Road Web Markup Language

- XML for Road Information Distribution on the Net -

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ABSTRACT

The Civil Engineering Research Institute of Hokkaido (CERI) has 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 XML-based Road Web Markup Language (RWML). XML (eXtensible Markup Language) is a next-generation Internet language.

The R&D includes an on-demand server technology that will enable road users to access a variety of information, concerning roads, sightseeing, events, and municipal services including facilities, weather information and disaster prevention, using the in-car mobile terminals of a car navigation system or Internet-accessible mobile phones.

This paper outlines the characteristics of RWML in comparison of XML and HTML, history of development and results of field experiments.

INTRODUCTION

The Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunications reported the number of Internet users in Japan as 47.08 million people in 2000 and estimated this number would rise to 87.20 million people in 2005 in the "2001 WHITE PAPER, Information and Communications in Japan(*1*)".

By the end of March 2000, the Internet-accessible mobile phones had achieved to 34.56 million in Japan. The recent increase of Internet users in Japan were brought by this type of mobile phone's increase. In additon, the numbers of car navigation systems had achieved to 7.90 million by the end of August 2000. The recent car navigation systems have also the internet access function using mobile phones. As car navigation systems advance, the demand for information during driving is expected to increase.

The Civil Engineering Research Institute of Hokkaido (CERI) has 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 XML-based Road Web Markup Language (RWML). XML (Extensible Markup Language) is a next-generation Internet language(*2,3,4*).

Provision of road information via the Internet is now based on HTML. However, operability and safety need to be addressed regarding provision of information to mobile phones and to in-car information devices. This means that such information provision should

include enhanced information search based on locational information and voice/sound output. HTML has limitations with regard to manipulation of information.

To address the above needs and issues, CERI is developing Road Web Markup Language (RWML). The Institute also has been conducting joint research with private enterprises and other organizations since April 2001. The parties concerned are aggressively pursuing research on information-provision devices whose capabilities include the handling of on-demand requests for road information during driving. These also should be capable of handling information on tourism, local events, administrative services, public facilities, weather, and disaster.

This study proposes an XML-based RWML that can select information from sources distributed across the Internet to provide users with locational information and information that meets their interests and preferences. The proposed system also enables information provision such that operability and safety during driving are addressed.

CHARACTERISTICS OF XML

Characteristics and limitations of HTML

HTML, developed as a markup language developed by the Conseil Europeen pour la Recherche Nucleaire (CERN) in 1991, totally changed the pre-1991 text-based method of presentation into one with enhanced presentation capabilities enabled by incorporation of color imagery and arbitrary page layout. In addition, HTML has a "net surfing" function that allows users to move around on the same Web page and between Web pages through links.

Today, individuals and organizations, whether private or public, are taking advantage of the presentation and Net surfing capabilities of HTML to develop Web-based information content for the Internet. As the capabilities related to frames, CGI, and the like, and those related to applications are upgraded, HTML is now asked to include capabilities for information search, telecommunications, and e-commerce, all of which exceed the original presentation capabilities of HTML.

The Web, HTML, and the browser are indispensable tools for today's Internet, and information is published and various services are provided based on these tools. However, HTML employs a language specification for presentation that was originally intended for information publishing. As Internet pervasion continued and the Internet became more useful for more purposes, the limitations of HTML began to be addressed. These limitations include a lack of extensibility and an inability to provide data definitions comprehensible for computers both of which are due to its specification of only the format of the document.

Emergence of XML, and its characteristics

Toward overcoming the limitations of HTML, the World Wide Web Consortium (W3C) launched an effort to make SGML Web-compatible. Upon examination of its advantages and disadvantages, it was modified into eXtensible Markup Language (XML), which was approved as a W3C format in 1998.

XML uses a simple and flexible language specification with a text format. While HTML supports only representation and layout of

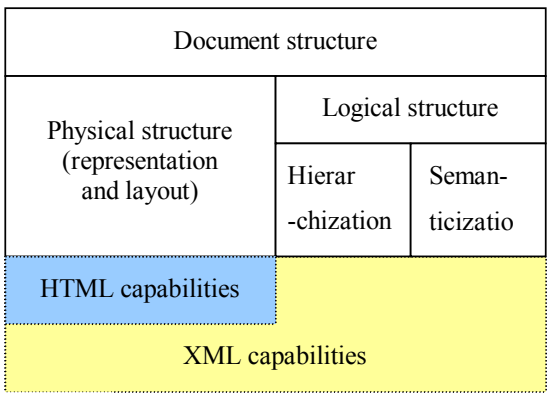

FIGURE 1 Differences between HTML and XML

documents, XML can support the logical structure.

The capability of XML to define the logical structure permits what computers used to recognize as mere text to be handled as data of semantic nature. Information distributed across the Internet by XML can be used as if it were part of a single huge database.

DEVELOPMENT AND UPGRADING OF RWML

Direction of development

RWML, still in the process of upgrading, will contribute to the construction of RWML-based systems by making road-related information compatible with XML and allowing distribution of such information across the network. Examples of RWML-based systems are management systems whose purposes include road management and disaster prevention, and systems to aid travel planning and driving convenience. In the planned system (**FIGURE 2**), the RWML-based system collects and manipulates RWML-based information and provides that information to users via the Internet.

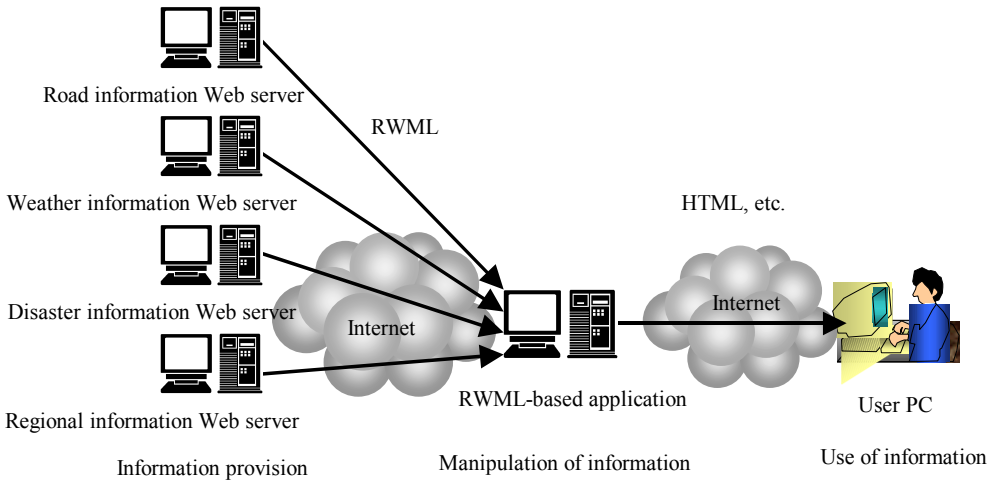

FIGURE 2 An RWML-based system

Regarding road-related information, RWML defines four categories: road, weather, disaster, and region. The road information mainly refers to road management (traffic congestion and traffic control), and the weather information to current weather, weather forecast, and the like. The disaster information relates to disasters, disaster prevention, and restoration, and the regional information to local events, regional tourism, and the like.

In addition to the information categorized as above, RWML requires incorporation of locational information (especially information on roads). Road administrators use kiloposts to represent locations along the roads they administer, for example, “Kilopost 5 on National Highway Rt.5.” Since it is common to represent locations by longitude, latitude, address, and place name, incorporation of road-referenced locational information is being studied and systematized for RWML.

Processing of the information provided by the RWML-based system and other systems is assumed to increase the usefulness of the information, as a result of the definition of additional information, such as updated data, details of the original information provider, and provision conditions.

RWML 0.71

In accordance with the development direction outlined in the section above, a joint research group has launched development of RWML. Version 0.70 was released on July 22, 1999, followed by Version 0.71 on October 20, 1999. Errors in the original version, including misspellings, were corrected in developing the upgraded version.

Version 0.71 was made compatible with the items required for the road, weather, disaster, and regional information. The required items were identified based on the relevant JIS formats, specifications of installed equipment on sites, and other aspects for development and upgrading.

FIGURE 3 is an excerpt of the table of contents from the specification document of RWML 0.71.

FIGURE 3 Table of contents for the RWML 0.71 specification document

A primary feature of RWML 0.71 is incorporation of four categories: basic information on location, updating, information management, and conditions for information provision. The location information contains geographic data of the site. This does not mean that the location information merely plots points on the map; it is compiled such that a certain zone, road section, or other geographical unit on the map is regarded as one area in terms of information provision. While it basically represents points on the map by longitude and latitude and contains route information, it allows representation by place name, meshes in a particular region, and other means. The update information describes time intervals between updates, the time and date of information provision and the like. The objective of giving details of the original information provider information is to clarify the identity of such by making a record of them. Information sources tend to be not identified due to secondary manipulation of information. The conditions for information provision include acceptability for secondary manipulation and inclusion of the use conditions and waiver of responsibly. RWML 0.71 requires incorporation of the basic information into information on roads, weather, disasters, and regions, and clarification of the location of the stored information, the conditions for information provision, and other items. An example of RWML 0.71 is presented in **FIGURE 4**.

```
<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE RWML SYSTEM "RWML-071.dtd">
<RWML>
 <regional-info category="store">
  <basic-info>
   <place>
    <point>     <latitude>42,51,12.4</latitude>    <longitude>141,06,03.9</longitude>    </point>
    <route>     <route-name>National Highway Rt.230</route-name>    </route>
   </place>
   <update>     <last-update>2001-07-15T11:00+09:00</last-update>    </update>
   <authority>
    <authority-name><organization>Hokkaido Michi-no-Eki Association</organization></authority-name>
    <liaison>    <contact-name>Hokkaido Michi-no-Eki Association Secretariat</contact-name>
                 <contact-method href="mailto:office@its-win.jp" />
    </liaison>
   </authority>
   <condition>  <permission>none</permission>   <limitation>escape</limitation>    </condition>
  </basic-info>
  <name>Boyo-Nakayama Road Station </name>
  <schedule>T09:00+09:00/T18:00+09:00</schedule>
  <outline>An ideal place to stop at Nakayama Pass. </outline>
  <detail>
 An ideal place to stop at Nakayama Pass.  Tourist information, souvenirs, and local specialties are available.
Note:/There are eat-in and take-out restaurants.
  </detail>
  <image src="http://www.niseko-youtei.jp/event-012.jpg" />
  <website href="http://www.niseko-youtei.jp/event-012.html" />
 </regional-info>
</RWML>
```

FIGURE 4 An example of RWML 0.71

RWML 0.80

The Niseko-Yotei E-Route Experiment was conducted in the summer of 2001. In the experiment, an RWML-based data exchange system was constructed and tested. Because of problems in adopting RWML 0.71, its upgrade, RWML 0.8, was developed and tested. The problems with RWML 0.71 follow:

(1) The location information required longitude and latitude, information. Continually checking such information was troublesome. It was thought to be better to compile the location information using only the place name.
(2) The specification of RWML 0.71 did not include messages from municipalities and information on facilities.
(3) Ambiguities with the specifications were thought could result in computer and human misinterpretation, thereby inconveniencing operation.

As for Problem (1), longitude and latitude were required as locational information in RWML 0.71, to facilitate operations by the RWML-based system, including location search. However, such search is not necessarily needed, depending on the system. The specification was modified accordingly.

To remedy Problem (2), regional information was categorized by message from the municipality, local event, and tourism; necessary items were added to the specification. This modification was made considering information exchange with the tourism XML, an ongoing effort that is being led by Japan Tourist Association.

To address Problem (3), ambiguities in the specifications relevant to this experiment were rectified. Rules were made for elements that are difficult to correct.

The above corrections resulted in the tree of RWML 0.80 (**FIGURE 5**).

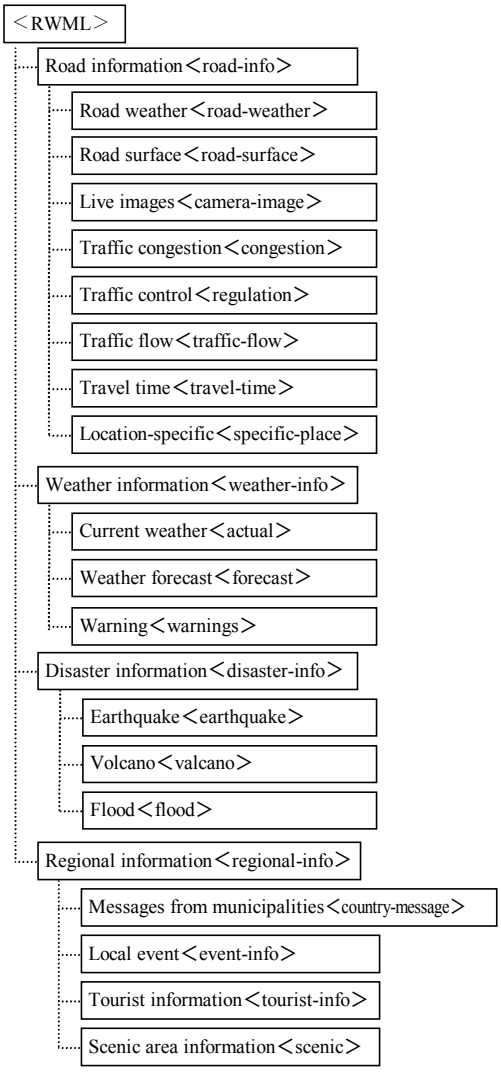

FIGURE 5 Tree of RWML 0.80

FIELD TEST OF RWML

Niseko-Youtei E-route Experiment (5)

The Niseko-Yotei E-Route Experiment was conducted in the Niseko-Yotei area of Hokkaido from July 2, 2001, to August 31, 2001. During the experiment, road information, weather information, and regional information including tourist and event information, was customized according to the locations and pre-registered information needs of users.

Terminals were mobile phones (so-called i-mode of NTT DoCoMo) and Internet-compatible terminal devices at road station kiosks. A system of information provision compatible with these devices was developed.

The road, weather, and regional information was compiled by RWML and distributed to servers on the Internet. As soon as the user transmitted locational information, relevant road and weather information was provided. RWML was confirmed to provide information upon selection by taking advantage of XML's capability of enabling documents to be handled as general data.

Terminal devices at road station kiosks utilized other advantages of XML, such as platform-independence and compatibility with already developed systems, including the World Wide Web. Various kinds of information common to towns and villages in the same region were displayed on the same page.

FIGURE 6 Display on the terminal device at the road station kiosk

For testing in 2002 is a new system with an expanded scope, covering not only Internet-compatible mobile phones and road station kiosk terminal devices, but also Internet-based car navigation system.

Smart Sapporo Snow-info Experiment 2002(6)

An information-provision experiment is scheduled for the winter of 2002, between mid-January and late February. Road information (mainly road surface conditions) and weather information (mainly snowfall) of Greater Sapporo will be provided to users according to their information needs.

This "Smart Sapporo Snow-info Experiment" has been under experiment for several years. Its objectives are to achieve smoother traffic flow and more comfortable winter living.

Although the specifics of the 2002 experiment are undecided, the system configuration has been planned. The system will describe road information, weather information, and other types of information by RWML and will publish such information on servers via the Internet. The servers tasked with information distribution will perform this based on the individual needs of users.

Employment of XML technology will help achieve smooth data exchange and sharing among multiple servers that are operating on different architectures and operating systems that are managed by different system administrators. Therefore, assessment of the practicality of RWML (an XML technology) will be an added objective of the 2002 experiment.

Information provision will be primarily by e-mail. Dedicated content will be prepared for PC and for a dedicated URL for non-PC Internet-compatible terminal devices.

The system will be designed to satisfy various needs. Another challenge will be employment of Java-equipped mobile phones as a new method of information provision. Also, content will be prepared that is exclusive to the Standing International Road Weather Commission (SIRWEC) and the 11th International Winter Road Congress (PIARC), both of which will hold congresses in Sapporo during the experiment period.

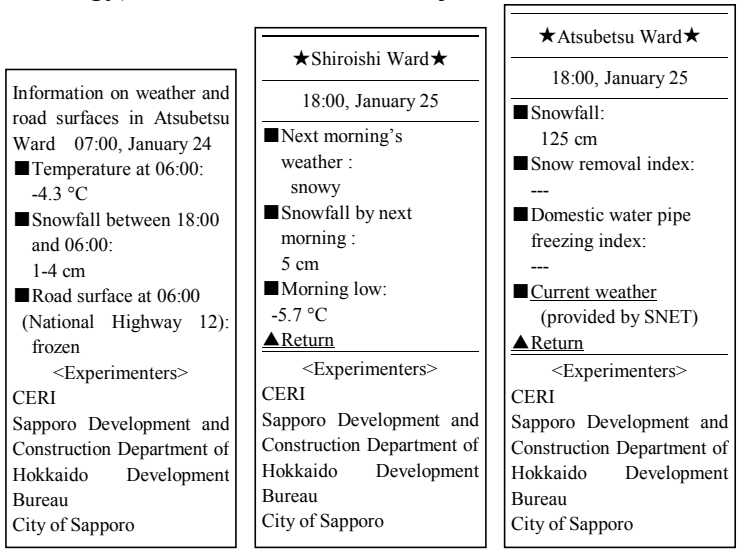

FIGURE 7 Examples of information provided to mobile phones (the 2001 experiment)

FUTURE DIRECTIONS OF RWML

Based on RWML 0.71a, which has been published, RWML 0.80 was developed for experimental implementation. The changes to the specification accompanying this upgrade focused on seamless operation. Therefore, information unnecessary to the experiment required deletion. To achieve coverage of a certain range of information items and smooth implementation of the system, the large, complex structure of RWML will made simple and consistent by the elimination of ambiguities.

Through employment of RWML in the Smart Sapporo Snow Information Experiment 2002 starting from January 2002, changes and additions to the specification will be constantly needed, to address issues for future application.

The direction of RWML development must be examined in line with the current and future trends of XML. These trends include compatibility with namespace, whereby names of attributes and elements can be assigned to different spaces, and compatibility with the schema language that can strictly define the structure (schema) of XML documents. Examples of the items defined include the type and scope of information content, relations among nested elements, and tags usable in XML documents. The future upgrade information about RWML

will be also available on the RWML Website(*7*).

CONCLUSIONS

Through the Niseko-Yotei E-Route Experiment, which was conducted during the summer of 2001 in Hokkaido, the operability of a system that takes advantage of XML characteristics was confirmed. In the test, road information, weather information, and regional information including tourist information were documented by XML and stored in servers connected to the Internet. Such information was provided to users after customization to their interests and preferences, to make use of the advantages of XML.

The characteristics of XML, which is a meta-language, permitted the rapid development of our application. Preparation for implementation began in April 2001 and that for testing on July 2. The time between these events is slightly less than three months.

Further development of RWML will be pursued through examination of a more efficient and concise language structure suitable for system operation and new trends of XML, such as compatibility with namespace and the schema language.

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