FEE-BASED REALTIME ROAD TRAFFIC INFORMATION PROVISION SERVICE FOR MOBILE PHONE AND PC

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1. Abstract

Japan sees heavy winter snowfall in the northeast and rainy summer typhoons in the west, both of which seriously affect road and traffic conditions. Such climatic circumstances make road traffic information provision to drivers important.

J-System of the Japan Road Traffic Information Center (JARTIC) provides accurate online road traffic information in real time to road users. J-System is advantageous in that information service providers can easily tailor the provided information to fit their media . Information of J-System that started operation in December 1999 is available via Internet, mobile phone with an Internet protocol address, and television stations etc. It was being used by 30 information service businesses and about 300, 000 end users as of June 2001.

J-System's basic data processing includes transforming VICS code information into text format to show an object with a specific route name, direction, and location. J-System prepares three typical data formats that can be used for various media. For information display, three formats are available: text only format, text plus *kana* (a phonetic Japanese syllabary) format, and simple graphics format. This paper reports the significance of road and traffic information provision in Japan, which experiences localized heavy snowfall and rain, the mechanism and utilization status of J-System for online traffic information provision, and its charge system.

2. Road traffic information provision service in Japan

Prefectural police departments and other road administrators (e.g., Ministry of Land, Infrastructure and Transport, local governments, Japan Highway Public Corp.) collect traffic information and develop infrastructure including vehicle sensors for information collection. In other words, most source information of traffic jams, accidents, traffic restrictions, and travel time etc. is collected by road administrators. Traffic information is provided to road users in two ways: direct information provision by information collectors (road administrators), and provision through JARTIC, which integrates information from the road administrators.

JARTIC was established in January 1970 under the leader ship of the National Police Agency and the former Ministry of Construction, with the aim of rapidly providing road users with comprehensive and accurate road traffic information. The information is collected and integrated through 144 branch offices of JARTIC throughout Japan. The information is collected in two ways. JARTIC staffs at individual branch offices enter the data from road administrators into terminals of J-System to send it online to communication servers in Tokyo and Osaka. These servers process it to update the database files.

JARTIC staffs retrieve requested information from the database file and provide it to drivers via telephone. Information also is provided to the public through local regular (special) TV and radio programs, as well as to other mass media and information service providers.

The information also is automatically collected around the clock through lines connecting JARTIC exclusively with road administrators.

3. Importance of road traffic information in heavy snowfall and floods

The Japanese archipelago consists of four main islands and many smaller islands extending some 2500 km from north to south. The long, narrow mountainous land between the Pacific Ocean and the Japan Sea features complicated geography and severe natural conditions, particularly the localized torrential rain and typhoons from summer to autumn and the heavy snowfall in winter.

Drivers' requests for traffic information provided via telephone by JARTIC staff or by automated phone systems has reached 10 million in 1999. JARTIC organized and analyzed the requested information of three weekdays per month for a year.

3.1 Ratio of road types for which traffic information was provided

The total road length of Japan is about 1,160,000 km. The length of trunk roads classified higher than national highways is 61,500 km. More than 95% of roads for which drivers request information are trunk roads, of which 85% are expressways and the Metropolitan Expressway.

Road classification	Sub-classification	Length (km)	Ratio (%)
Expressway	national expressway	6,452	31.8
	Expressway between Honshu and Shikoku		
	toll road		
Urban expressway	Metropolitan Expressway	596	52.8
	Hanshin Expressway		
	Nagoya Expressway		
	Fukuoka and Kitakyushu Expressway		
General and local road	national highway	53,685	11.4
	prefectural road	127,916	3.4
	other (municipal road)	973,838	0.6
Total		1,162,487	100.0

Table 1. Ratio of roads for which traffic information was requested (1999)

3.2 Information requested and the reason for request

Table 2 shows the breakdown of a sampling of 650,000 information requests (6.5 % of total) on weekdays. The breakdown is: traffic jam 38.5%, travel time and route guidance etc. 33.8%, confirmation of traffic restriction due to bad weather and car accident etc. 14.5%, and other 13.3%.

Information	Ratio(%)	Reason for request	Ratio by cause (%)
Traffic jam	38.5	heavy traffic	84.1
		car accidents	6.9
		road works	5.7
		road weather	1.0
		other	2.3
		Sub total	100.0
Travel guidance	33.8	distance and traveling time	61.9
		route guidance	15.7
		fare	9.0
		road weather	6.2
		others	7.2
		Subtotal	100.0
Traffic restriction	14.5	road weather	40.2
		road work	23.1
		car accidents	17.1
		service suspension	14.0
		other	5.6
		Subtotal	100.0
Others	13.2	sightseeing, hotel rates etc.	—
Total	100.0		

Table 2. Information requests and the reasons for request (in 1999)

3.3 Effects of weather on traffic information request

Table 3 shows number of information requests by season. 10 % of the information requests were made in summer that had torrential rains resulted from typhoons, 80 % were in winter that saw heavy snowfall and freezing weather, and 10 % were for other reasons. The results indicated that drivers' traffic information demand under bad weather was great.

3

Season	Month	Number of requests	Ratio (%)	Note
Spring	April	2,610	3.4	
	May			
	June			
Summer	July	7,999	10.3	Sept.12 torrential rain in Tokai district
	August			
	September			
Autumn	October	5,160	6.6	
	November			
	December			
Winter	January	61,833	79.7	Jan.5 Heavy snowfall in Tohoku district Jan.15 Heavy snowfall in Hokuriku district Jan.8, Jan.20, and Jan. 27 Heavy snowfalls in the Tokyo Metropolitan area
	February			
	March			
Total		77,652	100.0	—

Table 3. Relations between information requests and weather

4. J-System

　　Figure 1 outlines information provision by JARTIC's J-System

　　J-System is a general-purpose information provision system geared to information service providers (including publishing and broadcast media). The system processes the information collected by JARTIC from prefectural police departments and other road administrators to enable information provision via the Internet, mobile phone, television and other media.

　　In 1986, JARTIC started developing an information transfer system among relevant organizations. Upon its completion in April 1999, it launched development of J-System, which was completed in December 1999. The system was developed toward providing information faster and more accurately for anyone, anytime, anywhere.

　　Details of information service providers that use J-System are shown in Table.4. As the figure indicates, J-System is available through various telecommunications and broadcast media. The types of media number nine. Thirty kinds of services were being offered by 13 information service providers as of June 2001. Many other enterprises are planning this sort of service, including voice portal sites and data broadcast.
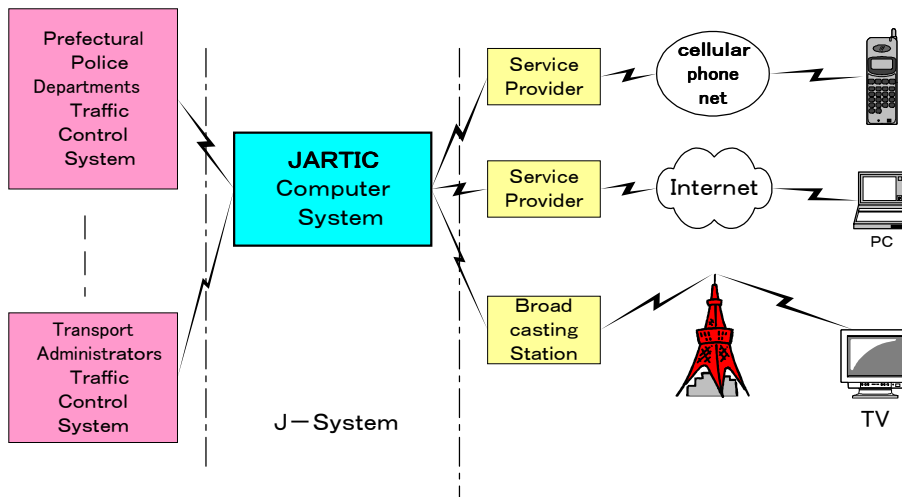
Figure 1. J-System's information provision service

J-System features:
1) Provision of integrated information.
2) Versatile adaptability to various media systems.

Media		No. of ISP*
Telecommunications	Mobile phone with Internet protocol connection	1 3
	Personal Handyphone System	5
	Internet	3
	multi-channel access	1
	car navigation	2
	telecommunication using PC	1
Broadcasting services	terrestrial broadcasting	2
	Satellite television	2
	teletext	1
Total		3 0

*Information service providers

Table 4. Information service providers using J-System (as of June 2001)

5. Configuration and Data Format of J-System

   The configuration of J-System is shown in Figure 2. The system uses equipment including four types of server: a communications server, a data processing server, a database server and an information provision server.
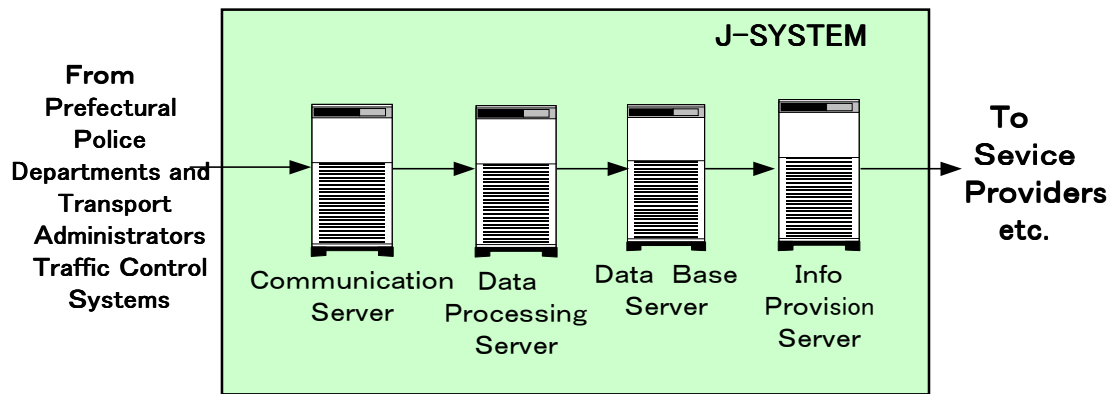
Figure 2. Configuration of J-System

J-System offers three typical data formats that are available for the various media: text-only format, text plus *kana* format, and graphic format for simple road network drawing. Kinds of data formats used for J-System and its adaptable media are in Table 5.

Format	Use	Available media
Text only	To provide information with text on traffic jams and traffic restrictions, etc. including route names, directions, addresses and geographic coordinates.	Internet Cellular phone with IP connection Mobile gear Television (terrestrial/satellite) Teletext Car navigation system
Text plus *kana*	Provides information with *kana* in addition to text.	Service by synthesized voice Radio broadcasting Voice portal site
Graphic	Provides color graphic information on traffic jams, road closures, car accidents, etc. Location is indicated by road kilometer post or geographical coordinates	Internet Cellular phone with IP connection (I.M.T.: International Mobile Telecommunications) Mobile gear Television (terrestrial/satellite) Car navigation system

Table 5. Basic data formats for J-System

Text-only is the most suitable format for providing data to television, radio and telephone. The graphic format enables traffic condition to be shown on a road map.

J-System data formats have high potential for broad use because they can be tailored by information service providers to fit individual media. JARTIC stores about 600,000

data including those of route names, place names and geographical coordinates for J-System operation.

6. Data Processing

Information collected by prefectural police departments and road administrators is combined and formatted with VICS system codes. The information requires conversion to text format to be used for J-System. This is the most important process for J-System.

J-System updates its information following the steps below, every five minutes around the clock.

① J-System receives the information on traffic jams and traffic restrictions etc., and combines it for transmission to a communication server which sends it immediately to a data processing server.

② The data processing server converts it to text format.

③ The data processing server edits the information by adding the appropriate route names and place names, before sending it to the database server.

④ Every five minutes, the information provision server retrieves from the database information necessary for information service providers to convert it to J-System format for information provision. The converted data is sent to the information service providers via exclusive lines.

Information for expressways is sent every minute to J-System by road administrators. However, there is a time lag between the administrators' data dispatch and their receipt by J-System. This is because J-System integrates and processes data by block, and it takes a few minutes for the information to be completely received.

Including the time lag, the total data processing time is set at less than four minutes. Examples of information provision by J-System are shown in Figure 3.
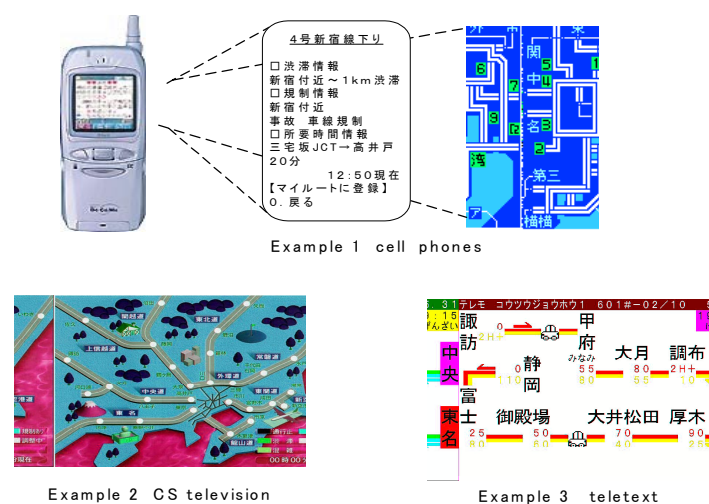
Example 1 cell phones

Example 2 CS television

Example 3 teletext

Figure 3. Examples of information provision by J-System
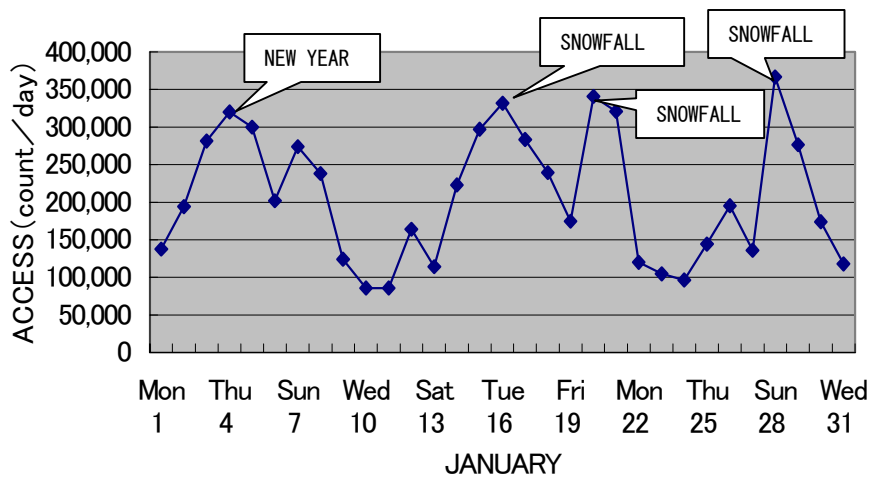
7. Information provision by J-System via the Internet

J-System provides information via the Internet at a Web site called "Road Traffic Information Now" (URL http://www.jartic.or.jp).

JARTIC's information service at the Web site to drivers and others started on July 20, 2000, concurrently with the G8 Summit on Okinawa Island.

As of June 2001, J-System has provided traffic information on expressways throughout Japan including the Metropolitan Expressway and those in Osaka and Fukuoka Prefecture, as well as national highways and major highways in the Kinki, Kyusyu, and Okinawa areas.

J-System is considered unique in the world among realtime information provision systems for its broad area of coverage and frequency of data update. Visits to J-System Internet site have numbered about 30 million from July 2000 to June 2001. Access tends to concentrate in specific periods of the year such as Golden Week in May, which is an extended national holiday, or on the occasion of widespread road disturbances due to heavy snowfall. Access in these periods increases several-fold to tenfold. As Figure 4. shows concentration of access to J-System at the time of unusually heavy snowfalls in the Tokyo metropolitan area in January 2001.

Item		Content	Display format of J-System
Data update interval		Every 5 minutes	
Format	Graphics	Information distinguished with colors. Black: road closure Red: traffic jam Blue: trafficability for only vehicles with tire chain Green : other restriction	Route map
	Text	Text only display of travel time in fixed OD and traffic regulations.	Text-only

Table 6. Design of "Road Traffic Information Now"

Figure 5. Route Information Map on the Internet (Sapporo City)

8. J-System information service via mobile phone

The most popular information service of J-System is that via a mobile phone with Web access by Internet protocol address and a password. I-Mode mobile phone is most popular of these in Japan. Information providers supply information to road users as a fee-based service, using the I-Mode mobile phone as the platform. The platform includes an authentication and charge system that allow the information service providers to easily provide fee-based services. (NTT DoCoMo lunched this service in February 1999.)

As of June 2001, service providers of traffic information via I-Mode numbered five. As each provider supplies the information through several mobile phone companies, the end service providers totaled 18. Users of the information service via I-Mode mobile phone number about 300,000. The end service providers provide the information to the users by processing the data into text format suitable for the I-Mode mobile phone. Three additional information service providers use graphics formats that enable display of a route map.

JARTIC charges information service providers for use of J-System to manage and maintain J-System properly for convenient and sufficient information provision. The monthly charge for the providers to access J-System via I-Mode mobile phone is shown in Table 7.

Charge Period	Monthly
Basic charge	170,000 yen
Access charge	30 yen×number of terminals

Table 7. Monthly charge for use of J-System via I-Mode mobile phone

9. Prospects for the next-generation mobile phone (IMT2000)
 Basic specifications and performance of a next-generation mobile phone follow.
1) More rapid communication bit rate: 144 kbps to 2 Mbps
2) Dual mode communication: simultaneous transmission of voice and data
3) Positioning function: identifying the phone location by GPS

 The next-generation mobile phone will enable more sophisticated road traffic information provision service.
1) The more rapid communication bit rate will enable J-System to send huge volumes of information such as that of large images that will be able to be scrolled at a terminal by using Java.

2) Simultaneous Audio communication and data transmission are possible. Specifically, simultaneous provision of animated real-time traffic condition and its audio explanation is possible.

3) Automatic identification of a mobile phone location by the positioning function facilitates search, by the user, of the surrounding traffic condition.

 JARTIC will seek development of J-System toward its further sophistication, to meet advanced mobile phone performance in the future.