A New Method for Designing Network Management System

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Abstract: - The development tendency of network management is the application of web service technology. This paper presents a method for implementing network management system based on the Web Services Distributed Management (WSDM). In the first place, we make a brief analysis of web service, present the web service model based on three basic roles and the Web service protocol stack used for implementing web service, then we analyze the idea, the principles and the methods of network management using web service, finally we design a WSDM-based network management system and explain how this system is used to manage network.

Key-Words: - Web Service; Network Management; WSDM; SOAP; Manageability Capability; WSDL

1 Introduction
The current development of network is characterized by large scale, distribution and diversity. Network management is becoming a challenging task due to the more and more equipments being attached into network and services provided by networks. Technology of network management is closely related to the scale of network and capability of service provided, so the traditional Manager/Agent management model no longer meets the requirement of management of IP network. Besides the emerging technologies such as distributed network management, Web-based network management, active network management and CORBA-based network management, web service is the most potential information technology and is developing rapidly. As an implementing method of service oriented architecture (SOA), Web service builds a layer independent of language upon heterogeneous platforms, realizing system integration and building an ideal distribution platform [1]. Network applications based on web service are becoming popular for its characters of distribution, loose-coupling and crossing-firewall. As Web service environment is becoming network infrastructure, it is practically significant to study the integration technology of Web services into network management.

2 The Basic Principles of Web Service Technology
Web service technology has been developing rapidly and applying widely in the construction of information system since the concept was put forward in 2000. We first make a brief analysis of web service.

2.1 Web Service Model
According to W3C definition, Web service is a software application identified by URI, its common interface and binding information are defined and described by XML.

Web service architecture consists of three basic roles, service provider, service registry and service requester. By a series of interacting activities of advertising, finding and binding, the three roles finish web service function. Service provider defines and publishes web service description on service registry (UDDI). Service requester finds service description locally or from UDDI, and binds it to service provider and calls service provider. UDDI provides facilities where service provider publishes its description information and service requester finds service information and gets binding information.

2.2 Web Service Protocol Stack
The implementation of Web service is based on a series of standard technologies. We illustrate Web service technology by a protocol stack figure, shown in Fig.1.
As the foundation of web service platform, the bottom XML technology provides a data presentation method. Web service relies one of OSI protocols in the service transition layer to transfer message, HTTP is the mostly selected. Service message layer defines message format and SOAP protocol is current playing a leading role in this layer. For the soap message is presented by XML data, so soap message format is the XML format too. The function of service description layer describes the way of using web service, including data type, message format, method name and parameter, etc. WSDL is also XML-based. Service publishing and discovery protocol is used by UDDI, which is widely used now. Service assembly layer is used to assemble several web services into a new one. There are many contenders as the candidates of this layer. The three longitudinal protocols in Fig.1 are related to service management, service quality and service security, which exist through total Web service lifecycle.

3 WSDM Network Management Technology

As specifications of network management technology based on Web service, WSDM (Web Services Distributed Management) standard was issued by OASIS in 2005, aiming at unifying management interface, sharing management information, and enabling integrated management.

3.1 WSDM Standard Framework

Based on Web service protocol stack, WSDM specifications enable the management of IT resources easier and more efficient.

WSDM specifications are closely depended on the two specifications of OASIA, which are WSRF and WSN. WSRF (Web Services Resource Framework) specifications solve the problem of presenting resources by Web service, stateful Web service resources (WS-Resource) can be produced by integration of Web service and stateful resources. The specifications specify how to describe accessing and operating on Web service resource presented by XML, including property, relationship, lifecycle, etc. Web Services Notification (WSN) specifies the rules concerned with event notification using Web service, including publishing mode, notification format and topic expression.

WSDM standards bring WSRF and WSN to a highly developed level, these standards expand the definition of Web service resources and add manageability capability into Web service resources. WSDM standards make Web service resources manageable. WSDM expands WSN event format and implements management event automatic notification by WSN register/publishing mechanism.

3.2 Enabling Network Management using WSDM

The WSDM standard consists of two standards known as Management using Web Services (MUWS) and Management of Web Services (MOWS). The MUWS constitute the basis of the standard and the MOWS standard may be viewed as the application of the WSDM MUWS standard and as an extension of the WSDM MUWS standard [2].

WSDM presents capability-based management concept and all Manageable Resources have its own Manageability Capability. Manageability Capability encapsulates information such as property, operation, event and relation, etc, and information is published through Web Services Endpoint, which provides the way of query or setting operation on Manageable Resources, etc.

Manager should firstly find out manageable resource through service finding mechanism and interact with Web service point of the resource for mutual information exchange, then access manageable resource by the provided service, and finally accomplish the management function for the network resource.

As WSDM manageability is extensible, so specifications just specify the basic capabilities on general, and leave resource related capabilities to be extended by manager itself as required. Meanwhile the resource model specifies the content of access information, which is not restricted by WSDM standards. All technologies above show the advantage of web service integration, managed resource information of other network management system can be easily integrated into WSDM management platform [3].
4 Designing WSDM Network Management System

According to WSDM standard, we design a network management system based on web service architecture.

4.1 Logical Objects Analysis

In the of WSDM-based network management system design, first we should follow the standard to decompose out some basic roles called logical object components, and then define the logical object elements and the relationships between them in the management system, finally we define basic architecture of network management. Fig. 2 shows the logical object elements and relationships.

As the executor of the system management function, Manageability Consumer is not only the consumer of Manageability Endpoint and Manageable Resource, but also the manager of Manageable Resource.

As the extension and supplementation of Web service, Manageability Endpoint provides the access point of manageable resource and publishes information of management interface.

Manageable resource is the extension of network resource and has capability of self-manageability described by Manageability Interface. Manageability Interface consists of manageability capability interfaces, which are presented as a web service that provides the way of accessing the resources.

As management notation unit, manageability capability component is the core of system and unifies the management description of network resource. Actual management function depends on the structure and component of resource manageability.

4.2 Resource Encapsulation

In order to implement unified network management, all resources need to be presented and accessed in a unified form. Manageability characters of WSDM standard provide a technical way of encapsulating management information of resources, and make it possible to implement unified encapsulation [4].

In WSDM network management system, encapsulated network resources become manageable; Fig. 3 gives the picture of describing resource encapsulation.

Logically, manageable resource consists of a real managed resource and a manageability Endpoint based on web service. Web service description document describes the relationship between a managed resource and a manageability Endpoint. Web service description document (WSDL) plays an important role in the process of resource encapsulation, and is the carrier of resource management information. Resource manageability information, such as resource attributes, operation guide, is totally described in detail in WSDL document. Meanwhile the extensibility of manageability can be easily implemented through extension and integration of resource management information in WSDL document. Both general manage capability information (resource ID, availability of resource, operation status) and resource special manage capability information (backup ability of disk resource) can be specified in WSDL document.

WSDL document contained resource management information can be published through manageability Endpoint, which is based on Web
service technical stack and implement standard Web service function, and publish uniform web service interfaces.

In order to be compatible with former network management technology and to be able to access resource information of different network management architectures, accessing mode of managed resources in WSDM network management system can be set flexibly, so the network resource can be accessed directly or indirectly by management agent mode so as to adapt different access mode.

### 4.3 System Architecture

WSDM network management system is built on Web service platform, and implements some basic services that support the management activities with the help of web service components.

All network resources become manageable and are presented as a manageable object in the network management system after being encapsulated. By a management-client program, Manager interacts with multiple objects, so-called manageable resources, and accesses management information and finally accomplishes management of the network resources. Soap message sent by client includes message request, operation command and event register, etc, server responses the message and sends event notification [5].

Fig. 4 gives the framework of network management system.

![Fig. 4 System Architecture](image)

More complicated large-scale network management system can be built based on the system, for example, to reduce management complexity, more management layers can be added to implement hierarchical management system. Web service can also be taken as manageable network management resource, managing it by web service and implementing self-management.

### 4.4 Implementation and Application

According to the system design plan, we implemented a typical WSDM network management system. For the cross-platform and extensibility, the system was developed using JAVA language. Web server environment is built on open source platform, using Apache tomcat as Web server and Axis SOAP as server engine.

WSDM network management system follows WSDM-MUSE v1.0 standard and implements standard manageability capability, supporting following network management actions: reading managed resource information; setting and updating, registering, sending and receiving the resource event information; setting interface for MUWS management event and resource relativity; implementing of QueryRelationshipByType operation, which is the only Manageability capability supported operation of Relationship standard in MUWS; a integrated Advertising Service, once a resource case is created or deleted in deployed MUWS services, corresponding Topics is produced and sent to Subscriber of the Topics, telling what is happened.

Now we give the concrete procedures for network management using WSDM network management system.

(1) Writing Web service description document. According to management requirement, management capability of manageable resource should be determined firstly, and then its attributes, supported operations, and service interfaces are specified in the WSDL document, which includes manageable information. Following is a WSDL document sample for managing a file system.

```xml
<definitions name="FileSystemResourceDefinition">

<types>
  //resource attributes
  <element name="MountPointDirectory" type="xsd:string"/>
  <element name="Type" type="xsd:string"/>

  //standard manageability capability attributes
  <element ref="muws-p1-xs:ResourceId"/>
  <element ref="muws-p2-xs:OperationalStatus"/>
  <element ref="muws-p2-xs:Relationship"/>

  //resource operations
  <operation name="GetResourceProperty"/>
  <operation name="SetResourceProperties"/>
  <operation name="Subscribe"/>

  //standard manageability capability operations
  <operation name="QueryRelationshipsByType"/>
  <operation name="Mount"/>

// service interfaces
```

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**Fig. 4 System Architecture**

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(2) Creating Web service resource. According to WSDL document, wsdl2java tool is used to create Web service resource, so-called java objects, then these created java files should be modified to fit the real needs.

(3) Connecting network resources. Web service resources eventually interact with real network resources, and interaction mode is defined by resource mode, which determines whether to access physical device directly or connect other management system through management agent.

(4) Deploying and managing. After manageable Web service resources being deployed on WSDM network management environment, managers may carry out basic management function on network resource through a client console.

5 Summary

Though WSDM may not solve all network management related problems, it provides a reliable and standard-based framework to manage computing resources and network devices in IT environment. Without redefining or renovating the prevalent technology, WSDM is built on current standards. The ultimate goal of web service is to facilitate the share of information, so the WSDM network management system based on web service is compatible with other network management technologies. WSDM concentrate on the technologies of encapsulation and message exchanging, try to provide a method of implementing integrated resolution to unify management system. WSDM technologies are developing and related standards are keeping improving, using Web service technologies for network management is orientation of technological development of network management.

References: