ITS BASED ON XML AND WEB SERVICE TECHNOLOGIES
- The future of ITS in the ubiquitous network society -

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SUMMARY

In the summer of 2001 and the winter of 2002, the Civil Engineering Research Institute of Hokkaido conducted information-provision experiments as part of a joint research group. In the experiments, the XML-based Road Web Markup Language (RWML) was employed for information provision. The experiments proved that information provision by RWML is able both to increase demand for circular touring in local regions and to alleviate winter transportation problems in cities. The tests also demonstrated that use of XML as a data format of RWML enables the information provider to efficiently construct systems that collect data from information sources distributed on the Internet, compile the collected data according to user needs, and provide users with the compiled data. This affords flexibility in adapting to specification upgrades. In light of these results, we propose the development of a comprehensive mobility-support service that incorporates the web service concept.

INTRODUCTION

The Civil Engineering Research Institute of Hokkaido (CERI) has been orchestrating a public/private effort to develop Road Web Markup Language (RWML), an XML-based, Web-compatible descriptive language. CERI has also been organizing related field experiments. Employed in this experiment are onboard, on-demand information devices to provide travelling vehicles with information on roads, weather, tourism, and the like that relate to local regions in summer and cities in winter.

In addition to reporting the results of the field experiments, this paper proposes realization of a comprehensive mobility-support service (Smartway web service), which incorporates the next-generation concept of web service provision. It also examines how the current version of RWML should be developed to realize such service.

DEVELOPMENT AND IMPROVEMENT OF RWML AND FIELD EXPERIMENTS FOR INFORMATION PROVISION TO TRAVELLING VEHICLES

CERI has anticipated integration of Internet-compatible mobile terminal devices (e.g., cellular phones) and vehicle onboard devices (e.g., car navigation systems), as well as constant Internet connection by vehicles. In response, CERI has been addressing the need to develop a technology that allows drivers to selectively acquire information depending on their tastes and the current vehicle location from information sources

distributed across the Internet. As a first step toward the development of such technology, CERI has been developing and improving the Road Web Markup Language (RWML), a language that permits description of road information by XML, a next-generation Internet markup language.

RWML enables road information to be XML-compatible, distributed across the Internet, and provided to its users. The users can select and compile such information using their applications. These capabilities of RWML can lead to the development of a system that assists its users in making travel plans and driving comfortably according to their current locations, information needs, and tastes.

Since the release of version 0.71 (http://rwml.its-win.gr.jp) in October 1999, a joint research group led by CERI has been striving for further development and improvement of RWML.

During the Niseko-Youtei-e-Route Experiment conducted in the summer of 2001, information was delivered experimentally using RWML. RWML-based road, weather, and regional information on the Net was customized according to current locations and tastes of user in order to spur demand for circular touring. During the Smart Sapporo Snow Information Experiment 2002, conducted during the winter of that year, weather and road surface information was supplied according to user needs and the possibility of traffic demand management in response to winter weather conditions was examined. The applications developed for these experiments are based on RWML Versions 0.80 and 0.81, which can be implemented on various systems. Employment of these two versions has enabled construction of a flexible system.

NISEKO-YOUTEI-E-ROUTE EXPERIMENT

The Niseko-Youtei-e-Route Experiment was conducted in 2001 for the two months from July 2 to August 31. In the experiment, information on roads, local regions, weather, and the like was integrated and transmitted to drivers. The objective is to propose a new way of using information that contributes to road safety and comfort. Some tourists visiting the Niseko-Youtei area were requested to be monitors of the experiment. Information was sent to i-mode-compatible cellular phones by e-mail and via the Web.

To provide information to users, we established separate servers for information on roads, local regions, weather, tourist, and the like made XML-compatible by RWML. The dedicated servers for mobile devices collect information from the aforementioned servers. This system compiles information according to current locations and tastes of experimental monitors and the time of the day, for distribution to cellular phones (Figure 1).

For identification of current locations, the monitors were requested to send a message from their cellular phones at twelve predetermined checkpoints to trigger automatic provision of information tailed to each location. The information was sent as e-mails containing "Country Messages" (messages from local government to tourists) and road and weather information by transmission of data on the checkpoint location, location-specific keywords, and the next destination.

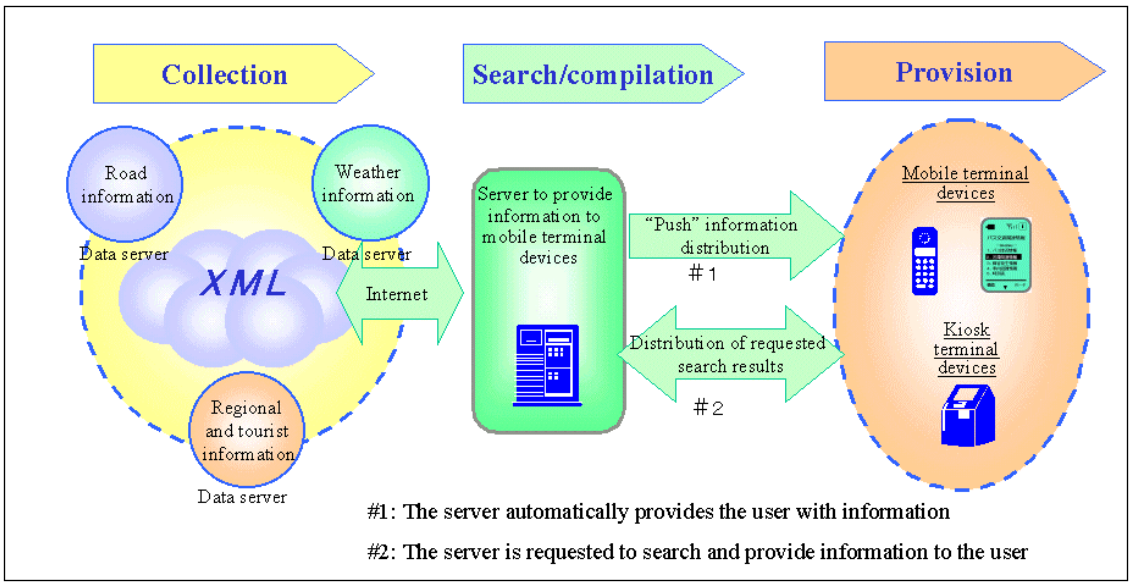

Figure 1:From information collection to provision

Over the two months, 461 tourists registered as experimental monitors, and 95 questionnaire sheets were recovered. It was found that 34 of the 95 respondents, or 36%, changed their plans because of the information provided during the experiment. For change in the activities of the 34, the largest response was "Stopped at places that had not been planned," followed by "Went using a different route from that planned" (Figure 2).

These results indicate that providing tourists with information according to their current locations and tastes, as well as the time of the day, can allow them to change their travel plans. The number of tourists can be increased depending on the information provision method, and the demands for circular touring can be increased.

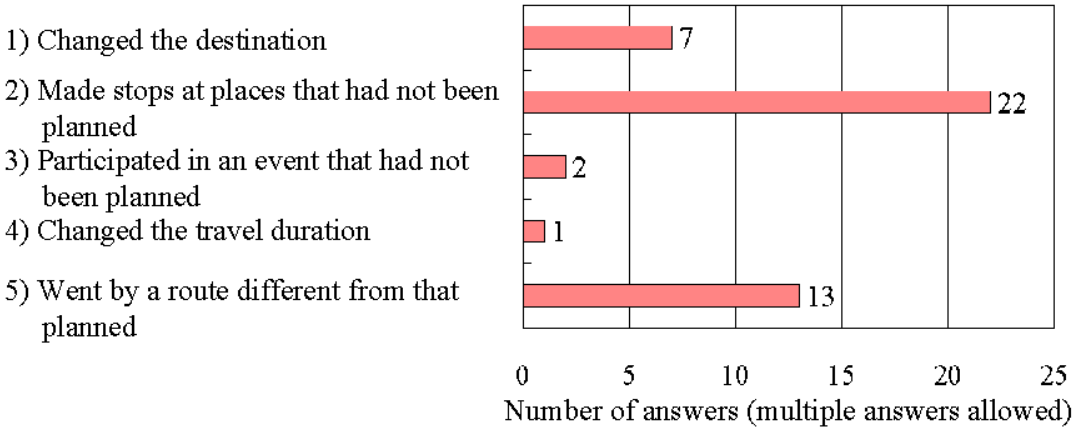

Figure 2:Answers with regard to plan changes

SMART SAPPORO SNOW INFORMATION EXPERIMENT 2002

The Smart Sapporo Snow Information Experiment 2002 lasted for the six weeks from January 17 to February 28, 2002. During the experiment, information was supplied to cellular phones and personal computers of experimental monitors by e-mail and via the Web. As in the above experiment, road and weather information was described by RWML, which has enabled integrated use of various kinds of information distributed across the Internet. Data collected from the Internet was compiled and modified to meet user needs for provision.

The most notable item is Snow-Related Information for Commuters. This information, which includes winter weather and road surface information provided to local car commuters, was taken advantage of by approximately 700 of the 776 experimental monitors. This information is provided toward easing traffic congestion in winter by prompting commuters to stagger their commuting hours and to use a different transportation means, as well as by realizing traffic demand management based on weather conditions (Figure 3).

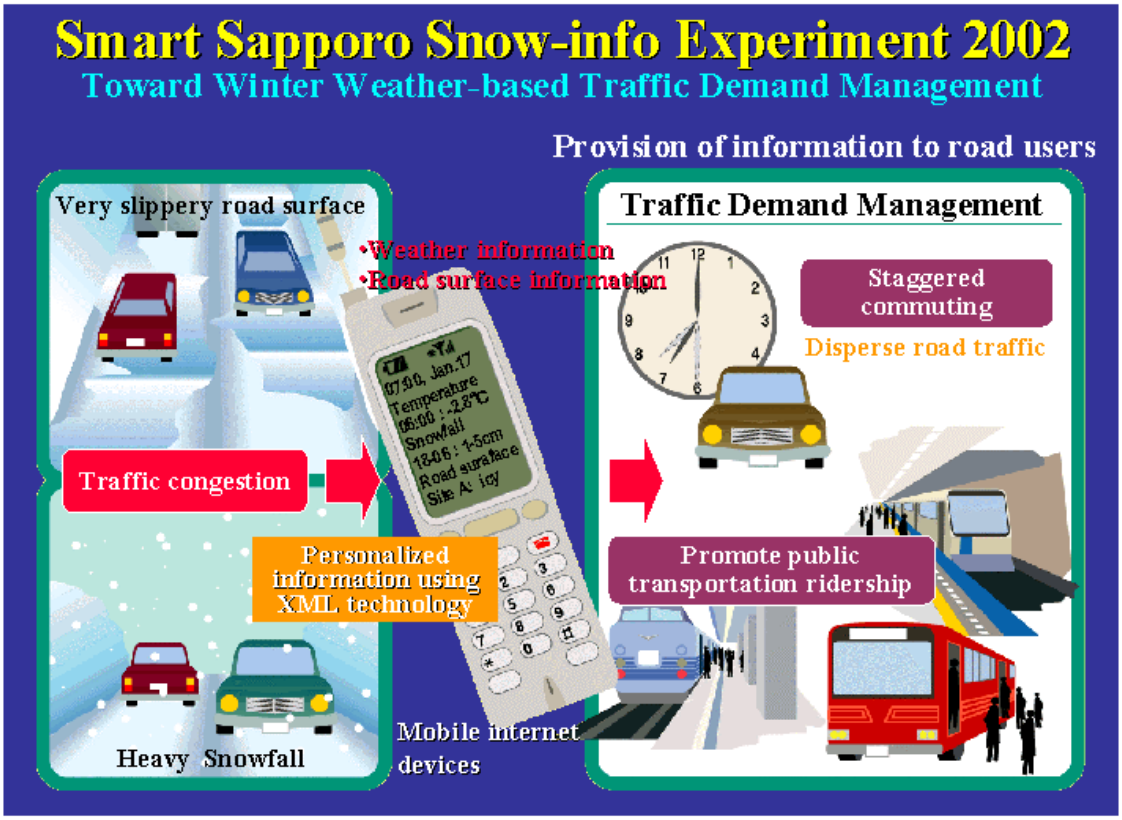

Figure 3:Traffic demand management in response to winter weather conditions

The questionnaire was filled out by 379 people, of whom 104 are car owners who took advantage of the Snow-Related Information for Commuters. Of these 104 people, 83 people, or 80%, said the information was useful in their decision-making for commuting. The most useful information was "Forecast of snowfall by next morning." The leading reason for usefulness was "Changed the time to leave home," followed by "Paid extra attention to slipperiness of the road surface" and "Mental leeway was

provided by road and weather information when commuting." That the information provided a sense of comfort and a reduction of stress during driving were among the reasons cited by many monitors (Figure 4).

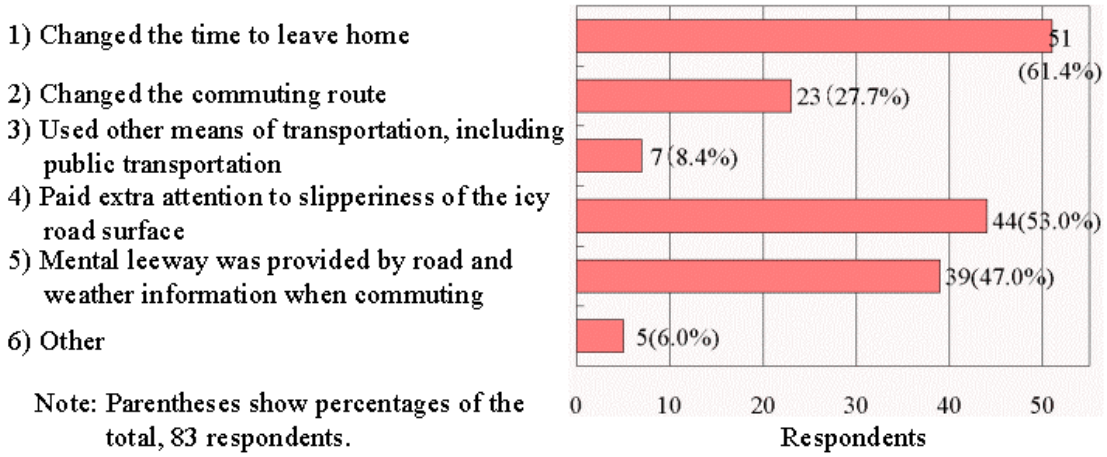

Figure 4: Usefulness of the provided information (multiple answers allowed)

Approximately 60% of monitors answered that they changed their time to leave home for commuting, travel routes, and transportation mode. Over 50% of the monitors responded that they "Changed the time to leave home because of the provided information" (Figure 5).

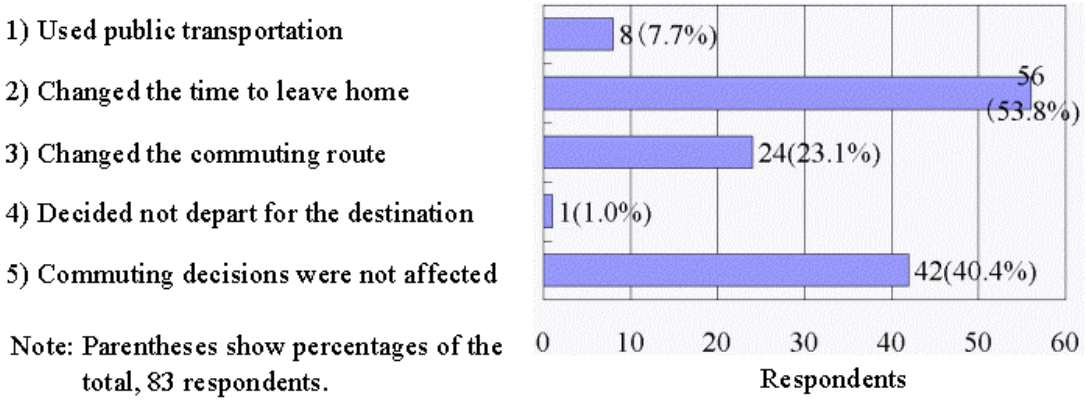

Figure 5: Whether commuting decisions were affected by information provision

About 50% of the monitors commented that participation in this kind of experiment would raise awareness of the needs to change alternative modes of commuting during winter.

The above results indicate that proper provision of winter road and weather information to encourage staggered commuting hours and the use of public transportation instead of cars could help to mitigate traffic congestion and foster smooth transportation.

These two field experiments demonstrated the effectiveness of information provision

to local regions. It can increase demand for circular touring and mitigate urban transportation problems unique to winter. Also, these experiments have proven the feasibility of using XML. The employment of XML as a data format enables information providers to collect data from information sources on the Internet. Accordingly, the information providers can efficiently construct a system to compile and offer the collected data that fulfills the needs of users and to flexibly respond to specification changes.

ITS BASED ON WEB SERVICE

Commercial use of the Internet, which started in the U.S. in 1991, and the development of Mosaic (browser software) have fueled increases in general-purpose Internet use.

HTML standardized the presentation of Web site content, such as text, images, and links. Also, it uses links to present the content of one Web site by arbitrarily combining it with that of another site. Moreover, it allows search of a gigantic database: all the Web sites in the world. XML standardized a method of defining the semantics and structure of data to achieve translatability into machine language. This standardization promises to accelerate the distribution of information on the Web, which is a standardized platform.

Consequently, standardization of services on the Web-based system and combination of multiple arbitrary services are promoted to offer new value-added services.

Since web-service-based ITS permits freedom in combination of services to satisfy the user needs, they can be flexibly customized according to users' current location and tastes, as well as the time of the day. Various ideas and local characteristics can be incorporated for flexible system construction. The opportunities for regional ITS business are expected to increase accordingly(Figure 6).

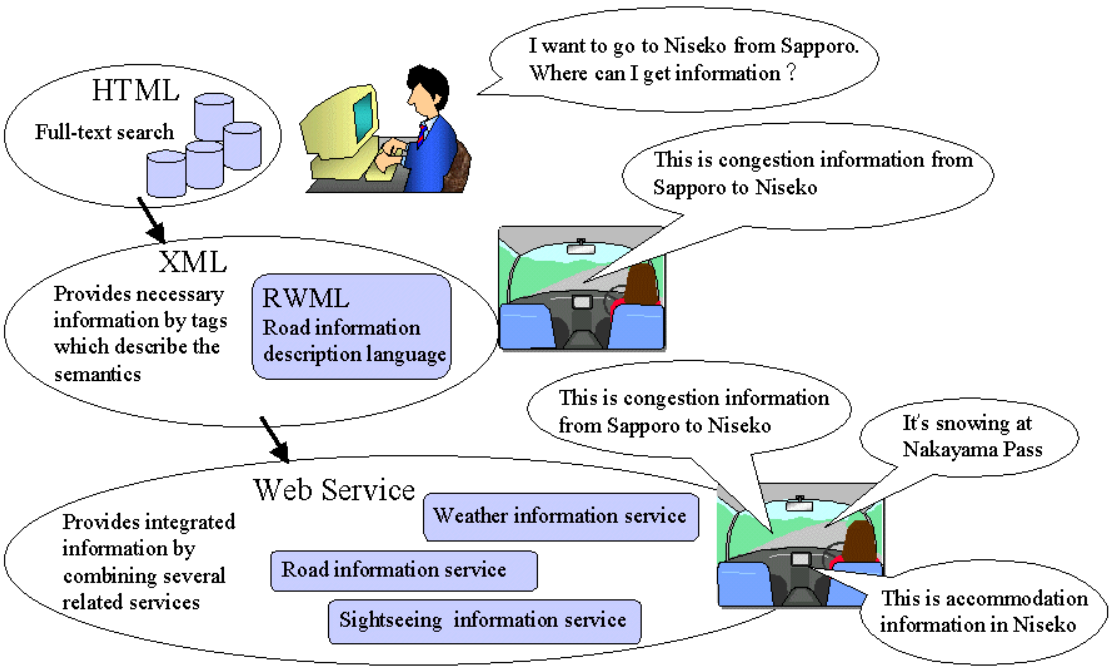

Figure 6:Transition from HTML to XML to web services

FUTURE DEVELOPMENT OF RWML TECHNOLOGY

The current RWML describes transportation-related information in conjunction with time and location on the road. Described information includes road information (e.g., road surface conditions), weather information, and local information (e.g., tourism and events). They can be used at all stages of information handling via the Internet: collection, exchange, sharing, provision, distribution, compilation, and selling. The later the stage, the more integrated the services. Introduction of the web service concept enables such integrated services.

If "Smartway web service" is to be a comprehensive mobility-support service then a "Smartway web service XML" (SW-XML) will be needed to realize that service. Because SW-XML will be an upgraded version of the current RWML, it must integrate different types of XML data, including those on tourism, public transportation, weather, and maps, and be able to combine web services based on all these types of XML data. Regarding the Internet, SOAP, WSDL, and UDDI are proposed as standard methods for service definition, input and output data, and procedures to integrate services. Employment of these proposed protocols and methods will be important.

SOAP is like the envelope of a letter. Information described by SOAP includes that on the destination required for web service connection. WSDL is a standardized description for service usage. It is like a user manual. UDDI is a search directory for web services. It can be used to search for corporate information and business information (yellow pages). The main organization providing the web service must register in the UDDI registry.

THE FUTURE OF ITS IN A UBIQUITOUS NETWORK SOCIETY

In a ubiquitous network society, the network would extend throughout society. All machines, including home appliances and automobiles, would be connected to the network. Any kind of information you might want would be available anywhere. Such a society will be materialized by mobile Internet technologies, such as IPv6, and the features of ITS will be profoundly changed as well. The current ITS, which depends on special networks and devices, will turn into an ITS that employs general-purpose networks and devices.

Road information is not the only type of information needed when driving. Other types are numerous: information on public transportation, tourism, shopping, and much more. Important from the standpoint of users is how many types of information are available and whether the provided services can answer the needs of users. XML and web services will be indispensable toward commercialization of ITS. With this trend in mind, we would like to further develop the RWML technology.

FUTURE PROSPECTS

The Niseko-Youtei-e-Route Experiment of fiscal 2001 showed that information provision had some effect on local tourism. The period of that experiment, which is to be held again in fiscal 2002, will be extended to the seventeen weeks from June 21 to November 4. With the addition of six municipalities in the vicinity of Lake Toya, the experiment will be conducted in fifteen municipalities. During the experiment, we will endeavor to put our system into practical use by improving the current system (e.g.,

affording ease of use during driving) and by adding new information-provision methods (e.g., interactive communications between local regions and users).

The Smart Sapporo Snow Information Experiment, which has proven that provision of information to road users can help to solve winter-specific urban transportation problems, will be held again in the winter of 2002 - 2003. The period of this experiment will also be extended to further examine the possibility of smoothing transportation by information provision.

In light of the results of these efforts, we will continue to strive for improvement of the XML-based RWML technology in order to provide comprehensive information services and mobility-support services based on road information that better address user needs.

ACKOWLEDGEMENTS

I would like to thank the organizations supporting and sitting on the Niseko-Youtei-e-Route Experiment Committee and the Smart Sapporo Snow Information Experiment Committee for their invaluable assistance.