The Use of Information En-route using XML Technology
- Mobile Internet Experiment using Road Web Markup Language -

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ABSTRACT

The authors have been developing XML-based Road Web Markup Language (RWML), and an "on-demand" server technology that will enable road travelers to access, using in-car mobile terminals, a variety of information such as that on roads, sightseeing, events, municipal services including facilities, weather and disaster prevention. This paper outlines the history of these development efforts as they relate to the Field Experiment on Use of Information En-route via Mobile Terminals, which will be launched in July 2001 in Hokkaido as a public-private joint study.

INTRODUCTION

The Hokkaido Development Bureau and the Civil Engineering Research Institute of Hokkaido have been promoting the ITS/Win Research Program for research and development of ITS technology intended for Hokkaido's cold and snowy climates. In this program, we have been developing a road information system that will be based on XML (Extensible Markup Language), a next-generation Internet language.

The R&D includes Road Web Markup Language (RWML), and an "on-demand" server technology that will enable road travelers to access, using in-car mobile terminals, a variety of information such as that on roads, sightseeing, events, municipal services including facilities, weather and disaster prevention(1,2,3).

This paper outlines the history of these development efforts as they relate to the Field Experiment on Use of Information En-route via Mobile Terminals, which will be launched in July 2001 in Hokkaido as a public-private joint study.

INFORMATION SERVICE TO ROAD TRAVELERS EN-ROUTE

In recent years, cell phones and car navigation systems have become increasingly sophisticated and pervasive. In the near future, cell phone users should be able to access a variety of information via the Internet whenever and wherever desired. Using sophisticated mobile and car-mounted multimedia devices as they become commercially available, road travelers should be able to satisfy their various needs for information.

In line with this scenario, the Hokkaido Development Bureau has been entrusted with the

development of the sub-service #160 “Utilization of Information in the Advanced Information and Telecommunications Sosiety” in the ongoing nationwide project to refine details of the ITS system architecture and to compile a guideline for implementation of the system.

This sub-service is intended to provide, via on-demand/push server, a variety of information such as that on roads, events, municipal services including facilities and disaster prevention to road travelers who are equipped with mobile or car-mounted multimedia devices.

In line with this, we have been developing concepts for providing road travelers and other users with information not only on roads but also on local characteristics. Based on this information, we are proposing a new form of information use that can help make driving safer and more pleasant and can contribute to the regional vitalization of tourism and other areas.

XML-BASED SHARING OF MULTI-SOURCE INFORMATION

Combined provision of road and other regional information entails the possibility of having many different information sources, because several organizations are collecting and compiling information separately. This potential problem can be overcome by the use of XML, which enables the relatively easy sharing of multi-source information.

Five stages are envisioned in the use of information via mobile terminals: (1) Mobile Sensor Service, (2) Mobile Personnel Support Service, (3) Mobile Support Service, (4) Mobile Edu-tainment Service, and (5) Mobile Commerce Service. The first stages are of a more public nature, whereas the latter stages are more business-oriented and are largely based on public-private partnership. Combined provision of road-related (public-sector source) and private-sector source information can afford higher added value, cater to specific user needs and possibly generate business opportunities.

The combined information provision, if realized and expanded, can benefit a great number of road travelers in various ways. To do this, an environment will need to be established that enables easy sharing of the multi-source data available on the Web. As XML is extremely promising for such application, the language will requires further study and evaluation toward developing related technologies for collecting, sharing and providing information.

XML is platform-independent, is easily converted to other media, and enables systematic linkage of time, location and information. As such, XML and its related Internet technology can prove to be an extremely efficient and practical solution for regions that desire to build an ITS system but currently have no related infrastructure.

CONCEPT OF FIELD EXPERIMENT IN HOKKAIDO

In the hope of using XML technology to help enhance the appeal of driving to tourist destinations as well as to resolve winter traffic problems, both of which are key challenges for Hokkaido, the Hokkaido Development Bureau and the Civil Engineering Research Institute have been striving for the realization of a field experiment for XML study and testing.

In Hokkaido, road conditions are relatively favorable in summer but can become hazardous in winter due to snowfall and snow accumulation. The field experiment, to be launched in July,

should aim generally to enhance the safety and pleasantness of road travel through the provision of information. It also should focus more specifically on the regional requirements of making summer driving more comfortable and further preventing winter traffic obstructions due to snowfall or snow accumulation.

Prior to the start of the field experiment, the Civil Engineering Research Institute established the Working Committee on Utilization of Information in the Advanced Information and Telecommunications Sosiety, by gathering XML experts from relevant fields including road traffic and telecommunications. The committee developed a concept for the entire experiment as well as models for use of XML and other information technology.

The working committee has decided that the field experiment, to be carried out in Hokkaido, should in principle 1) constitute a road project, 2) contribute to regional vitalization and the creation of new industries, and 3) be applicable to other regions. Two types of experiment have been envisioned: a summer rural experiment aimed at driving safety and comfort for tourists as well as regional vitalization, and a winter urban experiment designed to improve the safety, convenience and smoothness of winter driving.

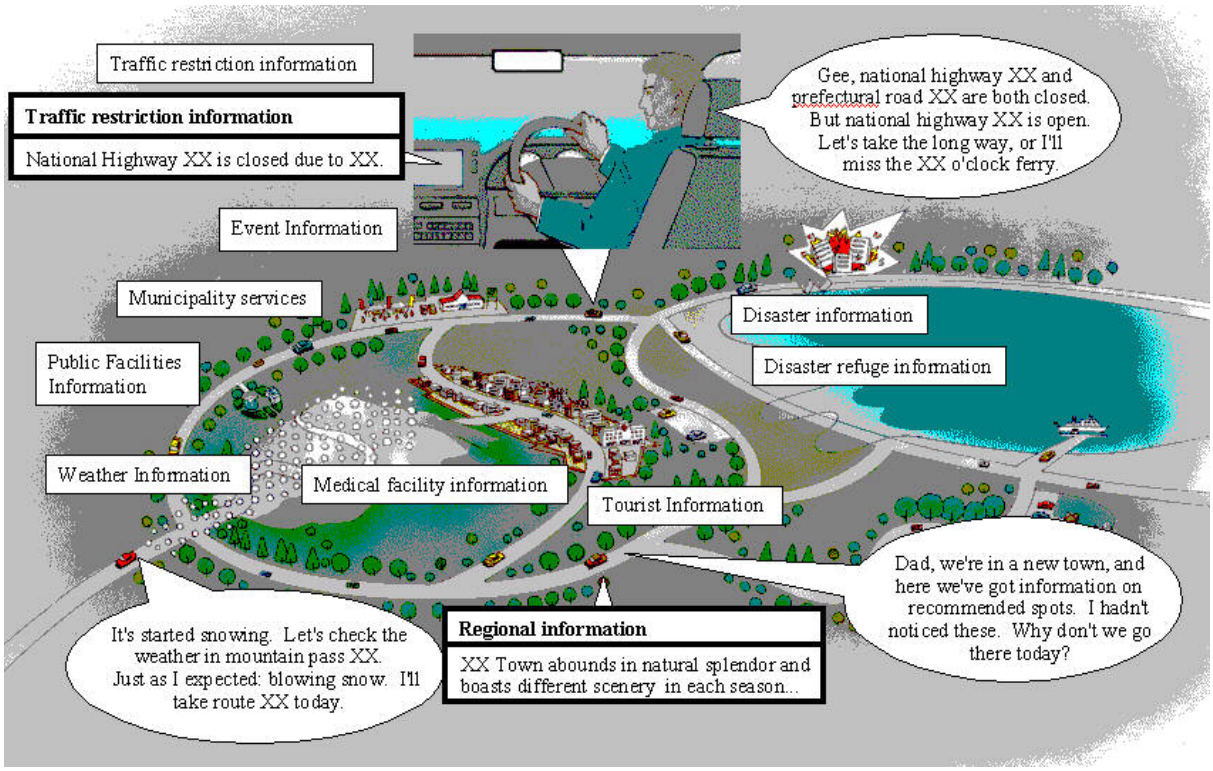


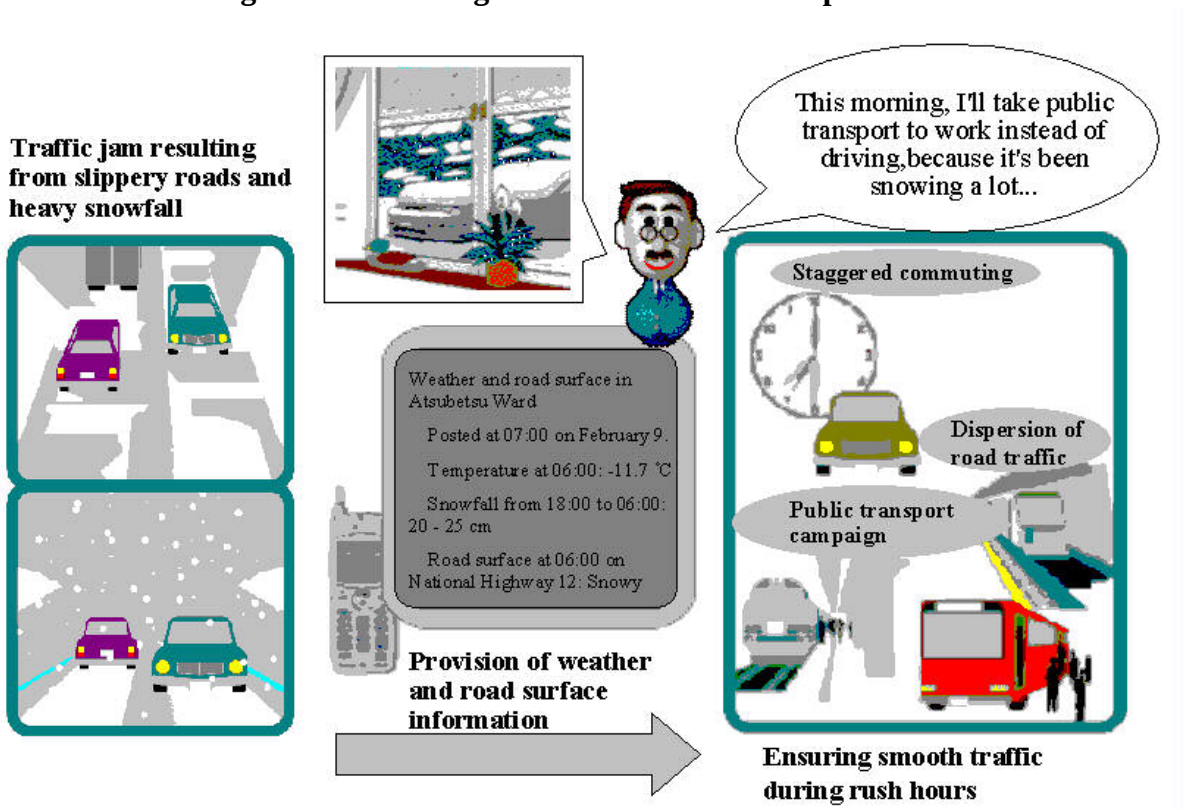
Figure 1: Rendering of the Summer Rural Experiment

Two models have been proposed for testing in the summer rural experiment on selected routes and in selected areas: A "push information" (predetermined) model in which a server will provide information on roads, regional roadside facilities and natural features to cell phones and car navigation devices; and an "on-demand" model in which a server will search for, tailor and provide specific regional tourist/event information requested by users on a real-time basis to car navigation devices, service terminals at road stations and cell phones.

For the winter urban experiment, three models have been proposed: a "push" model in which

a server will provide monitors with information via e-mail on road and weather conditions, public transportation, and disaster prevention during heavy snowfall; an "on-demand" model in which a server will search for, tailor and provide specific information requested by monitors on areas similar to those mentioned above; and an "info partnership" model in which road- and snow-related information will be collected on the Internet.

Figure 2: Rendering of the Winter Urban Experiment



The Civil Engineering Research Institute, based on the above proposals, solicited the participation of private companies in this research. In February 2001, the Institute launched joint research with successful applicants, on technologies for using information in the advanced information and telecommunications sosiety.

JOINT FIELD EXPERIMENT WITH LOCAL COMMUNITIES AND BUSINESSES

By using new systems and technology offered by the participating businesses, a chosen area, and a basic platform offered by the Institute, this joint research aims, through experiments, to provide services that are useful and interesting to road travelers as well as to formulate RWML-based XML specifications.

The joint research involves the 13 organizations and groups listed below. It will continue through March 2003.

Joint Research Participants

1) ARA Co.,Ltd. / CNI Co., Ltd.
2) NTT DATA CORPORATION / PACIFIC CONSULTANTS CO., LTD.
3) OKI ELECTRIC INDUSTRY CO., LTD.
4) Sapporo Information Network Co., Ltd.

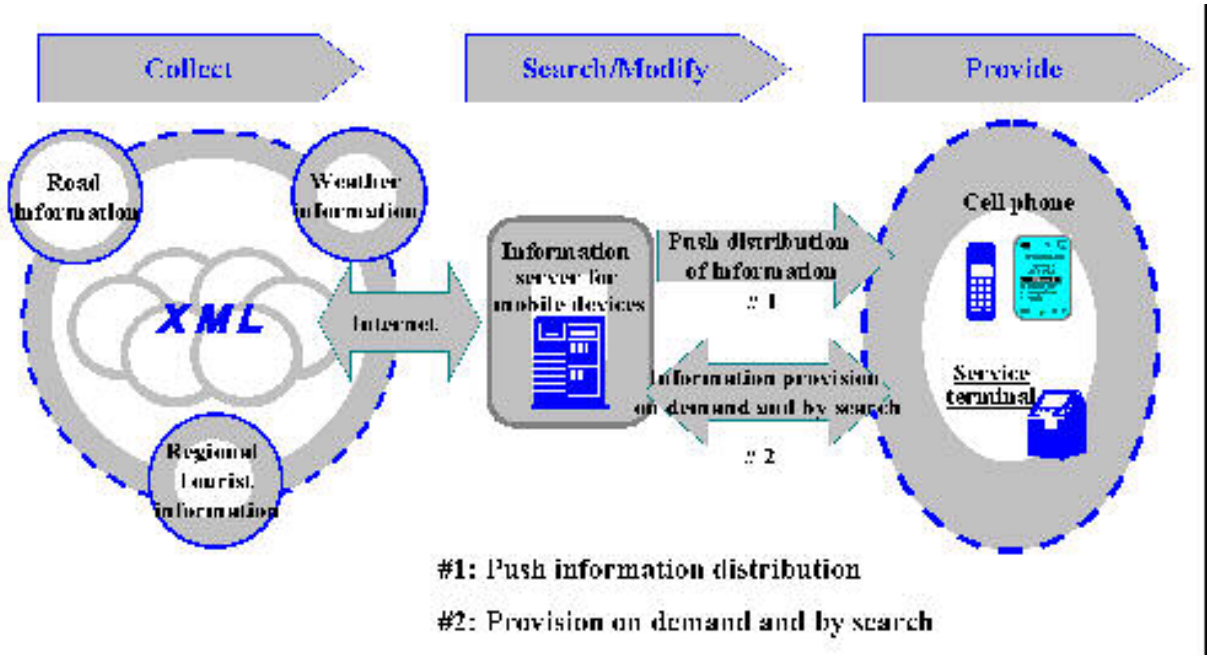
5) SUMITOMO ELECTRIC INDUSTRIES, LTD.
6) TOSHIBA CORPORATION
7) Nagoya Electric Works Co. Ltd.
8) Japan Weather Association, Hokkaido Regional Office
9) NIPPON KOEI CO., LTD.
10) FUJITSU LIMITED
11) Hokkaido Development Engineering Center / ADOS CO., LTD. / HBC FLEX.,Ltd. / Open Loop Inc. / Civil Engineering Services Co.,Ltd. / TI PLAN CONSULTANT CO., LTD.
12) Hokkaido Road Management Engineering Center
13) MITSUBISHI ELECTRIC CORPORATION

The Niseko-Yotei region has been chosen as the field for the summer rural experiment because the region is one of the busiest tourist spots in Hokkaido and close cooperation from local organizations and authorities can be expected. A preparatory experiment is set for the July and August 2001 period while the actual experiment is scheduled in the summer of 2002. The winter urban experiment will be carried out in Sapporo and its environs in January 2002, to coincide with the 2002 International Winter Road Congress (PIARC) in Sapporo.

For the summer rural experiment, the Civil Engineering Research Institute has established a joint council with the Otaru Development and Construction Department of Hokkaido Development Bureau and nine local municipalities in the Niseko-Yotei region. Preparations are underway for the experiment, called "Niseko-Yotei e-Kaido," in which monitors will be able to access a variety of information on their current location and upcoming destination via e-mail and on a Web site using their i-mode cell phones. These monitors will receive what are called "Country Messages" from local municipalities via e-mail as well as local information geared to their interests, in addition to server-push distribution of information on weather and local events. The monitors also will be provided with e-mail messages regarding any traffic restriction on the route. For those who ask for more detailed information, an on-demand search function will be offered at service terminals in road stations and on a cell phone Web site.

Data stored by individual sources, i.e. road authorities, weather agencies and municipalities, will be converted into RWML-based XML, ready for distribution by a common e-mail server through different data servers that are to be set up at the individual sources. The e-mail server will check a monitor's requested information together with his/her current location and upcoming destination against pre-selected local data, and distribute the information by e-mail.

Figure 3: Rendering of XML-based Information Collection/Distribution



In an attempt to make the summer rural experiment enjoyable to its monitor participants, the experiment also will offer a mobile version of the popular Hokkaido Road Station Stamp Rally. In this event, to be called "Mobile Challenge," the monitors are to visit designated sites on their ways to upcoming destinations, collect the sites' key words, and send these words to a server via their cell phones. Depending on the number of key words sent, the monitors will be entitled to apply for prizes.

Because of the limited amount of time available for preparations, monitors in the preparatory experiment of this summer will be asked to notify the e-mail server of their current locations and the upcoming destinations. Review will be carried out on the possibility of location data being automatically distributed by clients or automatically collected by an e-mail server, in the actual experiment in the summer of 2002.

Server systems such as that mentioned above can, when commercialized, have a great impact on the way car navigation systems are used. For example, entering a new municipal zone while driving can cause the server to send to the car navigation terminal the welcoming message of the town as well as information on scenic spots in the area that may not be included in guidebooks, possibly helping to promote the area's vitality by enhancing tourism.

Also, top priority can be given to the provision of location- and time-specific emergency information, such as on natural disaster as well as weather information on heavy rain, fog and other adverse conditions, which can help in ensuring greater safety for road travelers. Review is underway on the possibility of constructing a system in which emergency disaster warning may be sent out by personnel of the organization(s) concerned and by using a program which is not built in the system in advance simultaneously to the entire population of monitors participating in the preparatory experiment of this summer.

We will incorporate the results of the field experiment on the performance and feasibility of the mobile information services technology and the prototype system as well as user acceptance, in order to make the winter urban experiment, scheduled after the first one, and the summer 2002 experiment more productive.

FRAMEWORK FOR "SMART WAY XML"

As well as carrying the field experiments, as part of the study on use of information in a society advanced in information and telecommunications, the joint research extends beyond the areas in road traffic and includes efforts to offer, via a server, XML data on various other fields. These efforts aim to meet road travelers' varied information needs by constructing an environment in which multi-source XML data provided by road authorities, public organizations and for-profit ITS service providers can be commonly used. Such an environment is collectively called "Smart Way XML" (SW-XML).

In an SW-XML environment, the distributor of information will provide XML data to its users via various media such as car navigation systems, cell phones, a digital broadcast, and the Internet.

In Japan, the standardization of XML specifications in various fields is about to begin. XML data on roads, tourism, public transport, weather, maps and more are already convertible into SW-XML. It will need to be ensured that the Document Type Definition (DTD) for XML used for the current XML technology will work, wherever possible, in whatever the SW-XML environment. In line with this, a method has been proposed for designing DTD that enables the embedding of current XML data in a SW-XML framework. To achieve DTD that enables such embedding, the method proposes providing upper levels of the structure of XML data with tags that are used to embed (or wrap) various data.

```
<SW-XML>
<roadInfo>
...
(Enter XML road information.)
...
</roadInfo>
<touristInfo>
...
(Enter XML tourism information.)
...
</touristInfo>
<publictransportInfo>
...
(Enter XML public transport information.)
...
</publictransportInfo>
</SW-XML>
```

Figure 4: Intended SW-XML DTD

Under this method, large structures such as those described by the tags "roadInfo," "tourstInfo," and "publictransportInfo" will be defined by SW-XML, and a variety of other information at lower levels will be structured to various XML specifications. Problems with this method must be resolved, such as those that arise when the same data are described in different DTD and when lower-level data compete.

An SW-XML environment such as that described above, if commercialized, will allow the provision of combined, higher value-added road and private-sector information. For example, in cold, snowy regions like Hokkaido, the weather is extremely changeable in mountain passes and in early winter. Normally (in early winter and early spring), a small minority of cars wears winter tires in anticipation of localized snow accumulation or frozen road surfaces. An SW-XML-based server can assist poorly prepared drivers in cars mounted with summer tires and heading toward areas of unexpected snowy or icy road conditions in ensuring safe driving by sending detailed voice messages of road information, the appropriate areas for tire chain mounting on the route, and gas stations offering tire replacement. For those drivers who urgently need to purchase winter tires or tire chains, a server can provide customized information on roadside stores dealing in these items in appropriate sizes, complete with the stores' current inventory status and pricing data. The server also can handle online purchasing and settlement of payment.

The preparatory summer experiment will focus on RWML road data, using XML data only in limited fields including weather and tourism. As part of the joint research mentioned earlier, a working group has been further reviewing SW-XML's potential as the base for the winter urban experiment and the summer 2002 experiment.

CONCLUSION

The joint research group will continue to strive to develop, through the series of field experiments, XML mobile information services models and a technology platform that can be adapted to various regional ITS projects as sustainable solutions. The group also intends to present the results of its activities at the 2002 International Winter Road Congress (PIARC) in Sapporo.

We would like to conclude by expressing our appreciation to the members of the joint research group for their cooperation in this study.

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