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THE INFORMATION SHARING PLATFORM OF CHINESE RITS

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Abstract**:** In Chinese railway intelligent transportation (RITS) system, the existing data and their heterogeneous nature have brought on serious management problem. It is necessary to have an information-sharing platform which is regarded as the backbone of sub-systems communicating with each other in RITS. It is studied in order to contribute to thorough solutions to the problem of the heterogeneity and generousness of the data, and guarantee some functions including information collection, transmission, management and interoperability of subsystems. In this paper, the features of information about RITS are analyzed and whole scenario and architecture of the information-sharing platform are proposed. Then, the key technologies constructing the information-sharing platform are analyzed; finally, the system structure of the information-sharing platform is outlined; several tools are presented to manage the communication among the components of the architecture, they can be used in the development of resultant architecture.

Key Words: Railway Intelligent Transportation Systems (RITS), Information-sharing Platform, Information Integrated

1.INTRODUCTION

China has built some management information systems involved in railway passenger and

freight transportation. However, the systems above mentioned are isolated. With the rapid development and expansion of different functional systems, the interoperability demand between them is becoming intensified, but because of the absence of information-sharing platform providing and managing all types of railway transportation data, the requirement is unsolved up to date. As a result, the problem of "information island" is extremely highlighted, a large amount of valuable railway transportation information is difficult to be utilized, which leads to large waste. The information functional systems, which should be accelerator and catalyzer of development of railway transportation, are turning into the shackle of rapid development of railway transportation. Therefore, it is urgent that constructing information-sharing platform of RITS to normalize the development and interface of current operation system and to realize the interconnection among existing systems, and among existing systems and the newly-built; it is critical for the construction of information-sharing platform of RITS to solve bottleneck of development of Chinese railway transportation informatization(RITS research group, 2003).

2.THE FEATURES OF INFORMATION ABOUT RITS

Under the support of Chinese Government and Ministry of Railways from 2000, all researches about system structure, system architecture and experimental projects of railway intelligent transportation system have begun to be undertaken. The researches cover the all railway operation fields, such as transportation organization sub-system, locomotive affair sub-system, communication and signal sub-system and machine maintenance subsystem. Since management information systems of RITS were constructed, great amounts of information about RITS have been amassed. These information can be classified four kinds: (1) railway spatial information, it includes all management departments of railway, railway fixtures, railway traveling facilities and relations each other; (2) railway fundamental information, this kind of information come from the course of transportation; (3) railway management information, which illuminates features of each process of transportation; (4) decision supporting information, decision-maker of all operation departments can draw up coming schemes according to it (Ke *et al*., 2002).

Because the management information systems are established individually, the information is stored various management information systems and databases. The database management systems include Oracle, Sybase, FoxPro etc., in addition, networks consist of large-scale host computers, UNIX workstations and PCs, whose operation systems and network communication protocols differ in various ways. Meanwhile, the facilities distribute in various areas and connectivity among systems is relatively weak. Although the data sources are designed independently, RITS requires the data sources to both be exchanging and sharing, meanwhile, they must be kept independent and autonomous. Under heterogonous and distributed circumstances, it is one of the key integration technologies of RITS to realize

the interconnection and interoperation between application systems, application and differently data sources, to achieve data sharing on the basis of data source autonomy and to build an outstanding information integration system.

3.ARCHITECTURE OF INFORMATION-SHARING PLATFORM ABOUT RITS

3.1Constuction Plan of Information-sharing Platform

Chinese railway computer network is a nationwide system and consists of 4 classes LANs of Ministry of Railways, Railways Administration, Regional Railways Administration and station and depot branches, whose function subsystems have individual management information systems. The Chinese railway computer network is classified as LANs of Ministry-Railways Administration-Regional Railway Administration. When the information-sharing platform is planed, the structure features of Chinese railway computer network should be taken into account. Therefore, from the viewpoints of convenient use and easy construction, the information-sharing platform can be diversified as 3 hierarchies, meaning platform of Ministry, platform of Railways Administration and platform of Regional Railway Administration, which make the system well-layered and clear. Moreover, different levels of the platforms will not communicate with each other till necessary conditions, which would decrease the network congestion as is shown in Figure 1.

3.1.1 Information-sharing Platform of Regional Railways Administration

Information-sharing platform of Regional Railways Administration is the core of the system. According to the characteristics of each information management system, firstly the data marts of each operation subsystem is built, then information-sharing platforms are established by integrating of these data marts. The information management system of Regional Railways Administration mainly manages the information resources of station and depot branches. Information resources are involved in railway space information, basic resource information of daily operations for each management transportation department, and detail technologies of each information system, they are important information of each information management system and ensure the operations go on wheels. These kinds of information are primary information, which obtained from various bills of document produced by daily transportation or static information describing the station equipments, facilities and rules and regulations. They are very detailed information without any processing and play an important role in comprehensive development and use of railway information resources. These kinds of information are not update frequently and operations on them mainly include selection, displaying and retrieving etc.

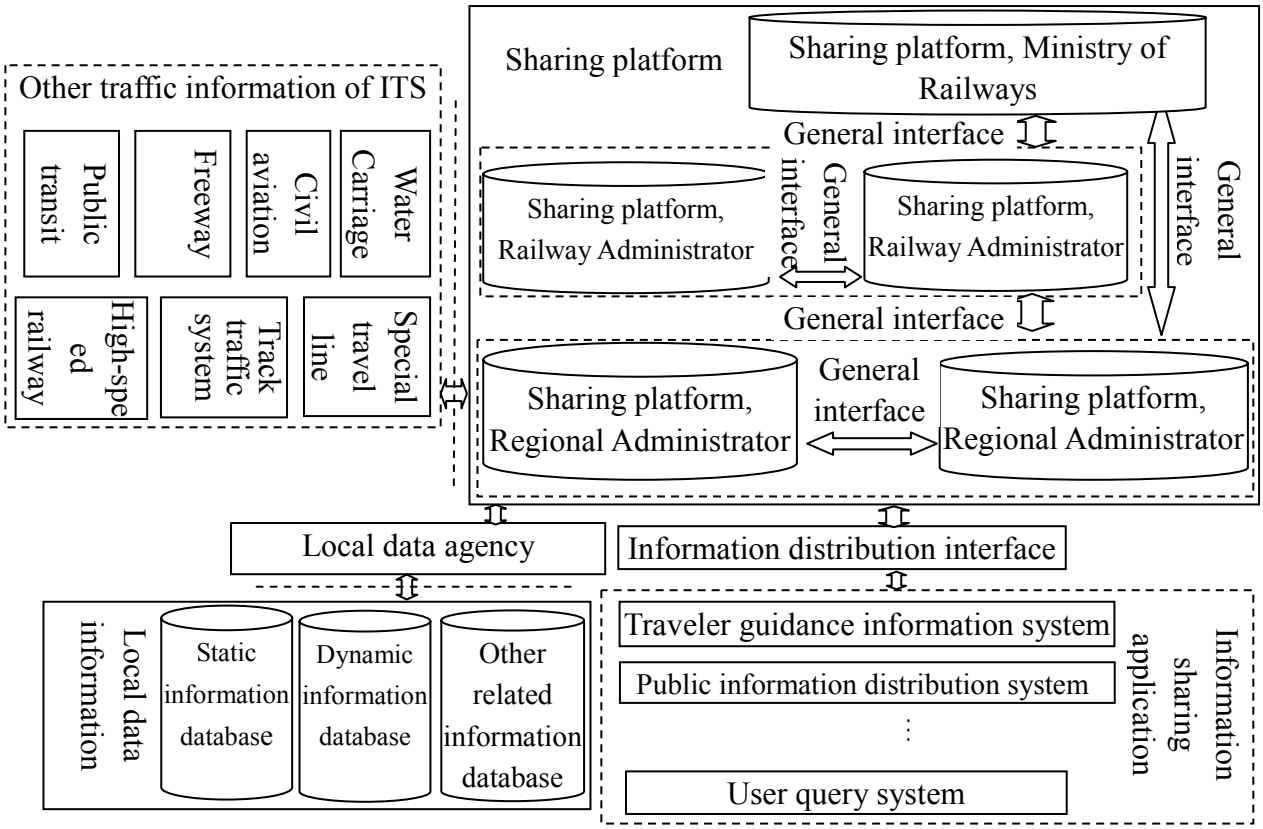

Figure 1. The Whole Framework of Information-sharing Platform

The information-sharing platform of Regional Railways Administration connects with every management information system of function systems of stations and depots directly, extracts detailed primary data from them. It also describes and analyses features and every operation of railway transportation activity. Moreover, it will eliminate differences of database management system and data schema of each subsystem, and provide a uniform interface that every application can easily call on. If the new-built systems need to be added, as long as its interface measures up the interface specifications about platform, they can ensure be seamlessly connected with platform and other function subsystems. Therefore, every subsystem can provide shared information, and guarantee that information management system of every station access all kinds of shared information as if it access the information which comes from its own database management system.

On the basis of integrating information management system resources of every local station and depot, the basic data can be filtered, processed and analyzed, ulteriorly, the data mining and knowledge discovery on the information of every operation application system. Then aided decision support information for the leaders of Ministry of Railways and Railways

Administration is provided.

The information platform of Regional Railways Administration provides two general interfaces: The first is to provide integrated information resources of every station and depot for other platforms of Regional Railways Administration and superior platforms and receive the feedback information and orders from the superior platform; The other is to provide the public and other traffic management departments for passenger, freight and train timetable information in this Regional Railways Administration, and extract the information which other transportation modes require. This information not only provides the management staffs of this department for aided decision support, and offers the passengers and the consignors for the necessary information, but also helps them to choose transportation mode in the course of traveling and consigning goods.

3.1.2 Information-sharing Platform of Railways Administration

Information-sharing platform of Railways Administration manages uniformly the traffic resources that come from Regional Railways Administration, integrates every functional subsystem and fixes attention on all information about it. The platform contains the processed information resources in the information management system of all the stations and depots of Regional Railways Administration. The information is not the detailed data but the integrated data of each operating management department. After data mining and knowledge discovery, the referential decisions on operating management of Railways Administration can be made in accordance with the conclusions obtained from knowledge discovery in databases.

Information-sharing platform of Railways Administration is the middle level between that of Ministry of Railways and that of Regional Railways Administration. One of its interfaces collects the professional information from each platforms of Regional Railways Administration, and conveys orders and instructions to platforms of Regional Railways Administration; the other interface receives the instructions from Ministry of Railways and responds to information.

3.1.3 Information-sharing Platform of Ministry of Railways

Information-sharing platform of Ministry of Railways integrates various comprehensive data, which come from different operation departments in Railways Administrations. Different operating management departments can query integrated information of corresponding department of each Railways Administration from the platform as well as the information of related departments of Railways Administration. Furthermore, when needed, the information of other information management systems relative to the department can be called so as to be favorable for policy making and routine planning as well as take key measures in operating of

the department.

Information-sharing platform of Ministry of Railways possesses one general interface, by which information from that of Railways Administration and Regional Railways Administration can be received and all kinds of instructions and orders can be sent out.

3.2 Structure of RITS Information-sharing Platform

The function of information-sharing platform about RITS involves information extracting, information transiting, information mining and information distributing. These processes make all operation management systems integrate with each other, change static management into intelligent dynamic management. Reasonedly, the platform extracts diversified and assorted departmental information and operation management information, firstly; then, in order to meet long-term plan, policy changing in near future and routine operation and promote productivity of every operation processes, the information can be transformed into shared information according to pre-drawing up principia and criterion. Meanwhile, platform can provide information service for the public and improve competitive capacity among all traffic modes. So, the platform should consist of integrated traffic data warehouse and information exchanging module, etc. Figure 2 reveals the RITS platform structure.

4. REALIZATION OF INFORMATION-SHARING PLATFORM

Because every subsystem may operate under the conditions of different hardware and operation system platform, and system is developed through various languages and software technologies, the information-sharing platform will be developed by component object technology and Open Database Connectivity (ODBC).

ODBC, standard interface of access database, provides a group of standard API to access database. So ODBC can access database with any driven program and solve the problems of access heterogeneous databases.

At present, there are three popular component object technologies such as COM/DCOM of Microsoft, CORBA of OMG and JavaBeans of SUN, which have their own merits. Facing differences of operation systems and hardware platforms and combining the advantages of CORBA and EJB, one application server framework is designed by complying with J2EE and CORBA specifications to realize “plug and play” of application procedures, which includes the following modules: Management Console, EJB Container, Naming Service, Transaction Service and other services(Qi *et al*., 2001).

(1) Management Console

Management console is a graphic user interface realizing the deployment and monitoring of application server system and administrators the server. The console is composed of three main modules, i.e. application server management module, module of Java Naming and Directory Interface (JNDI) management and module of Visibroker service management. In addition, it has a function of setting and displaying of all types of system parameters.

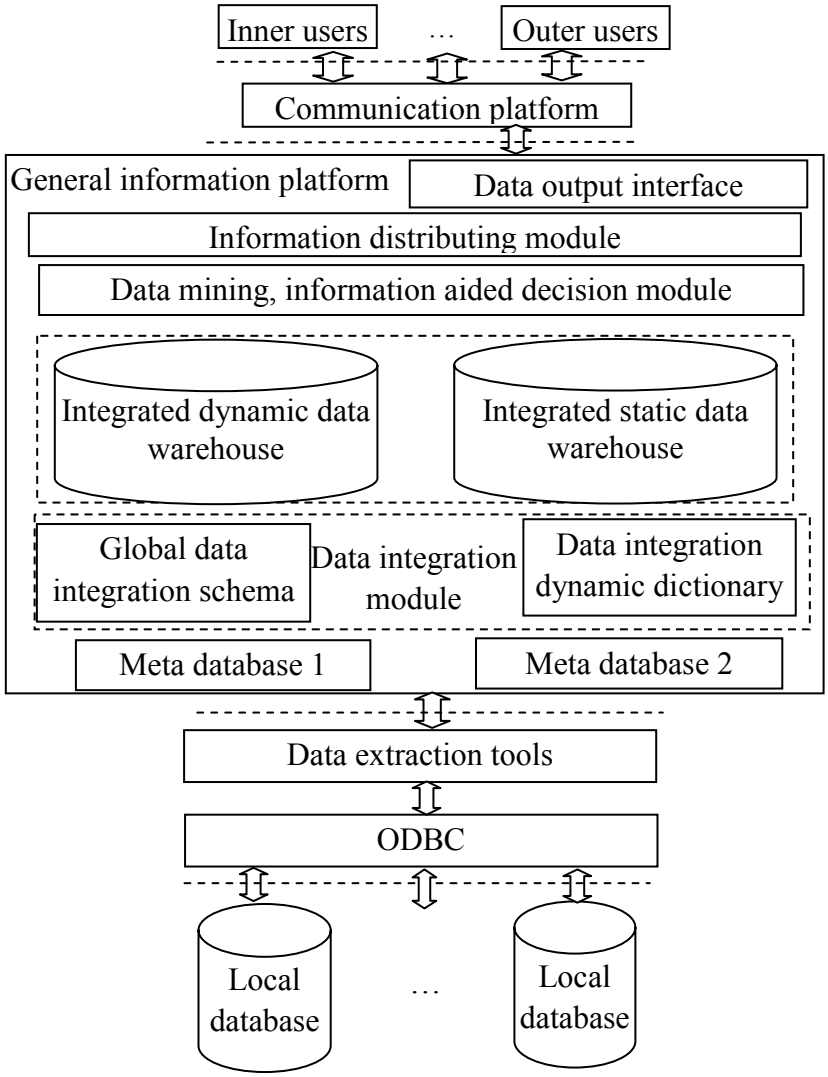

Figure 2. The Architecture of Information-sharing Platform

(2) EJB Container

The container offers system services for the EJBs, controls their life cycle and administers

almost all transactions of system:

The safety module stipulates that different clients can visit different enterprise objects of various servers. The container adopts the mechanism that only the authorized users can access servers when the clients call on the methods.

Life cycle management module: the user simply builds the EJBs instances and removes them. But the container is responsible for managing these EJBs instances in order to optimize occupation of internal memory and efficiency of implementation, which are realized by activating EJBs and using EJBs buffer pool.

The transaction management module defines one transaction claim of EJBs while the container is responsible for managing the complex problems of distributing transactions.

(3) Naming Service

The naming service is one of the cores of application server. Users of naming service can search for the objects and deploy the meaningful names for them so that the application server connects with the names and objects in the process of querying. The application server contains a JNDI which realized by Visibroker in naming server. And the clients application program can look up all kinds of objects by calling on APIs of JNDI.

(4) Transaction Service

Transaction Service is one of the most important parts of enterprise computing. Object Transaction Service (OTS) provides one object-based framework of distributed transaction dealing. The transaction service design of the application server complies with the Object Transaction Service (OTS) of the OMG organization and realizes the transaction service--JTS according with two-stage submission protocol by IDL/Java mapping.

(5) Other services

Besides the modules mentioned above, the application server also provides many kinds of services, such as affair service, life cycle service, etc. These services can simplify the complexity and difficulty of the developing of applications and constitute a completely and practically application server by combining with other modules.

5 DATA INTEGRATION

In order to solve the heterogeneity of system data schemas of each member about multi-database system, the system of integrating heterogeneous data should provide the

method of mapping a concept data schema into another schema. There are two kinds of ways: The first is to transform all data schemas into the leading data schema in the system; the other is to provide one common data schema, into which each member schema will map. Therefore, the common schema is the basis of realizing integration of the heterogeneous data. But this common schema should be the schema into which each member database system is easy to convert. The eXtensible Markup Language (XML), a kind of meta markup language, tends to be perfect. It cannot only permit the users to build their own tags for all kinds of data and establish varieties of Markup languages, but also describe the data structures, such as linear tables, trees, figures etc., convenient for information exchange among systems, and present the open data independent on platform and language. XML is easy to be read and may tag various characters, graphics and binary files.

5.1 Schema Integration

EXtensible Markup Language (XML) is a simple, very flexible text format and derived from SGML. XML also plays an increasingly important role in the exchange of a many varieties of data on the web and elsewhere. XML schemas provide mechanisms for defining and describing the structure, content, and some semantics of XML documents. XML Query Language provides flexible query facilities to extract data from real and virtual XML documents. So hetergeneous data from multi-database are integrated by XML technology. As is indicated in reference 2, there are four-level schema architecture is necessary to address the requirements of dealing with distribution, autonomy and heterogeneity in a multi-database system (Sena *et al*., 1996):

(1) Local Schema. Local schema is managed by local database management system and is expressed by native model of local database; local schemas are different in different database management systems.

(2) Export Schema. When taking part in multi-database integration, export schema is derived from local schema into canonical data model, which describes the local data as global sharing in local database.

(3) Federal schema. Federal schema organically integrates a group of independent and heterogeneous export schema viewed as concept schema of system scope. It depicts in detail the data relationship of local integrated databases, integration schema, and export schema of all local databases and mapping of operation orders of machine data.

(4) External Schema. External schema confronts with users or application, connects with man-machine interface directly and contains the information not involved in local database probably.

The method adopts three classes schema transformation, that is to say, local schema after being packaged can create export schema conforming to common model, part of which integrates into global schema.

In order to guarantee the outstanding open feature of system, integration model can adopt the object-oriented model according with ODMG95 standard. In a similar way, global languages come into use. They include object definition language, object operation language, object query language and object integration language, which enables to make full use of the standards available, such as OMG、SQL-92、INCITS and so on(Wilcox *et al*., 2003).

As mentioned above, multi-data source integration is in essence to make the data source in distributed system register to object depository by object packaging, so concrete operation is to make description information of each data source structure express into object definition while the data of data source forms object example mapping the service and operation into the method of object. Detailed operation method is decided by respective the type of data source:

(1) Because of having fixed data model, the structured data source can directly build local schema into export schema expressed by integrated model;

(2) As for the half structure or no structure data source, they have no fixed data model. Firstly, the basic operation set and operation data set are extracted, then schema structure is abstracted and finally export schema and its mapping are set up adopting operation mapping method.

5.2 Shared Data Warehouse and Data Organization Schema

Although the data extracted from each department are integrated, because requirements of data format of each subsystem is different and data amount is enormous, the data warehouse should be built to implement the organization management for all types of data, make use of the current data completely and perfectly, and realize the intelligent decision. In terms of function demands, the data marts may be established for each department firstly and integrated into data warehouse, or the Operational Data Store (ODS) technology can be used to take short-term analysis.

Because each subsystem is distributed and the management is centralized relatively, data organization is adopted as distributed database system. These mass data, which are accessed frequently, are stored in global data warehouse. The other data are stored in local database management system and manage them by meta data.

The system employs two kinds of meta data: The first is the function which convey operation

data from operation environment into data warehouse, that includes the names, attributes and their transformation methods of operation data; The second is in the data warehouse on the purpose of building the mapping between multi-dimension commerce model of the final users and the terminal tools.

6 CONCLUSIONS

At present the integration of heterogeneous data source is a significant field of database, which involved in technologies about information, computer, communication and operation research. In accordance with the requirements of RITS, the paper researches the technical routine, main functions and features and technical frame of information-sharing platform of RITS, presents the system architecture of multi-database integration system based on B/S architecture.

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