Research on a DATEX II based Dynamic Traffic Information Publish Platform

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Abstract

The Dynamic Traffic Information publish platform is a core component of the ITS information service system, which focuses on the function of retrieving ITS data from background servers and delivering them to the registered client terminators. The Intelligent Transportation System data format is characterized by its diversity and the complexity, and the traditional data representation cannot fulfill the performance goal of ITS data publish. For this reason, a new publish platform of Dynamic Traffic Information was discussed in this paper. Basing on the latest DATEX II data exchange standard, the platform's scalability and functionality were greatly enhanced.

1. Introduction

The dynamic traffic information publish platform is one of the information services bearing platforms; meanwhile, it is also an important part of the Intelligent Transportation Systems (ITS) platform [1]. Intelligent Transportation System is composed by series of relatively independent subsystems and components that work together. The overall efficiency of the ITS platform depends on the coordination and integration of the subsystems. Furthermore, the data publish in the dynamic traffic information publish platform is one of the most important issues within the intelligent traffic information projects. However, it is difficult on the implementation process of the specific traffic information dissemination. The first one is the difficulties on the data sharing and centralized storage. In general speaking, the information source was comes from different geographical places and the scattered resources brought a lot of trouble on the information processing. The second one is conversion issues of the heterogeneous data which is to be exchanged between the different systems with the larger complexity and unsatisfactory efficiency also. This has lots of reasons, such as the lack of the unified standards and specifications, the imbalances construction level of the different subsystems on planning and development, the duplication of reconstruction, the separation from the management system, or the barriers between information departments. All those problems led to the isolate information island. The last one, we do a great deal of work on the maintenance of data consistency that still cannot fulfilled the large requirement on the purposes to provide diverse and comprehensive transport information to the traffic information users, let alone it can provide additional value-added services based on the basic traffic information effectively.

2. The data exchange technology in dynamic traffic information publish

2.1. ITS-related data types

(1) Road monitoring data, including the freeway traffic flow monitoring data (traffic flow, speed, road share, cars classification, when away from the front, the length of the queue, etc.), the urban road traffic flow monitoring data, the video monitoring data, and the other intersections.

(2) Traffic control data, including the ramp control on high-speed road and priority signal control on trunk road, and the traffic signal cycle, phase and the time difference, such as traffic lights.

(3) Traffic management data, including the traffic and parking management information, the management of Intersection and electronic data, and the other charges.

(4) Public transport management data, including the public transport vehicles with GPS data, the time and bus traffic data lines, the bus priority control data and data transfer, such as public transportation.

(5) Security and incident management data, including the accident log data, the train arrived data, the location records of the emergency vehicles data, and the building and construction of regional identification data.

(6) Cargo vehicles transport data, including the certificate data of dangerous goods, the cargo transport fleet records, and the transport of goods attribute identification (category of goods), the cargo transfer data, and other safe operation records of vehicles.

(7) Environment and weather data, including exhaust-related parameters data, the weather and environmental data (temperature, precipitation and light).

(8) Vehicles and passenger information data, including the GPS data of vehicles, the vehicle detection data, the variable intelligence data, the vehicle trip data, the route guidance data provided by the department of data services (such as Traffic Management Center, TMC), and the parking price data.

978-0-7695-3497-8/08 $25.00 © 2008 IEEE
DOI 10.1109/IITA.2008.81

2.2. The dynamic traffic data exchange format

So far, there are two mature international standards of the traffic data exchange: the U.S. traffic data exchange standards and the European Union traffic data exchange standards. In addition, three new traffic data exchange standards are in researching and development right now. They are The XML-based traffic data exchange standards, the TransXML-based traffic data exchange standards and the CORBA-based traffic data exchange system [2].

(1) U.S. traffic data exchange standards

The NTCIP (National Transportation Communications for ITS Protocol) is the United States standards which is a standard communication protocol between electronic equipments in the field of Intelligent Transport System (ITS). The NTCIP is a joint standardization project of AASHTO, ITE, and NEMA, with funding from the RITA ITS JPO. The main objective of NTCIP is to ensure the "Interoperability" and "Interchangeable" between the traffic control units and ITS system components. The NTCIP defines a series of common communication protocol with the data dictionary and information collections for the data transportation, which is supported by the traffic management computer systems and the peripherals [3].

NTCIP application is divided into two categories: Center to Field (C2F) and Center to Center (C2C). The former include road-side facilities, the management of the transmission information between computers and vehicles and the latter refers to manage the various computer systems and data transmission between the centers, these centers could be in the same room, but also could be in adjacent operations management centre or across the center. The C2C in this simple application can be viewed as two centers for data exchange between computer, which is based on DATEX and CORBA communication protocol.

(2) XML-based traffic data exchange standards

In October 2003, NTCIP proposed the draft of XML-based applications to exchange traffic data. The draft involves two groups of XML-based standard protocol. The first is the Web services architecture based on the XML standard application protocol, which is defined by the W3C, including SOAP (The Simple Object Access Protocol) and WSDL (Web Service Description Language). The second one is called XML Direct which is a XML file based transfer protocol. This standard is still in the exploratory stage and waiting for the further improved. There is no successful case right now.

(3) TransXML-based traffic data exchange standards

TransXML traffic data exchange standards come from the National Highway collaborative research projects which are sponsored by the U.S. state and federal highway departments. The standards focus on four areas, the road measurement and design, the highway and bridge structure, the construction and materials and the transport security of the system.

TransXML traffic data exchange standards is widely used in the transport business areas, including asset management and information exchange. For its extensible and open language features, it provides a summary of the basis of map or database structure to a variety of applications to share information. From March 29, 2004, the United States Bentley Systems and Cambridge Systematics began to develop TransXML.

(4) CORBA-based data exchange standards

In 1998, AP2Corba has become one of the U.S. NTCIP (class E) Profile standards. With the maturity and the strengthening of object-oriented technology, CORBA (Common Object Request Broker Architecture) based communications is expected to become an ISO standard.

CORBA provide a development framework to connect different object-oriented system, particularly suitable for application in the following system of information transmission: object-oriented system, faster processing system and wide bandwidth system.

Object-oriented software can give full play to the advantage of CORBA, and to carry out rapid development. Many systems developed into a model of traffic exception, such as GCM GATEWAY in the United States.

3. The DATEX and DATEX II data model

DATEX is a communication standard developed by the European countries. The name was come from “Data Exchange”. DATEX provides simple and cheaper solutions that meet the general needs, in particularly for those systems that needs rapid real-time data transmission or those systems that has heavy load of transmission with insufficient bandwidth.

3.1. The DATEX data model

DATEX is a facilitator for the electronic exchange of traffic and travel related data between traffic centers including cross-border exchange. It acts as the “market place” between organizations in the information chain.

Over time various flaws with DATEX became evident while it was being used for data exchange within Europe. Persistent interoperability issues between different vendors’ implementations meant DATEX was not well suited for simple standardized data exchanges between countries.

DATEX has become out-of-date as recent developments in data exchange technology between businesses have focused increasingly on use of the Internet. In addition, new requirements for information have emerged which are not supported by the DATEX pre-standard [4].

3.2. The DATEX II data model

DATEX II is the successor to DATEX, a widely implemented pre-standard for the exchange of traffic information and traffic data in Europe [5].

DATEX II provides a rich and deeply structured data model specified using the Unified Modeling Language (UML). This features a platform independent model that can be mapped to multiple possible implementation platforms, which makes the modeling itself future-proof. At present, the model is mapped to information encoded in XML (eXtensible Markup Language) by automatically creating an XML schema definition. XML and XML schema are the most widely used data definition technology, and XML is sometimes referred to as the 'lingua franca' of today's data exchange. This choice ensures that DATEX II interfaces can easily be integrated in as many implementation technologies as possible for traffic centers and service provider systems.

In addition, DATEX II now features a high level of flexibility through an extensibility option. This allows individual users to exchange data content beyond that which is in the current DATEX II content model, but which is relevant to their special needs, and yet still remain DATEX II compliant. DATEX II enables this by offering a methodology for user extensibility of the data content model. This methodology guarantees that a traffic centre which applies any extensions according to the defined methodology will still be able to communicate with any other DATEX II compliant system at the basic model level without any special processing.

Similar to these improvements on the content side, DATEX II introduces the same split between abstract specifications and concrete implementation mappings on the exchange side. The abstract exchange specification again uses UML notation, and concrete mappings to widespread standard Internet technologies are specified, namely the HTTP protocol for simple exchange systems with low entry threshold and the Web Services' protocols (WSDL & SOAP) for exchanges with higher functional requirements.

DATEX II allows the paradigm of data exchange to be upgraded from one of exchange between fixed nodes (point to point) which was used in DATEX to one where data is available at any location across the Internet by using a DATEX II compliant client.

3.3. Information that can be exchanged using DATEX II

The domain coverage of DATEX II is all traffic and travel information related to urban and inter-urban road networks, ranging from traffic events such as accidents and road works to traffic flow, occupancy and journey times [6]. The main types of information exchanged through DATEX II showed in Table 1.

Table 1 information types exchanged through DATEX II

Type	Remarks
Accidents	
Obstructions	
Activities	public events, police operations etc.
Abnormal traffic conditions	queues etc.
Driving conditions	weather, road surface etc.
Poor road infrastructure	
Network management	closures, restrictions etc.
Sign information	VMS settings etc.
Roadside Assistance	
Car parking information	number of vacant spaces etc.
Transit information	rail and ferry connections etc.
Service disruption	Motorway service area information etc.
Measured traffic data	travel times, flow data etc.
Measured weather/pollution data	wind, precipitation, visibility, air quality etc.
Traffic view	a combination of event information and URLs for CCTV cameras etc.

4. The framework of DATEX II based publish platform

4.1. The framework introduction

This framework can be divided into three layers, the first layer is called the interactive layer, including the message queue management and various interfaces to receive the requests and publish the services; the second layer is called the process layer, including services registration components, service pack and access components, user privileges validation components and load balancing, etc.; the third one is the service layer, including all kinds of pre-packaged components. The Figure 1 shows the basic structure of the DATEX II based dynamic traffic information publish platform.

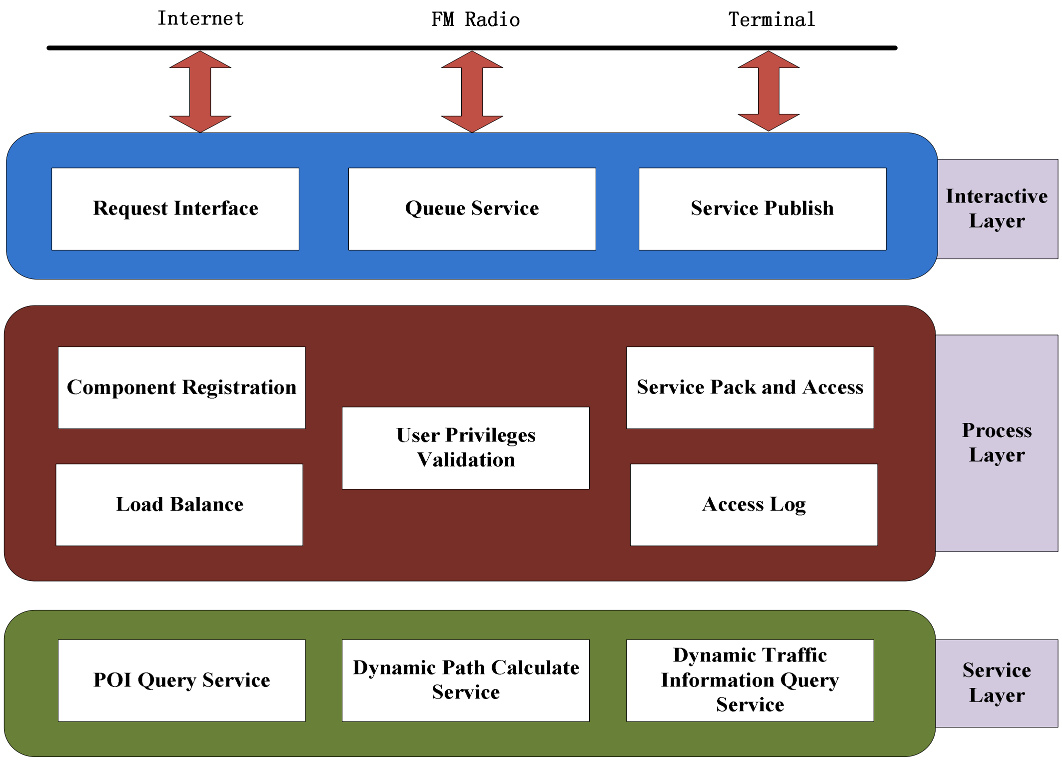

Figure 1 the framework structure chart

4.2. The structure of the framework

The interactive layer contains various interfaces to receive and resolve corresponding user requests forms, including Web Service, Socket, FTP, etc. the requests are converted into a DATEX II based specific formatted messages, those messages are added to the message queue then. Through the message queues, those messages are sent to the processing layer immediately. At the end, the result returned by process layer will be sent back to the user interface too.

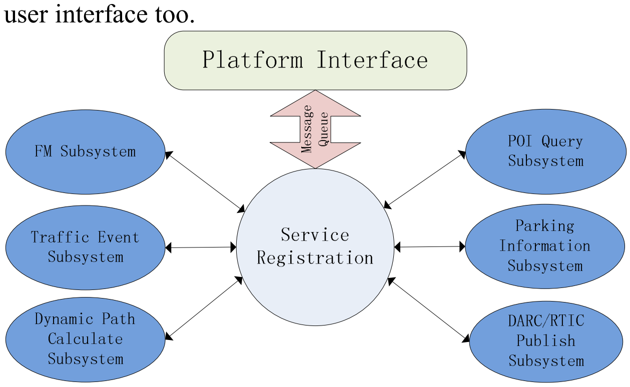

Figure 2 the service registration example

The main purpose of the process layer is to handle the request message queue that delivered from the interactive layer. Meanwhile, this layer is also responsible for the management of components, such as the implementation of the registration, management and remove operation of the dynamic traffic information service component, so when the user requests a service, the platform can find relevant information / service components quickly and accurately. Therefore, each component or subsystem needs to register first when the component or subsystem wants to be added into the platform, as shown in the Figure 2.

The service layer contains all the pre-packaged subsystems. For the differences of data nature between the various subsystems, the subsystems must be plugged into the platform by their own adapters. Travel information subsystem with the corresponding data adapter is formed as component, and a single component or the combination of multiple components is formed as services. In other word, the various subsystems are packaged as components and the components then can be combined as services. By the using of the advanced components technology, all kind of subsystems can be distributed in various locations. The platform communicates those services through the XML format messages which are defined in DATEX II data model, at the same time, the configuration and scheduling of services is managed by the implementation of a unified management module.

4.3. The data exchange in the framework

The data exchange is mainly implemented by the message queue in this platform. The interactive layer receive some kind of initiated request comes from the client, and execute the authentic operation. The valid requests will be converted into the specific formatted messages by the request conversion module. The interactive layer will then put those messages into the message queue and send them to the process layer for further procession. Moreover, the process layer analytic the received messages to deliver them to the appropriate service where to handle. After this, the processing results will send back to the interactive layer through the message queue too. The specific message will be returned to the client as well as the same format in request. The whole process is as illustrated in Figure 3.

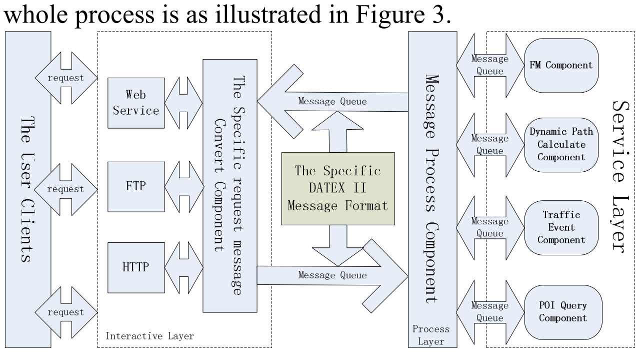

Figure 3 the application of DATEX II based message model

This platform uses the JBoss messaging component to establish the message queues, the client request will be converted into DATEX II based specific message format. Then, the converted message enters the message queue in some pre-defined orders. An example of this specific message in the message queue is showed in Figure 4.


```
<D2LogicalModel>
  <Exchange>
    <supplierIdentification>SenderGUID</supplierIdentification>
    <clientIdentification>ClientGUID</clientIdentification>
    <requestType>request</requestType>
    <subscriptionReference>SubscriptionGUID</subscriptionReference>
    <creationTime>2008-09-08T11:06:28</creationTime>
  </Exchange>
</D2LogicalModel>
```


Figure 4 an example message in the message queue

By the services/components model integration technology, the message queue and the specific message format based on DATEX II, this platform has great advantage of scalability and configuration ability. It's convenient to add a new subsystem which has already packaged as a component into the platform and publish the component as a new service by just a few configurations.

5. Conclusions

In this paper, we discussed a DATEX II based framework of dynamic traffic information publish platform, which is based on the domestic and international experiences on the traffic data exchanges. Furthermore, an expandable solution is provided for data sharing and service publishing. The framework of dynamic traffic information publish platform provide a solid foundation of realization for the public information dissemination and query, the traffic-induced and the other kind of value-added information services of Intelligent Traffic System. Based on the advanced message queue and services/components model integration technology, the dynamic traffic information publish platform has greatly facilitated to expansion and could possible to implement the further function integration within enterprise and service providers.

Acknowledgement

It is a project supported by the National Scientific Support Project (Grant No.2006BAG01A01).

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