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The Hierarchical Network Topology Management System based on Managed Object and View Mechanism

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Abstract

Now how to improve the developing efficiency and enhance the scalability of network management system has become a hot issue in the current research. In this paper, according to the actual demands, understanding the functional requirements and analyzing the process of network topology management, we propose the hierarchical network topology management system based on managed object and view mechanism. Using an object-based management method, it achieves the expansion of the three-layer model of network topology management; using the view mechanism, it reduces the dependence on the specific needs for the system and achieves a hierarchical network topology management system.

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Keywords: Hierarchical network; topology management; managed object; view mechanism; mapping; network management

1. Introduction

With the expansion and complexity of network scale, management and maintenance of the network has become critical. And network management systems(NMS) have become an important part of network construction and maintenance[1]. Meanwhile, network topology management(NTM) is the basic part of NMS, and most of the functions will be through topological graph to reflect.

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Network topology is the physical or logical layout, corresponding the physical or logical relationship between network nodes. Grasping the topology information accurately is the basis of a series of functions[2]. NTM is a flexible and difficult subsystem. It not only requires to design the interfaces, through graphic symbols display the connection relationship between devices and attribute, but also deals with the real-time interactions with network performance and alarm subsystem, reflecting the monitoring function[3].

2. Related Works

2.1. Life cycle

NTM has its fixed life cycle. First is the data acquisition stage. The second is the data analysis stage. And the third is presenting stage, presenting the related topological information according to the user's demand. And with the change of requirements, it can adjust the presentation of mode and content. The last is using stage. The users can configure and monitor the managed object.

2.2. Key technologies

- Hierarchical display strategy

Here we adopt the hierarchical display strategy, the following IP network as an example. The first layer shows the main topology, namely the relationship between router and subnet. The second layer displays interconnection in the subnet; if the subnet also includes router or switch, It can also go deep into the port level for the third layer of topology structure.

- Graphic coordinate allocation strategy

It is a technical difficulty to distribute coordinates to network reasonably and make them more attractive on the screen[4]. Based on the hierarchical structure, they can automatically generate the network topology, thus improve the appearance of topology in order to manage the topology intelligently.

- Data loading strategy

Ordinary loading model is generally used, because of the small amount of data. Multilevel loading model is the premise of the hierarchical network. When the system is initialized, it only presents the uppermost data. The multilevel loading model can not only save space, but also improve the speed of loading system.

In general, NTM will be developed in the intelligent and hierarchical direction in the future[8]. In the whole life cycle, the most difficult is analyzing topological data, and the large amount of work is database construction, graphic processing and external interfaces.

3. Overall Design

The design mainly includes three points: based on the design of managed object, mapping managed object to database, the implementation of functions. Architecture design adopts three-layer architecture model.

3.1. Based on the design of managed object

The managed objects are abstracted from network resources[5], namely the basic elements of network topology, such as network equipment, network type and network relationship. Various network elements can be abstracted as managed objects, and they can be viewed as an instance of managed object[6].

3.2. Mapping managed object to database

It adopts the view mechanism, including data mapping and operation mapping. Data mapping refers to the data mapped into memory object, and operation mapping sucks the changed data into database as shown in fig1.

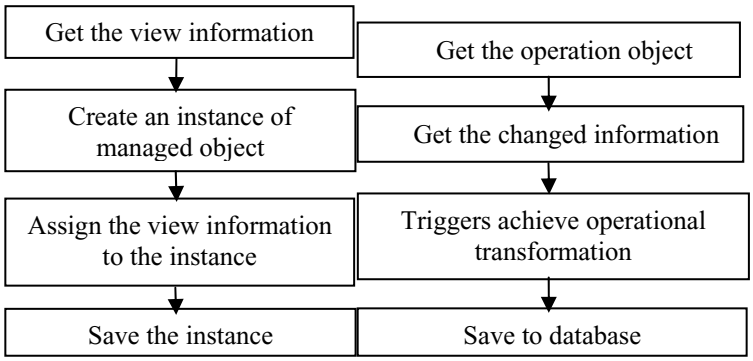

Fig.1. (a) Data mapping module; (b) Operation mapping module

Data mapping module includes two parts of capturing object and converting object. Capturing object refers to getting the object from database; Converting object refers to the transformation from the obtained object into the identified memory object. Operation mapping module includes acquisition and transformation. Acquisition refers to the operation of topological interfaces, resource tree, information in the table, such as the operational records of modifying/deleting/adding the managed object. Operation transformation refers that the operating results are saved to the database.

3.3. Architecture design

The architecture design is the foundation to realize the software system, and one good architecture design helps implement overall hierarchical structure[7]. The architecture based on hierarchical design can be divided into data processing layer, logic business layer and graphical presentation layer. Data processing layer includes data mapping and operation mapping, which is responsible for obtaining the managed objects; logic business layer includes four parts: processing the topology, analyzing managed objects, alarm interface, and performance interface, which is responsible for topological operations and analysis; graphical presentation layer includes topological graph, resource tree and information table,which is responsible for presenting the managed objects. Each layer module communicates by means of the managed object and message mechanism to realize the data exchange and sharing. The hierarchical structure of system is shown in fig2.

3.4. Functions

From the view of software, the functional modules can be achieved through the graphics rendering and graphics packaging, so they can be divided into the following modules: topology presentation module, topology management module and the data control module. Topology presentation module includes topology, resource tree and information table, corresponding to the graphical presentation layer in the software architecture; topology management module includes processing topology, analyzing managed object and external interfaces, corresponding to the logic business layer; the data control module includes two parts, corresponding to the data processing layer.

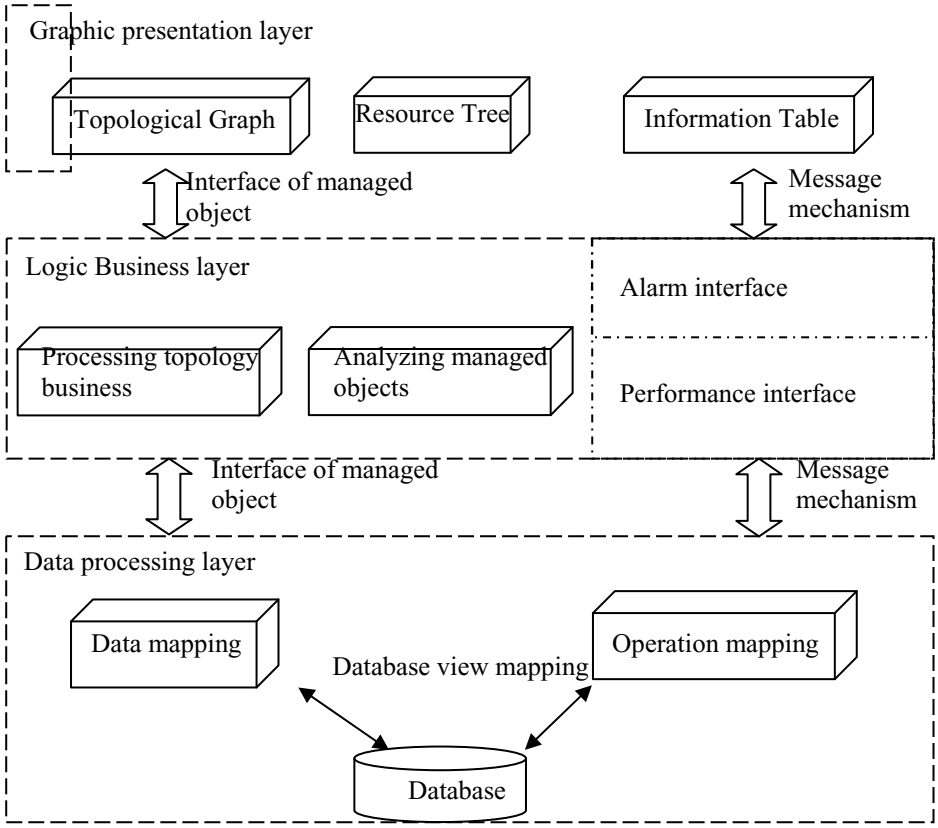

Fig.2. The hierarchical architecture of system

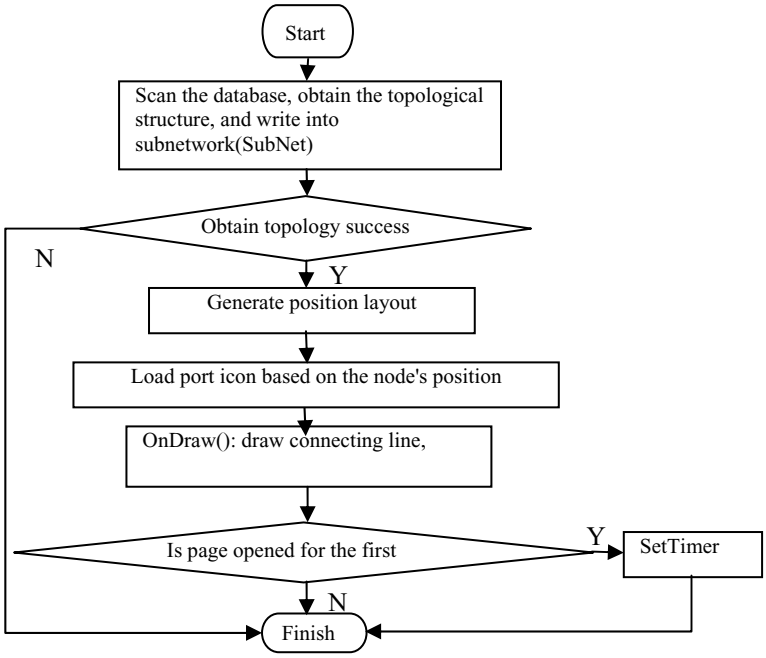

Fig.3. The flow chart of topology drawing module

4. Implementation of Main Functional Modules

4.1. Topology drawing module

According to the location of father's node to determine the location in the hierarchy, scan the database to get the node number and network topology, and compute the position of node icons, then load icon and form the topological layout. Every five minutes, the page will update the view. The flow chart is shown in fig3.

4.2. Information table module

Information tables mainly include three types: attribute information, error rate information and flow information. The specific form relates to the specific format of managed object. Therefore, we only present the basic information, and some specific characteristics need to be implemented in the extended class.

4.3. Resource tree module

Resource tree mainly reflects the managed objects in the form of tree. First, display the top level topology of the whole, then gradually show the subnet details. The flow chart of resource tree module is shown in fig4.

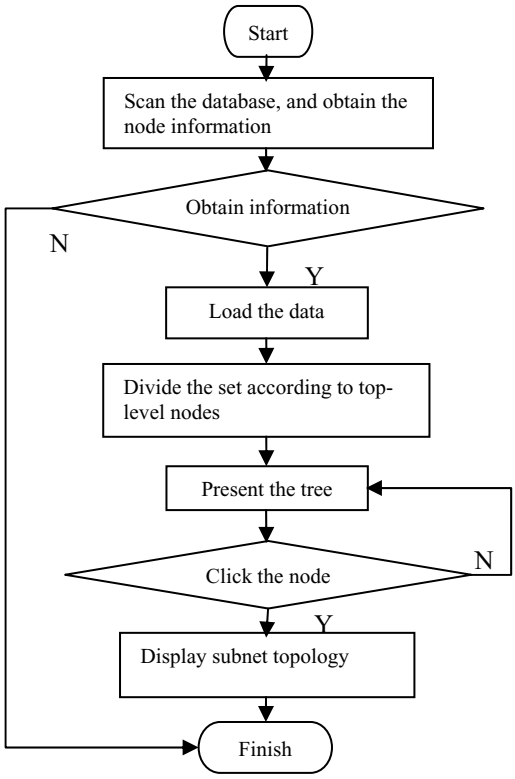

Fig.4. The flow chart of resource tree module

5. Conclusion

The system achieves various functions of network topology using hierarchical structure and modular design. Opening interface implements the extension of system, and multilevel loading data improves the efficiency of the system. In this system, first pull data from the database by the mapping method, and use the functional module to handle the data between database and managed object; then analyze the difference and connection through business analysis module to satisfy the needs for topological business. Finally, present the data through the graphical interface. The system is flexible, expansible and easy to maintain. And the performance management system and warning system are required for further study.

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References

[1] Yang Liu, Li Zhenning, Du Nin, Zhang Dafang. Design and implementation of next generation internet network management system[A]. Computer Engineering 2008;34-7:104-106.
[2] Li Tao. The research and implementation of network topology management system based on SNMP[D]. Institute of software 2003.
[3] Zhang Wei, Tang Xuewen, Ma Ying. The design and implementation of graphical campus network monitoring system[A]. Computer and Modernization 2007;05-4:72-75.
[4] Liu Yuhua, Xiao Debao, Xu Zhankui. The design and implementation of discovering automatically and displaying campus network topology[A]. Computer Applications 2003;23-11:56-58.
[5] Meng Luoming, Qi Feng.Modern network management technology[M]. Beijing University of Posts and Telecommunications Press 2001.
[6] Liu Huiyong. Telecommunication network resource management model[A]. Beijing University of Posts and Telecommunications 2004;1007-5321:01-08.
[7] Liu yong. The design and implementation of lightweight and scalable network management system[A]. Jichang College 2008;1:101-104.
[8] Li Juxi. The implementation of universal distributed network management and IP network topology management[D]. University of Electronic Science and Technology 2005.