Design and Implementation of AIS Information Sharing Service Based on SOA

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Abstract

The paper by analyzing the existence current situation of multiple independent information systems for maritime departments, proposes can use the Service Oriented Architecture (SOA) for the AIS information sharing to do theoretical direction and functional design, in order to solve information island phenomenon of data exchange difficulty between maritime each independent information system. Based on SOA AIS information sharing adopts software engineering method based on service oriented theory, encapsulates AIS data distribution function module as Web service, achieves conveniently called by desktop, mobile phone and so on many kinds of client cross platform, cross platform, cross language, and has the ability to publish the service aggregation integrated with other server GIS service.

Keywords: SOA; Web service; AIS information share

1. Introduction

Automatic identification system (AIS) is a key system that IT, computer technology, satellite navigation technology and other High-Tech applied in the field of n avigation system. In recent years, with the popularity of AIS applications, AIS technology has been used not only for ship identification and collision avoidance, but transformed into a kind of system have various maritime functions. Therefore, maritime administration service department pay more and more attention to the development and application based on AIS maritime service information system, a variety of marine services constantly increase and call into use. However, the related service system of maritime in most cases is development relatively separate, the phenomenon of data exchange difficult of information island between the maritime services independent information systems becomes more and more serious, not only limits the shared use information resources and waste the government fund. In order to better reuse function module had have, make this kind of reuse needless consider the difference of their operation platform and development operating environment, and can speed up the new future software system development speed, and the reused module can easily incorporated into new system from the old, this paper proposes software design method called service oriented architecture SOA can be widely used in the maritime information system.

2. Overview of the Development of Software Development Model

SOA is architecture also a kind of software development model. Computer software development model mainly experiences four stages such as command software development, object oriented software development, and oriented approach software development and service oriented software development.

Early stage of command software development namely imperative programming is direct process abstract to Von Neumann type computer execution sequence, only according to the conditions to execute commands in order, cannot inherit even they have no message event, code is difficult to reuse, and maintenance workload is large; Object-oriented software development have the characteristics of inheritance, encapsulation, polymorphism, the package of things is abstract, because the package size is small, it is difficult to form larger reusable module; component oriented software development is the extension and development of object technology, component and object technology is abstract to the real world, involves encapsulation, the difference is that component is the modeling function and service provided by the entity or entities of the objective world, objects emphasis the corresponding between real world and entity as well as entity modeling, component's particle size is larger than object, but the limitations of component oriented is associated with the specific OS platform and development technology, unable to use the existing software modules developed by different techniques; service oriented software development is extension and development of the component technology in the distributed environment (especially in Internet environment), openness follow open standards, has nothing to do with the platform technology, self descriptive, particle size of encapsulation is larger than the component. These four kinds of software model development particle size and coupling degree are shown in Figure 1.
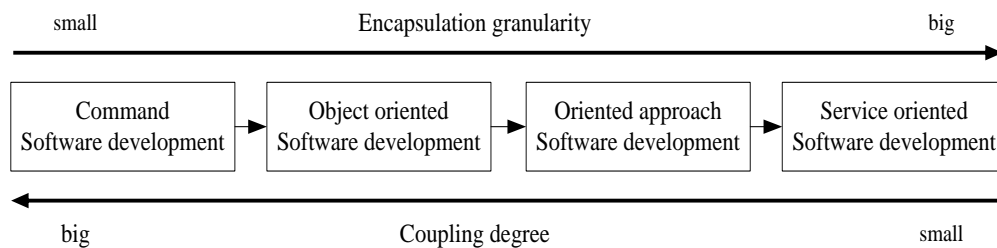
**Figure 1. Encapsulation Granularity and Coupling Degree**

3. The Basic Concepts and Advantages of SOA

3.1 The Basic Concepts of SOA

Service Oriented Architecture (SOA) is essentially a component model. It will be an application according to certain size split into several different functional units. These units are also referred to as services. SOA is independent of implementation services hardware platform, operating system and programming language, has a platform independent self description XML document. Web Services Description Language (WSDL) is the standard language for describing services. SOA services through registry of play directory listing for maintenance. The application finds and invokes the service in the registry. The universal description, definition and integration UDDI is the standard of service registration.

3.2 Structure Models of SOA

SOA service providers develop all kinds of useful services, the services are released to the public service registry after rigorous testing, service consumers can find the needed service by lookup service registry, then can binding and use the service provider of needed services, its structure model diagram as shown in Figure 2.
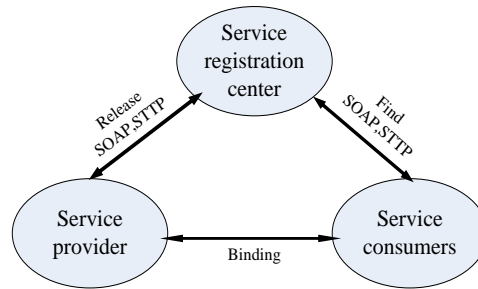
Figure 2. SOA Syntactic Model

3.3 The Implementation of SOA

A web service is an implementation of SOA, and is now the most suitable for the realization of SOA technology, the popularity of SOA to a large extent thanks to mature Web service standard of popularization and application. In Web service, all access is done a simple object access protocol based on XML coding information, using the interface encapsulation definite in WSDL, directory search through UDDI.

3.4 The Advantage of SOA

SOA is loosely coupled, coarse-grained services architecture, by defining a neutral interface for communication between services, has the following advantages:

(1)Reduce complexity

SOA architecture through loosely and coupled relationship between service requester and provider, shielding the complex business logic of the system. The surface layer can only see the service interface, and is not required to care about the specific implementation details inside the interface. The complexity of the system logic components is reduced greatly.

(2)Cross – platform and data reuse

Through standard interface between different services, free to quote, without having to consider the need to reference service in what position, what is the platform, or by what kind of language development. So as to realize the real meaning structure system of the remote, cross platform and cross - language. The core of the SOA architecture is expected through loose coupling system service portfolio to achieve specific functions, and achieve a higher level of system components reuse.

(3)Simplify the maintenance

SOA simplify the maintenance operation, reduces the maintenance cost. Modular and loosely coupled characteristics of the system make the maintenance personnel just simply follow the service contract for specific services, not have to worry if they will affect the other modules in integration is the norm rather than the implementation. It provides transparency of implementation, and will minimize the impact of degree brings by the changes of infrastructure and implementation. Through the service standard of system construction, make application integration more flexible and easy to manage.

4. Brief Introduction and Physical Network Architecture of AIS

4.1 Brief Introductions of AIS

Full name of AIS is Automatic Identification System, Chinese name is usually called automatic identification system or vessel automated identification system, it is the essence of the transponder of a satellite positioning system information, sharing location information between ship-ship, ship - shore. The main function of Ship borne AIS equipment is receiving all kinds of ship sensor data information such as the latitude and longitude provided by GPS, azimuth provided by gyrocompass, ship speed provided by

log, and these data provide real-time wireless broadcast out. Specifically, the core idea of AIS is automatically transfer dynamic and static information such as longitude and latitude, ship speed, azimuth angle, ships name and Length and width at current geographical position at a certain time interval use VHF wireless digital communications radio to the other ship and AIS base station around, let the ship and the AIS base station sharing the information, so as to help each other automatic identification and monitoring of ship. This recognition especially helpful to safe driving and collision avoidance for a ship sailing in a narrow and complex waters under fog, haze, rainy days, night poor visibility conditions of the ship.

4.2 Physical Network Architecture of AIS Information System

The physical network architecture of AIS information system mainly divides into the intranet, extranet cable network, AIS wireless communication network and the telecom operators. Physical network system architecture as showed in Figure 3. Among them, the AIS wireless communication network is comprised of a plurality of the AIS base station on land and the ship's onboard AIS equipment together, the latitude and longitude of AIS positioning information are provided by the GPS satellite.
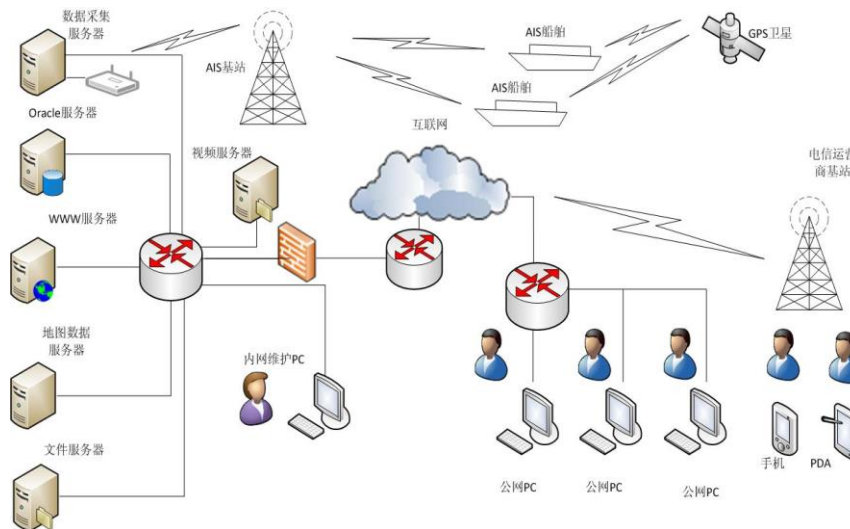

Figure 3. The Physical Network Architecture of AIS Information System

According to the design idea of AIS, through VHF wireless digital communication broadcast on the physical network level has achieved fair sharing. Nevertheless if in the logic of the software application level, if not used SOA framework, it is easy to let the software system into the information isolated island.

5. AIS Information Sharing Service Based on SOA

Because SOA has above advantages, the AIS information sharing can use SOA software architecture the software system level, and through the Web Service technology to achieve specific, it is easy to AIS data information unified export as well as invoking by desktop, mobile phone and other client cross platform, cross network, cross language, also conforms to the sharing of the spirit of AIS.

5.1 Web Service Design Services of AIS information Share

AIS information data acquisition is mainly depicted in client software such Web GIS, desktop and mobile phone version of the GIS, *etc.* Various kinds of GIS used on the customer, make the ship intuitive visualization displayed on the map according to the longitude and latitude information issued. AIS database on the server record various data, in order to decrease the network bandwidth occupation, reduce the redundancy communication data quantity of client and server, for the GIS client, there only needs to load the AIS data in current scope of vision. The GIS client has WSAD four boundaries of contemporary view, namely the maximum and minimum values of the latitude and longitude, such as can be set to lonMin, lonMax, latMin and latMax. These 4 parameters can be utilized as the invocation arguments of AIS information sharing service. Namely AIS information sharing service only returns AIS data range of latitude and longitude. In addition, because of AIS information is the real-time data, AIS database on the server have dozens of records per second into warehousing, GIS client read an AIS information sharing service at a fixed interval seconds, so that the GIS client on the ship's position information to maintain the latest data. In order to reduce the amount of read data of AIS next time, the data acquired last time will not be read, it can add a parameter maxim, as well as biggest records number ID had read currently, in AIS database, next time they just take data greater than the current maxim. This call the AIS information service needs five parameters, respectively are maxim, lonMin, lonMax, latMin and latMax. So the parameters of the AIS information service invocation in Web services based on SOAP of XML forms can be designed as showed in Figure 4.

```
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Body>
    <GetAIS xmlns="http://tempuri.org/">
      <maxid>long</maxid>
      <lonMin>double</lonMin>
      <lonMax>double</lonMax>
      <latMin>double</latMin>
      <latMax>double</latMax>
    </GetAIS>
  </soap:Body>
</soap:Envelope>
```

Figure 4. SOAP Form of AIS Information Service's Calling Parameters

Returns the object AIS information services in addition to the largest number of maxid and AIS object group record the current AIS database, including AIS data object each return need ship MMSI longitude, latitude, azimuth angle, length breadth, time of occurrence attribute, return structure of AIS information services in Web based on Service XML SOAP forms can be designed as in Figure 5.

```
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
<soap:Body>
    <GetAISResponse xmlns="http://tempuri.org/">
     <GetAISResult>
      <AIS>
        <ID>long</ID>
        <MMSI>string</MMSI>
        <SHIPNAME>string</SHIPNAME>
        <LAT>double</LAT>
        <LON>double</LON>
        <HDG>int</HDG>
        <Width>string</Width>
        <Length>string</Length>
        <SHIPType>string</SHIPType>
        <Speed>string</Speed>
        <OCCTIME>string</OCCTIME>
      </AIS>
     </GetAISResult>
     <maxid>long</maxid>
    </GetAISResponse>
  </soap:Body>
</soap:Envelope>
```

Figure 5. SOAP Form of AIS Information Service's Return Structure

5.2 Invoking Realize of AIS Information Sharing Service

After Web Service of AIS information sharing service released in UDDI, various GIS client such as WebGIS, desktop GIS, and mobile GIS can access the network to invoke real-time information of AIS data. Because of Web Service technology standard is platform-independent, various GIS client can cross-platform calls, such as using WebGIS development by FLEX to call and the result of calls is shown in Figure 6.
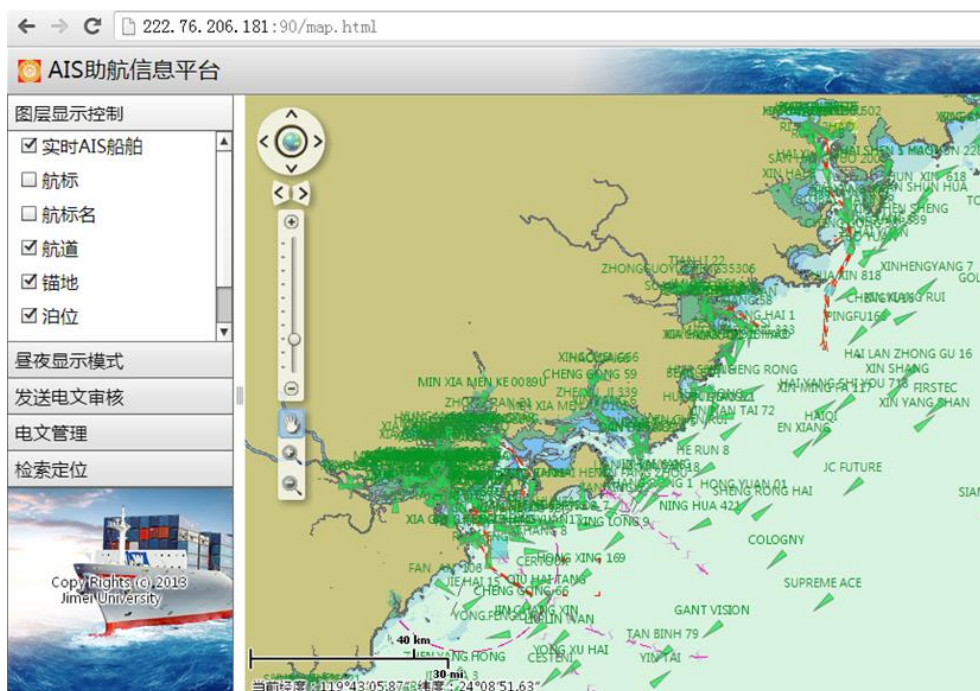

Figure 6. The Display Results from AIS Information Service on Web GIS

6. Conclusions

Using SOA software architecture to realize sharing of AIS information services, can realize the seamless integration of the application of AIS information system, to meet the needs of modern maritime management information service development, and can help AIS information data invoke in multiple GIS clients expanding platform, convenient for future expansion of new client and agile development.

Acknowledgments

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