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# The Realization of CIM Data Access Mechanism Based on FastDB\*

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**Abstract**

FastDB is an open source real-time database with characteristics of high efficiency and the object oriented, supporting the various object-oriented, running on different operating system platform, convenient for realizing CIM data access mechanism. Through the analysis of CIM data access mechanism, this paper states the methods of the resources location, data query, data describing in the process of data access. The realization code, the function and exception handling methods of CIM data access interface ResourceIDService, ResourceQueryService code based on FastDB are given. FastDB can effectively use CPU cycles and memory, to some extent, meet real-time requirements of the system on the data, and increase the development, maintenance efficiency of the whole system in the different industries.

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*Keywords*: FastDB;DAF;Data access;CIM;Interface

## Introduction

With the rapid development of computer technology, database system is everywhere, and although relational database is powerful, open well, the general application for the realization mechanism is difficult to satisfy EMS application for real-time/quasi real time request. IEC 61970 standardization technology is a kind of criteria achieving the different manufacturer, different control center Information sharing [1] and system integration, including that CIM (Common Information Model, CIM) describes data of exchange and CIS

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explains how to exchange CIM data. CIS gives detailed descriptions of the information exchange according to the standard way among the applications and interface of public data access, insertion and using among the application systems. In recent years, the interoperability tests have been operated several times based on the model CIM XML at home and abroad , and has been successfully used in the actual system [2]. But with the continuously increasing of system size and application complexity, these are difficult to meet the requirements of various systems and the system function expansion exists a lot of difficulties. At the same time the CIM model is a typical object-oriented model, in the development process, after detailed comparison research, using open source real-time database FastDB as development prototype system. FastDB is the real- time database of the object oriented by using C/C + + [3], supporting SQL query, Web page query, export and import of XML data files, online backup of transaction process and automatic recovery and so on, running on Win32 / Unix/Linux and other kinds of operating system platform, which has brought convenience for the realization of the CIM data access mechanism.

## Data access facilities

Data Access facilities (Data Access Facility, DAF) is one of the main contents of IEC61970, in order to improve the EMS application and other systems, and application of collaborative work ability as the goal, which accesses CIM public data for different suppliers to provide a public use application program interface (API) and public service mechanism [4]. The design concept of the DAF is to provide a simple application easy API. DAF is one of the most basic CIS interface standard, including DAFDescriptions, DAFIdentifiers, DAFQuery, DAFEvents module, the core of the module is corresponding interface. For the external system of internal system CIM data acquisition system, DAF provides enough interface in the function [5]. This paper only uses DAFDescriptions. Idl, DAFQuery. Idl and DAFIdentifiers. Idl .

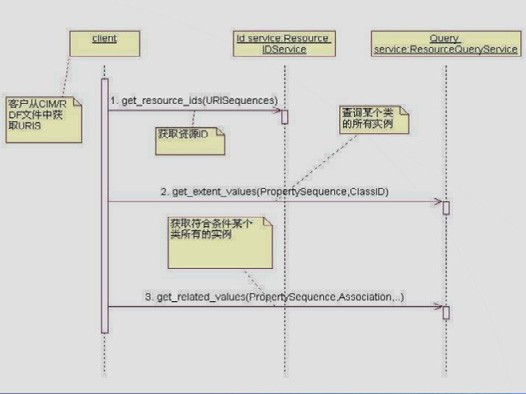
DAF makes use of resources, properties, and values to inquiry the formulation results. A resource is anything of an unmistakable identity. Typically, That a unified resource identifier (URI) pluses an optional fragment identifier may label any resource. But, in the DAF inquires and the search results, a more compact ResourceID of URI should be used. A property is the aspect a resource may describe. When appearing in inquires, nature expresses through the type PropertyID, and nature itself is a resource, so PropertyID is defined as a ResourceID. A property has a domain (resource collection) and a range (value collection). The relationship between the resources through some properties is created, and the nature of the domain and range is also a collection of resource.

In the resource description framework, the value is a basic data unit, and can be a string, integer or resource reference. In the DAF, value type SimpleValue, is actually a combination of several basic types and ResourceID.

## The realization of CIM data access

* 1. *Data access process*

DAF provides a series of standard data access service of orientation, inquiry, description and inform event and so on, and , through this public data access interface, realizes the integration between application system. DAF mainly includes positioning, and inquiry, describing services The below figure describes a basic DAF data access process. First clients input a series of string, and the server will return to the string in the database of location. Because the string is based on URI format, the access is a standard form, namely resources positioning. And then in the query service, the information users input is a ResourceID positioning and PropertyIDSequence obtained in resource orientation, which is the corresponding with ResourceDescriptione, such as data query. At the last, ResourceDescriptione in query is analyzed and then get the needed data, such as data description.



Data access process maps

* 1. *The realization of ResourceIDService interface*

ResourceIDService provides conversion service between the ResourceID and URI. The goal of ResourceIDService design is to reduce a price of repeatedly analyzing, comparing and searching for URI.

1. get\_resource\_ids () method

The input of Get\_resource\_ids () method is a standard URI sequence, and its output is a ResourceID sequence. Function prototype is:

DAFIdentifiers::DAFIdentifiers::ResourceIDSequence\*get\_resource\_ids( const DAFIdentifiers::URISequence & uris)

throw (DAFIdentifiers::LookupError);

Parameter uris is a standard URI sequence, and its return value is a ResourceID sequence.

Function: CIM/CIS server analyzes URI sequence, and the elements will be transformed into the corresponding ResourceID. Finally, return sequence in the same position is assigned. For no analytical URI, corresponding ResourceID is empty (Container and Fragment are 0). The realization HTML code is as follows:

dbCursor<UrlToname> UrlTonam\_Cursor; // Define the UrlTonam\_Cursor cursor of UrlToname table char name[256]; // Define the string array, used for storage of resources to inquiry

dbQuery q=”name=”,name; // Find the resource identifier portion after uris colon;Copy this part of the string into //the string array name;

If (UrlTonam\_Cursor.select(q)>0) // If the corresponding ResourceID is found in UrlToname table return UrlTonam\_Cursor->fragment; // Return result

else{

}// Not found

In order to conveniently implemente ResourceIDService interface, in the FastDB, a extra storage table UrlToname stores the mapping of resource ResourceID to resource. With this form and FastDB strong inquiry function, the realization of the get\_resource\_ids method will be simple and clear, and its analytical process isdescribed as the program.

1. get\_uris () method

Get\_uris method is the inverse process of the get\_resource\_ids method. A standard ResourceID sequence is input , and then a URI sequence is output. Function prototype is:

DAFIdentifiers::URISequence\*ResourceID ServiceImpl::get\_uris(const DAFIdentifiers:: ResourceIDSequence& \_ids)

throw (DAFIdentifiers::LookupError);

Function: CIM/CIS server analyzes ResourceID sequence, and the elements will be transformed into the corresponding URI. Finally, return sequence in the same position is assigned. For no analytical ResouceID, corresponding position returns to an empty string. When this method errors in inquires (class\_id is found, but not a class (or form) or check error), an DAFIdentifiers: : LookupError shows abnormal.

The realization HTML code is as follows:

|  |  |  |
| --- | --- | --- |
| DAFIdentifiers::URISequence uris; // | Definite | the URI sequence to return |
| dbCursor<UrlToname> UrlTonam\_Cursor; Definition the UrlTonam\_Cursor cursor of UrlToname table dbQuery q=“+fragment=”, \_ids; //\_ids is a standard ResourceID sequence transferred if(UrlTonam\_Cursor.select(q)>0) // If the corresponding resource ResourceID name is found in UrlToname list  {  if(Resources is class of)  uris=“http:”+ “#”+ “C”+“:” +“Resources name”; else if(Resources for attribute)  uris=“http:”+“#”+“P”+“:”+“Resources name”; else // Resources for example uris=“http:”+“#”+“I”+“:”+“Resources name”;  return uris;  } | | |

* 1. *ResourceQueryService interface*

ResourceQueryService interface DAF is a central part of the DAF that defines basic resources service inquires interface. In ResouceQueryServiceImpl class the interface is implemented.

1. interface definition

interface ResourceQueryService{ ResourceDescription get\_values(

in ResourceID resource,

in PropertySequence properties) raises( UnknownResouce, QueryError );

ResouceDescriptionIterator get\_extent\_values( in PropertySequence properties,

in ClassID class\_id) raises(UnknownResource, QueryError); ResourceDescriptionIterator get\_related\_values(

in PropertySequence properties, in Association association,

in ResourceID source) raises(UnknownResource,UnknownAssociation, QueryError); ResourceDescriptionIterator get\_descentdent\_values(

in PropertySequence propertiesm, in AssociationSequence path,

in ResourceID parent,

out AssociationSequence tail) raises(UnknownResource, QueryError);

};

1. get\_values () method

Query returns to a given ResoureID resource description, which is one of the most simple data request. If the terminal and name of a switch, function prototype is:

DAFDescriptions::ResourceDescription\* ResourceQueryServiceImpl::get\_values( const DAFIdentifiers::ResourceID& \_resource,

const DAFIdentifiers::ResourceIDSequence& \_properties) throw(CORBA::SystemException, DAFQuery::UnknownResource, DAFQuery::QueryError);

The parameter resource is ResourceID of the resource record to inquiry; Properties are the attribute logo sequence to query, and returns to ResourceDescription.

Data service throws UnknownResource abnormal when no finding input resources; and throws QueryError abnormal when Database query fails.

The realization of the get\_values method, only according to the ResourceID and given resource attribute ResourceID sequence in the form of inquires directly Link, returns to the results.

The realization HTML code is as follows:

|  |
| --- |
| DbCursor<Link> Link\_cursor; // Define the cursor of Link table |
| DAFDescriptions::ResourceDescription rd;//Resource description object to return |
| Dbquery q="objectID=",\_resource;  //Write the query classes,instantiate query object, the parameter \_resource is transferred ResourceID |
| If(Link\_cursor.select(q)>0) //Find all the objecID and query resource record ResourceID |
| {  rd.iD= Link\_cursor->objectID; //Assign the object objiectID to the resource object resourceID  do {//According to transferred attribute sequence identify, initialize each sequence attribute value of  //resource description objiect attribute value for(CORBA::ULong I=0; I<=\_properties->length; I++)  { if(Link\_cursor->propertyID==\_properties[I])  {  rd..value[I].property=\_properties[I]; rd.value[I].value= Link\_cursor->value;  }  }  }while(Link\_cursor.next())  return rd; //Return to resource description  }  Else  {//No finding  } |

1. get\_extent\_values () method

When get\_extend\_values method gives a ClassID, inquiry returns to all the resources description of a given ClassID. Function prototype is:

DAFDescriptions::ResourceDescriptionIterator\_ptr ResourceQueryServiceImpl::get\_extent\_values(

ConstDAFIdentifiers::ResourceIDSequence&\_properties const DAFIdentifiers::ResourceID& \_class\_id) throw(CORBA::SystemException, DAFQuery::UnknownResource, DAFQuery::QueryError);

Parameter PropertySequence properties is the attributelogo sequence of query. ClassID class\_id is the ResourceID of inquiry, and returns a iterators (ResourceDescriptionIterator).

If class\_id isn’t found within the scope of the data dictionary, an UnknownResource is thrown abnormal. If class\_id is found, but not a class (or form) or check error, an QueryError is thrown abnormal.

In order to realize get\_extent\_values () method, first according to a given type of ResourceID, the ResourceID of the all instances are returned; then the table Link, by example ResourceID and the given attributes of the query results returns to ResourceID sequence.

The realization HTML code is as follows:

/\*In order to query in the link table and instance table, define two table cursors\*/ DbCursor< Instance > Instance \_cursor;

DbCursor<Link> Link\_cursor;

vector<unsigned long long> v; //Define vector,which is used for temporary storge of all ResourceID of query class

DAFDescriptions::ResourceDescription rd; ResourceDescriptionIterator iter //Define the iterator to return char objectID[256];

Dbquery q1=”objectID=”, \_class\_id; Dbquery q2=”objectID=”, objectID;

If(instance\_cursor.select(q1)>0) //According to class\_id,//find all instances in class Instance

{

do{ v.push\_back(instance\_cursor->objectID) //Put all such instances in the class instance table into a vector

}while (instance\_cursor.next()) while(!v.empty())

{ objectID=v.begin(); //The instance resourceld in //the vector is assigned to objected of q2 if(Link\_cursor.select(q2)>0){

rd.iD= Link\_cursor->objectID;//ObjectID is assigned to resource description object resourceID to return for(CORBA::ULong I=0; I<=\_properties->length; I++)

{ if(Link\_cursor->propertyID==\_properties[I])

{

rd..value[I].property=\_properties[I];

rd.value[I].value= Link\_cursor->value;

}

}

v.pop\_back();

}

}

iter = &rds;

return iter; //Return to an interator

}

else

{ //No finding

}

1. get\_related\_values () method

First inquiry the correlation table, and return to ResourceID sequence of the given instances according to instance and relation ResourceID. Then check attribute list, and based on instance ResourceID sequence and a given property ResourceID sequence, return to several attribute values of all such instances, specific method is similar to section 3) .

## Conclusions

Various industries often need operations of fast storage, query, update, and delete for a large amount data, particularly outstanding in some energy management and other large enterprise applications. In these cases, the high performance real-time database should be chosen. Through the in-depth analysis and comparison, this paper chooses real-time database after FastDB as a prototype system and analyzes the realization process of the CIM data access. Detailed methods of realization of the main interface function, code and exception handling are given. At present there are many real-time databases of the strong performance, but the price is expensive, in not large system construction, the free open source real-time database can achieve good effect, especially in equipments of physical memory enough big.

According to various the specific application of the demand of energy management system in the future, combining with FastDB open source database, and gradually improving various functions and performance, we will make all-round analysis and extended application for the CIM data access mechanism, so that the CIM mechanism has better inclusiveness and versatility.

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