

# A Virtualization Model of Network Services Management

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**Abstract.** As the coupling degree between current network management system and network element is very high, the management system has poor reusability, flexibility, scalability. Network service management middleware can well solve these problems by shielding differences among network elements. With ITSM management philosophy, this paper proposes a layered model of network service management, which can support the development of network service management middleware and measure the quality of service.

**Keywords:** network services management; virtualization; middleware; model; the quality of service

## 1. Introduction

Currently, network service management system is developing in the direction of comprehensiveness, intelligent and distribution. The new technologies of cloud computing [1], virtualization, service-oriented architecture (SOA), middleware, etc are emerging, while not only increase the network heterogeneity and complexity, but also make service diversity. Meanwhile, the requirements for network service management are constantly changing and it is necessary to ensure quality of service for user. In this new regulatory environment, the development method of traditional network service management system faces enormous challenges. The traditional network service management system implements system hardware management, performance management, desktop management, and other management functions through a proxy or directly calling the underlying resources management interface. However, this high coupling between the network service management system and network elements make management system poor reusability and flexibility. In order to ensure network performance and reliability and provide users with high-quality services, we must change the development method of the existing network service management system.

Recently, the middleware technology has been widely used. A network service management middleware is able to shield communication details between the network service management system and network element, make network element functionality virtual, and improve the reusability, flexibility, scalability of network service management application integration. We can build thin client management system by calling service provided by the middleware. So, we need to propose a virtualization model of network service management to support this middleware development.

The rest of this paper is organized as follows: in the second section, we briefly introduce the related research work; in the third section, the network service management virtualization model is proposed; in the fourth section, we describe the role of this model in the development of management middleware; in the fifth section, the results of model application is presented; in the seventh section, we summarize the thesis and propose future task.

## 2. Related Work

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IT service management (ITSM) is a set of methods used to help enterprises to manage IT system efficiently. ISO20000 [2] is the first standardized IT service management standards recognized by industry, based on ITIL's customer-focused, orientation-operation and maintenance management services.

In the field of SLA, Tele Management Forum (TMF) has done lots of related work and formulated a series of specifications and guidelines; Service level agreement (SLA) is a negotiated agreement between two or more parties about services, responsibilities, priorities, etc. It refers to a common understanding and expectation of service provision [3]. To be more exact, SLA is a set of related goals and procedures which are made to achieve and maintain specific quality of service. It usually contains three aspects: QoS parameters and measurement methods, compensations for service violations and Communication rules between the parties. The definition of parameters, measurement and report of QoS are the keys to build and manage SLA. The QoS definition in ITU-T E.860 [4] refers to "degree of conformance of the service delivered to a user by a provider in accordance with an agreement between them".

To solve the problem of distributed heterogeneous, middleware concept has been proposed. Middleware is a

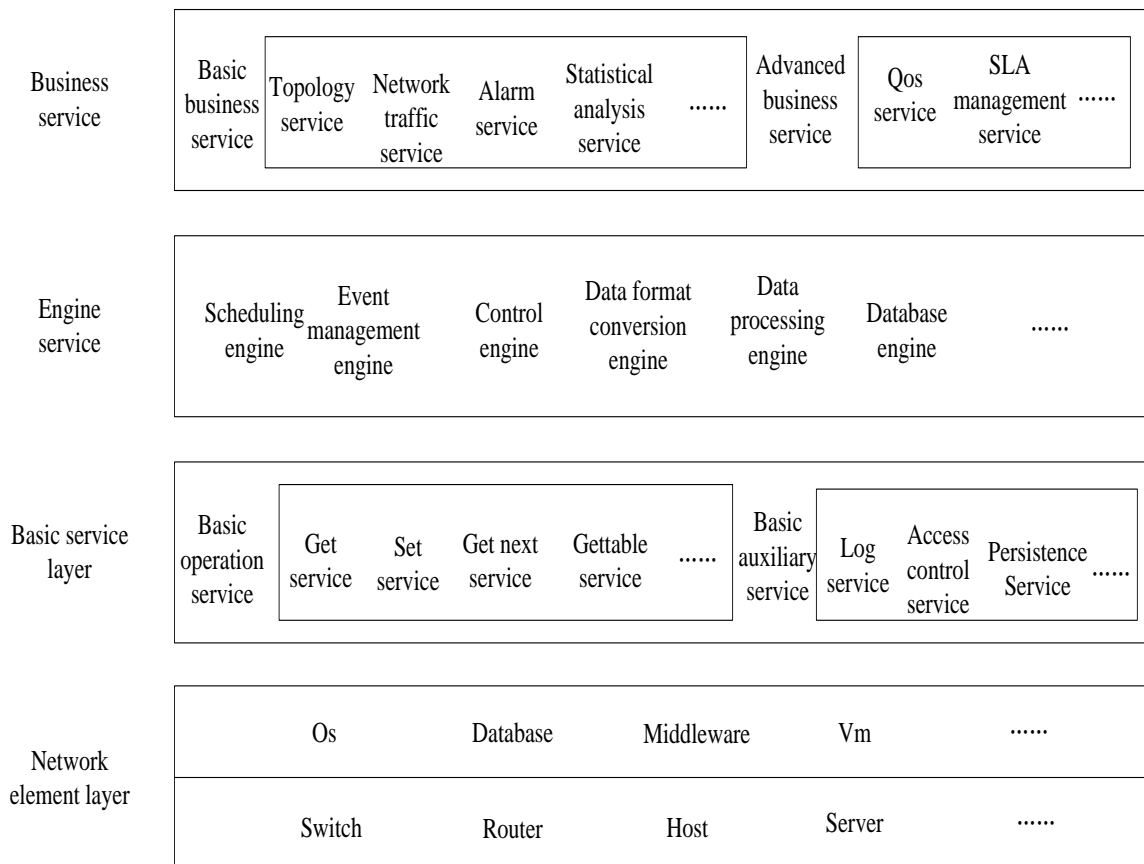


Figure1.Virtualization model of network service management

function layer of the software between application layer and network layer, make application system independent of the heterogeneous operating systems, hardware platforms and Communication protocols. With further research and universal application, middleware standardized specification and product have formed, such as CORBA, DCOM, J2EE. The goal of J2EE specification launched by the sun is to provide platform-independent and portable, supports concurrent access and security, is based complete middleware standards based on developing of server-side. It has a complete Java-based language development, business-oriented applications published specifications, including the Java Servlet, JSP (Java Server Page), EJB, JBI and other forms, to support different business needs [5].

JBI (Java Business Integration) is the solution proposed by SUN Company to SOA program. The aim of JBI 1.0 specification is to establish an open, standards-based platform for integrating enterprise JAVA application .JBI framework has the following three main components: service engine which behave business

logic driven. Binding component sends and receive messages based on a specific protocol and transmitter; normalized message routing is a fast, reliable, in-memory message bus.

### 3. Network Service Management Virtualization Model

With ITSM management philosophy, this paper presents a network service management virtualization model. Fig. 1 shows the model. The model can be broadly divided into two parts. By analysing all kinds of network element of network element layer, we establish a management index system which support to measure the quality of service. By analysing required services during the network service management we establish a layered service model including basic service layer, engine service layer, business service layer to support the development of network service management middleware.

#### 3.1. Network service layer

Network elements are at the bottom of architecture model, which mainly include IaaS platforms, composed of network physical devices and various interfaces, and various systems and applications deployed in the IaaS platform. The equipments composed of IaaS platform include servers, routers, switches, hosts, etc, which can be called hard network element; applications deployed on the platform include operating system, database, virtual machine, etc, which are called soft network element. In order to ensure the quality of network elements service, network elements is needed to be managed. The management of QoS of network element resources mainly divides into four aspects: availability, performance, throughput and utilization of service. We use object-oriented approach to analysis various network elements, build object model. Fig. 2 shows the object model.

Network element
Public attribute
Private attribute
Availableservice : Map(attribute )
Utilizationservice : Map(attribute )
Performservice : Map(attribute )
Thoughoutservice :Map(attribute )

Figure 2. The object model for network element

The attributes of one object can be classified into public attributes and private attributes. Public attributes are common concluding object name, object type, object manufacturers, IP address, etc.; private attributes are characteristics property of network element object itself. Services provided by network element object are classified into the availability service; the utilization service; the performance service; the throughput service, one of which is related with one or more attribute. In this article we establish a index system by analyzing switch, router, operating system, data base. Fig.3 shows the network element management index system.

Index Network element	Availability	Performance	Throughout	Utilization
Switch	Availability	Address forwarding table Port traffic		
Router	Availability	Routing table Port traffic		
Host	Availability	Disk read and write speeds The switching speed of the process		Cpu utilization Memory utilization Utilization of disk space
Database	Availability	Service process status	Transactions per minute	Table space utilization

Figure3 .The network element index system

### 3.2. Basic service layer

Basic service layer is the lowest level of service, the basic of engine service and business service implementing. Basic services include basic operation services and basic auxiliary services .Basic operation services can obtain resource data, which the engine service business and business services process. Basic auxiliary services include log service, access control service, persistence service, etc. Those services are small associated with the main flow of business process, but are called by most by business processing services.

Basic operation services are directly related with network elements, a set of services reflecting the current state of network operational state. These services obtain data by calling management interface provided by network element. Typically; network element supports specific management interface or specification, such as traditional Q3 interface, CORBA interface, SNMP interface, or even proprietary management interface. The interface has three elements: the communication stack, network management protocol and management information model. Communication protocol stack is response for sending messages between network management applications and device agent. Management information model is the abstract representation of network element, which shows various managed in formations in with a abstract data structure .Network Management Protocol is some rules performed by management application, which can operate information model, including the parameters encoding and transmission of network management operation request, operational error return and handling operation, ect. Generally, network management protocol provides some management operations .Currently, most of the network element support SNMP/SMI management interface [6]. Communication protocol stack use UDP/IP, and information model use SMI (Structure of Management Information) to describe, define the composition, structure and representation of information. SNMP management protocol support several operational services, such as get service, set service, get next service, gettable service. For example, we can obtain some parameter value of `ifInError`, `ifInUcast` and `ifInNUcastPkts` about error rate of switch port by get service.

### 3.3. Engine service layer

. Engine service is the underlying key to combine bottom services, which can provide business data by obtaining and processing resource data. Engine usually has following three interface: lower interface which is used to call other service for data ;upper interface which can be called by other service ;the management interface which can start ,deploy and monitor engine. The engines used in this article are scheduling engine, the event management engine, the control engine, data format conversion engine ,data processing engine ,database engine and so on .Scheduling engine is the key engine ,can obtain resource data by calling bottom service with some scheduling strategy. For example ,we can obtain data by polling various network element. The event management engine manages a variety of system events, such as trap event, and log. The control engine is able to control network element by communicating with some basic operational services,

such as set service. The data format conversion engine conversion all kinds of format information into a uniform. format, which makes data storage and processing convenience. The data processing engine obtain business data by computing service. For example, we get required business data of port error rate, and the data unit is kbps by calculating  $\frac{\#iflnErrors}{\#iflnUcastPkts+\#iflnNUcastPkts}$  (where indicates the difference between the two acquisition).The database engine implement the operation on the database,with which business service can access business data .

### **3.4. Business service layer**

Business service is coarse-grained service to meet user's requires based on business data and is the core layer of network service management system. In accordance with the variety of network service management requires, we divide business services into two basic business services and advanced business services.

Basic business services are some common services, such as network topology service, network traffic service, alarm service, statistical and analysis service, etc. Network topology service show the relationship among interconnected network devices and is pre-condition for the network service management and performance analysis. Network traffic service can reflect any port nodes traffic with a defined time. Alarm service can send related information when service is not available or some alarm condition is satisfied. Statistical and analysis service analysis the highest value, minimum value, etc of service with a certain time.

Advanced business services are mainly for some users, including QoS service and SLA management service and defined alarm service,etc. QoS service calculates the quality of service according to quality parameters, which is the basis for SLA management. SLA Management includes SLA negotiation, determination, QoS report generation and . SLA violation hanling.The main purpose is to negotiate SLA with users in a standard and unified way.The defined alarm service can send alarm message according to the condition defined by users.

## **4. The Model And Management Middleware**

Network service management middleware shield the difference among network elements and provide various management services, which can be published to ESB and be used in the form of Web Service., administrators call these service to realize the network management through management terminal.

Service model in this paper support the development of management middleware. In the JBI [7] environment, the development of middleware can be mainly divided into two parts: the binding component development, the engine component development.The binding component connect with service consumer and provider .The engine component mainly implement business processing In the service model ,basic operation service can support the development of binding component. For example,get service, set service, get table service,etc support the development of SNMP component, which can control and management SNMP device .Engine services, basic auxiliary services and business services all support the development of engine component During the development of management middleware, we also need to consider this component development, deployment, management and maintained, and so on. All of these can be introduced in detail in another article.

## **5. The Application Result of This Model**

The model is applied to the development of management middleware in the JBI enviroment . We can build thin client middleware-based network service management system. Thin client complete service customization and network service management.Fig.4 shows a router port's traffic in one day by thin client calling management system



Figure 4 . Network traffic service

## 6. Conclusion And Future Work

In this paper, we build a management index system by analyzing various network element from four areas which well support to measure QoS .Meanwhile ,a service model is also proposed concluding basic service layer ,engine service layer and business service layer, the role of which is described in the development of management middleware in the JBI environment .At last ,we show the application result of this model .

The index system is just several typical network element, therefore, indicators of the network service management system is not perfect. In addition, service model also needs further improvement to satisfy the continually changing requirement.

The purpose of service measurement is to manage services better .So, in the next step, we should consider various factors infecting the quality of service and management service according to the measured data.

## 7. Acknowledgements

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