Development and Application of Visual Network Management System For Campus Based on B/S Architecture

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***Abstract*—In order to improve development efficiency in system of business platform networked management, enrich function in network management system, enhance easy-use and applicability in network management system, this paper studies system frame, function and corresponding development technology in network management system, and also puts forward a B/S framework-based model in visualized network management system in terms of campus network characteristics. Furthermore, this paper studies the system structure in general network management, development method of simple networked management protocol, development method of SVG and AJAX, and finally solves key problems of design and development in general network management system. The test results show that our model can effectively support secure operation on campus network platform and accord with networked management system development trend in terms of functional advantages of general network management system on traditional network management.**

Keywords-network management system; campus; SNMP; SVG; AJAX

I. INTRODUCTION

Campus network is a networked platform to offer teachers and students' convenient and efficient teaching, research and comprehensive information service. With gradual expansion of campus network scale in universities, dependence of teaching and research on information has been stronger and stronger, campus information development is faster and faster, networked structure is more and more complex. Difficulties in management operation lead that construction in campus information of university faces more and more challenges. It urgently needs visualized monitoring method to be in unified management of equipment resources. Users' information and equipment resources will be combined to be in centralized monitoring in equipment warning, equipment performance, and rapid location of business default to offer comprehensive statistical analysis forms.

This paper introduces the status quo and research significance in networked management system. On this basis, through introduction and analysis of SNMP protocol, it puts forward overall design scheme in system and mainly studies two core functional modules: performance management module and default management module which analyze and solve its core problems. Through OID in MIB, performance management module obtains networked flow information to further get networked performance data through calculating formula. It proposes a polling mechanism on the basis of adjusting DLL file for timing data acquisition and innovatively adopts SVG technology to realize real-time networked flow drawing so network managers can understand networked operation in time. Finally, functions in functional requirement are tested. Test environment and points for attention are introduced in system. Test results are offered at last. By means of repeated test, it is proved that the system can be stably, reliably and efficiently operated and users' requirements can be completely satisfied.

II. REQUIREMENT ANALYSIS

Allocation management module must offer network topology display. Performance management module needs to set up complete management systems with functions in monitor, pre-warning, statistics and analysis. Default management module needs to reflect defaults in network timely and accurately. When there are some situations including violation closed value, it will notify network management system in time and warn managers' abnormal situation through pre-setting modes in order to implement default management.

The basic functional requests in network management system are generalized:

(1) According to enterprise-leveled network equipment monitoring requirement, for various-leveled network managers and maintainers understanding and grasping the whole network status in time, this system needs to be operated and managed in B/S form.

(2) In order to realize automatic monitor of the whole network communication lines and dynamically offer communication lines operation status, when there is something wrong with lines, corresponding warning will be offered such as graphic display, window ejection, sound warning and short message notice, etc.

(3) In order to realize network main equipment and key server to operate automatic monitor in the whole network system, the system offers monitor display such as flow, operation, port status, hardware, memory and CPU occupancy rate of key equipments. After there are problems, corresponding warning function will be offered such as graphic display, window ejection, sound warning, short message notice, etc.

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(4)System can realize equipment default information of monitor according to statistical analysis based on year, ten-day and month to form report. Default information needs to display time, place, duration, equipment name, port number of default of default information so that network managers can accurately eliminate default source.

III. OVERALL DESIGN SCHEME

A. System Framework

General network management system is an integrate-styled network management system and it is made up of network management server, network management terminal computer and the monitored equipment. Network terminal computer communicates with network management server through Http protocol so network management monitor terminal only needs a general computer with Web browser without installing any special software or hardware equipment. The monitored server communicates with network management server through SNMP protocol. SNMP has been actually a standard protocol in network management field and all the monitored server offers SNMP Agent support. Therefore, the design in general network management system can be seen as a software design in network management server.

The software of network management server is divided into three layers: data acquisition layer, data processing data and transmission layer. Data acquisition layer uses SNMP protocol to acquire the monitored equipment status to transmit equipment status to data processing layer. Data processing layer calculates the acquired data which need analysis and calculation in formula. The presetting warning threshold in network management system will be used to judge whether equipment status alarms or not. If it needs warning, it will transmit to data processing data through JMS message queue. Data transmission layer is a layer in network management system and it is mainly for warning appearance. Then, program set which is offered by data processing data is for various system allocation, data query and data statistics function. The overall design of general network management server is depicted as figure 1.

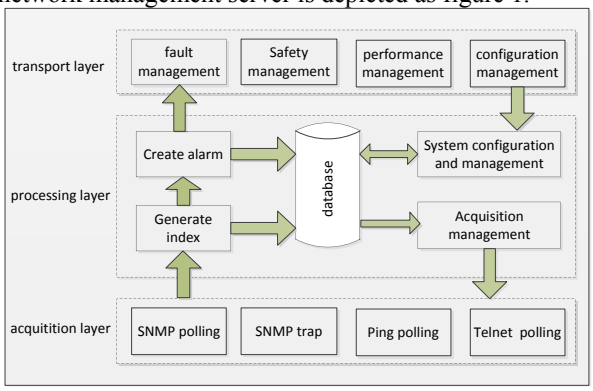

Figure 1. Overall design of network management system

B. Web-based B/S Framework Design

Web-based B/S mode usually adopts three-layer structure: data presentation layer, data storage processing layer and data acquisition layer. This can largely slow down client load, reduce cost and work load of maintainance and updating in system to further reduce user's total cost. It can effectively protect data platform and management access authority. Meanwhile, server data is also very safe. Web server is mainly used to interact with users and data expression layer offers users' related network management parameters through browser allocation by Web page. Meanwhile, results and analysis reports present to users through Web page.

Based on page requests from console, data presentation layer extracts related allocation information data from database. If there is no information from database, request will be submitted to data acquisition layer which extracts information to be presented from network equipment. After extraction, functions from data storage processing layer store it to file or database. Related modules in data storage processing layer read file or database and extract network monitoring data to store in database for foreground presentation according to users' submitting related parameters in allocation files.

The function in data acquisition layer is to obtain monitoring data from the managed network equipment according to the demand and the obtained data information will submit to modules in data storage processing layer for processing.

Various monitoring results in data storage processing layer will be in cluster analysis to be written in database file for presentation. Detecting results and detecting analysis reports will be displayed to users through Web page.

In terms of functions of real-time display such as interface flow and IP flow, data presentation layer can directly adjust modules in data acquisition layer to obtain presentation information in requirement.

C. Database Design

The system mainly studies network performance management and network default management so these two modules and related database table design of these two modules will be mainly listed. These tables mainly contain basic information table of network equipment, Devices; interface information table to display interface performance, Interface; interface performance data object table, Interface PerfDataObject; IP information table to display IP performance, IpInfo; IP performance data object table IpPerfDataObject; related events table of network equipment default, Event; event type table EventType, etc. Figure 2 depicts the logic model figure of database table.

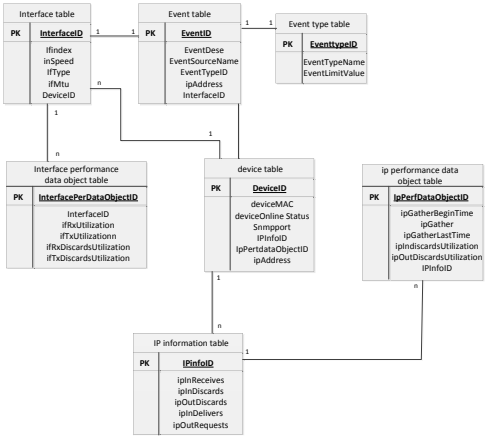

Figure 2. Logical model diagram of the database

IV. Analysis and Realization of Key Technologies

A. SNMP-based Bottom-layer Data Acquisition

All data acquisition program which is written in SNMP++ will be compiled into DLL file for foreground code adjustment and further corresponding processing. Some data are directly written into database table and some data are directly used for foreground display. All importantly monitored network equipment, server adjusts compiling DLL file obtains one-time interface data and IP data through IP address at certain time interval.

There are two forms of data acquisition. One of them is to trigger bottom-layered DLL for data achievement through foreground operation to be directly displayed at foreground page. The display of interface real-time flow is in this form. The other form is to compile background program into service program in management item to follow start and close of server for automatic operation. This is mainly for data flow statistics because statistics is based on month, ten-day or year so data flow information must be stored in database. The data acquisition process is shown as figure 3.

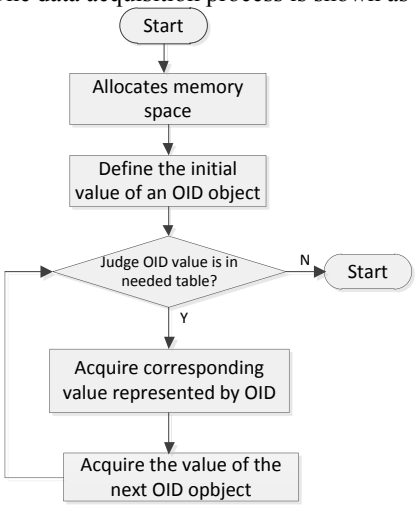

Figure 3. Flowchart of DLL files to acquire performance data

B. Topological Image Display Module

In order to display topological graph, a basic topological display framework will be established at first to transform the given node information and its connecting relationship into graphic expression. That is to say, each node will be drawn in drawing field and nodes with connecting relationship will be drawn to lines. Functions such as node dragging and graph zooming will also be offered for users.

In addition, in order to distinguish different equipments during display and various states during equipment operation, different nodes will adopt different icons drawing functions. Considering the cost in development realization, the third-part component product JUNG will be used in this network management system.

When establishing topological graph, API from JUNG can be directly adjusted to realize image display. However, JUNG image base is not directly adjusted during designing and developing this network management system but one JUNG wrapping layer is set up.

When drawing topological graph, various drawing operations will be submitted to wrapping layer. Then, wrapping layer reassigns this request to JUNG to finally realize function of drawing topological graph. During generating topographical figure, Applet at client requests topological information on client. After it receives files including topological information, it will analyze its content to obtain the needed topological information. Then, according to topological information, Applet adjusts drawing interface of topological graph display layer to set up nodes and connection on topological graph. Finally, the needed topological graph will be obtained. Meanwhile, according to different equipment types and online status of equipment, different icons will be applied to distinguish during topological graph display.

C. Foreground Management and Displa

1) Data status data definition

Equipment status data transfer between server and client in the form of XML format so data format in equipment status must be designed before its development. The reason is monitoring interface only concerns whether various equipments have warning and it is not necessary for all status data of equipment to send to client in real-time. Therefore, data for client do not need include specific equipment parameters but only need to send equipment name, equipment type and alarm level. Alarm level is usually divided into 6 levels from high to low and they are emergency, importance, minor importance, warning, suggestion and normality.

2) State interface of development server

The server reads warning state of all monitored equipments from database. After it receives equipment state request at server, all equipment states will be sent to client in pre-defined XML format. Since server needs to receive several even dozens of data requests at monitor client and each query database will consume system resources, alarm information at server needs to be stored in memory and this reduces query quantity of database. When server receives

equipment status request at client, interface program reads alarm states of all monitored equipments from HashTable and sends Schema format of all equipment states to client. The example of process is described as follows:

```
<system>
  <device type=" server" id=" x3650 database" alarmlevel=0/>
<device type=”server” id=”x3650_application” alarmlevel=0/>
  <device type=”router” id=”cisco3500” alarmlevel=1/>
</system>
```

3) Device alarm state display

When the client receives equipment state XML data from server, its XML data will be analyzed through DOM technology to traverse all equipments to display equipment. According to warning level of equipment, equipment will be displayed with different background colors on interface. Alarm level from high to low will be displayed in black, red, purple, blue and green in general network management system.The codes of traversing equipment are:

```
var devices=xml Doc.document Element.child Nodes;
for (i=0;i<devices.length;i++){
device_type=devices[i].get Attribute("type");
device_id=devices[i].get Attribute("id");
alarmlevel=devices[i].get Attribute("alarmlevel");
Set Device Image(device_type,device_id,alarmlevel);
}
```

V. SYSTEM TEST

The network management system is mainly made up of network management server, database server and several clients. Due to conditional limitations, database server and network management server are installed on the same one server. Network management server performs data exchange with front controller of various front ends. In network management system, in addition to various data, data process is also realized. For example, according to the acquired IP address, corresponding topological structure map can also be calculated. After normal work in equipment network management system, its main interface in management and the whole topological structure map are shown as:

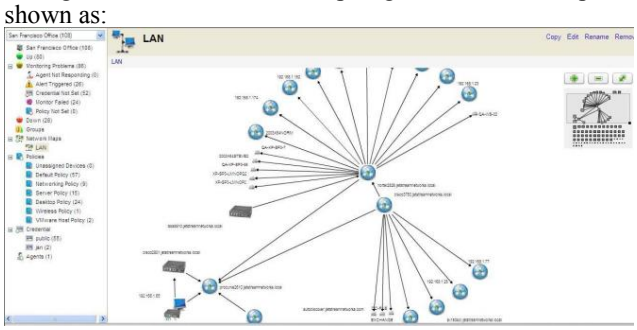

Figure 4. Main interface of network management system

In main interface “network performance management”, system will firstly choose network equipment and then choose “checking interface information” so it can query interface performance information in chart form. Meanwhile, interface and IP real-time chart can be drawn. It clicks displaying equipment on main interface to appear equipment items of interface performance and IP performance. This respectively chooses items to be displayed and draws real-time chart in figure 5.

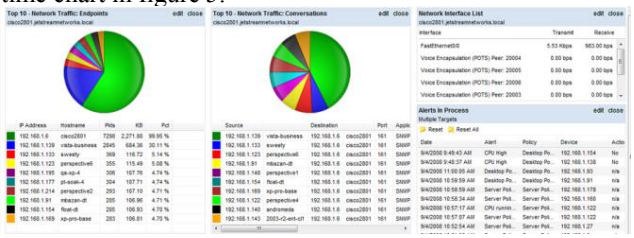

Figure 5. The performance information of IP and interface

Background service program of monitoring default information will be triggered. If there are defaults, scalable menu in first page of system will show the latest default information which respectively display default location, equipment type, event-source name, event generation time, event degree, etc, in figure 6. When default occurs, we can count the designated default events according to year, month, ten-day and day to generate report form which is classified into default detail report and default summary report. From detailed report of default, we can see equipment type of default, area, port default and default end time. From default summary report, the default times can be in statistics according to time, equipment types and default source.

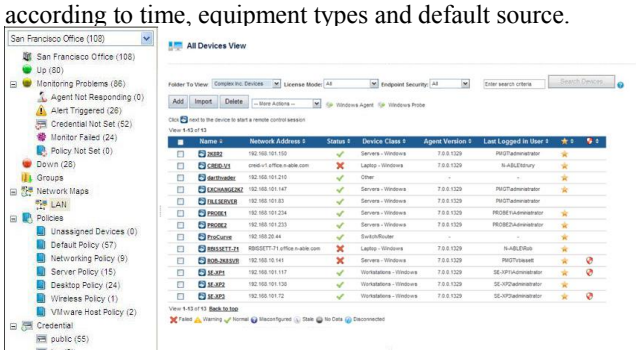

Figure 6. Breakdown detailed information report

VI. CONCLUSIONS

This paper discusses SNMP protocol-based related modules realization of network management system in campus network. It mainly introduces flow measurement of network core exchange equipment route, switch interface and discovers network logic topological chart through reading route table of router. The paper also illustrates key technologies during development. After previous development and test, these technologies have reached router interface flow achievement and network logic topology exploration.

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