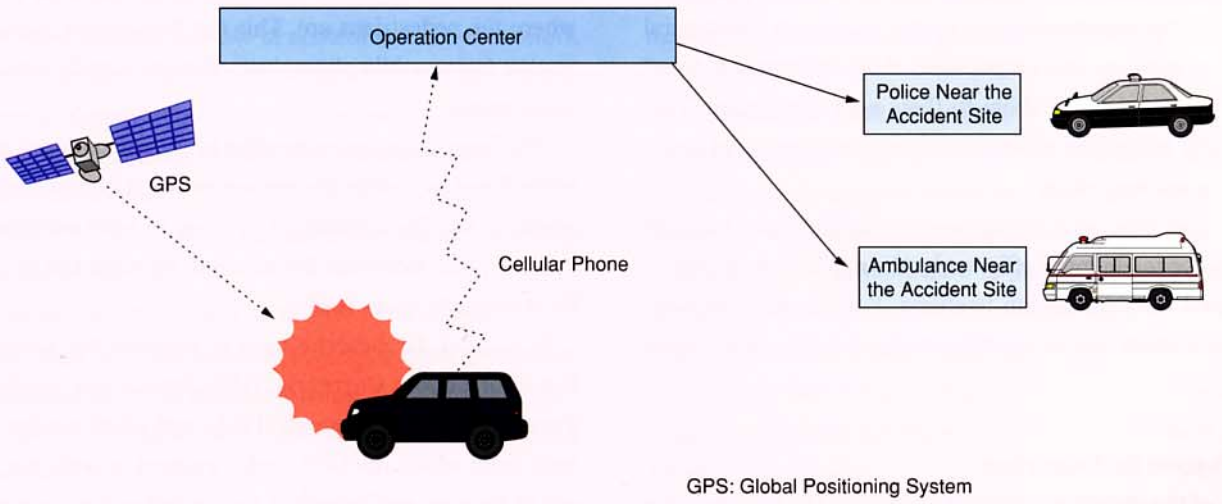

Figure 8 Assistance for Emergency Vehicles' Operation (Emergency Notification Service)

4.5 Support for Emergency Vehicle Operations

Any driver who encounters a car accident can use his/her mobile phone to dial 110 for the police, or 119 for an ambulance. The problem is that the exchange connecting the mobile phone will not necessarily have a direct link to the closest police or fire station. If a distant station receives the call, it will take a while for them to arrive. This can be avoided by a system that directs the driver's call to a control center that will transfer the call to the nearest police or fire station, based on the location information received from the vehicle (Figure 8). This kind of service is available from E-Call Japan Co., Ltd. and Japan Mayday Service Co., Ltd.

5. Adapting to IMT-2000

The introduction of International Mobile Communications-2000 (IMT-2000) will lead to a rapid acceleration of communication speed at links, and thus enable the diversification of ITS services. New opportunities will arise by combining the normal IMT-2000 service with additional information, such as information about the user's location. Potential services include the download of music and the transmission of high-definition still pictures and full-motion video according to certain times and place. Nonetheless, as 384 kbit/s might not be enough to accommodate such multimedia information, the solution will probably still involve a combination of package, broadcast/narrowcast and communication media, integrated to take full advantage of the merits of each.

6. Conclusion

This article has introduced the application of ITS services to the real world, by using public networks.

It is hoped that ITS and mobile communications will achieve rapid progress in harmony with each other, and expand and advance as one core mobile multimedia services.

References

[1] Highway Industry Development Organization (HIDO), ITS Handbook, 1999.

[2] Telecommunications Technology Council, ITS Information Communication System Committee Report: Information Communication System for Intelligent Transport Systems (ITS), 1999.

[3] NTT DoCoMo Group: DoCoMo Vision 2010-Challenging the Mobile Frontier, 1999

[4] K.Enoki: "*Special Issue on i-mode Service*", Concept of i-mode Service, NTT DoCoMo Technical Journal English Version, Vol. 1, No.1, pp.4-9, Oct.1999.