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(54) **HIERARCHICAL MANAGEMENT SYSTEM ON THE DISTRIBUTED NETWORK MANAGEMENT PLATFORM**

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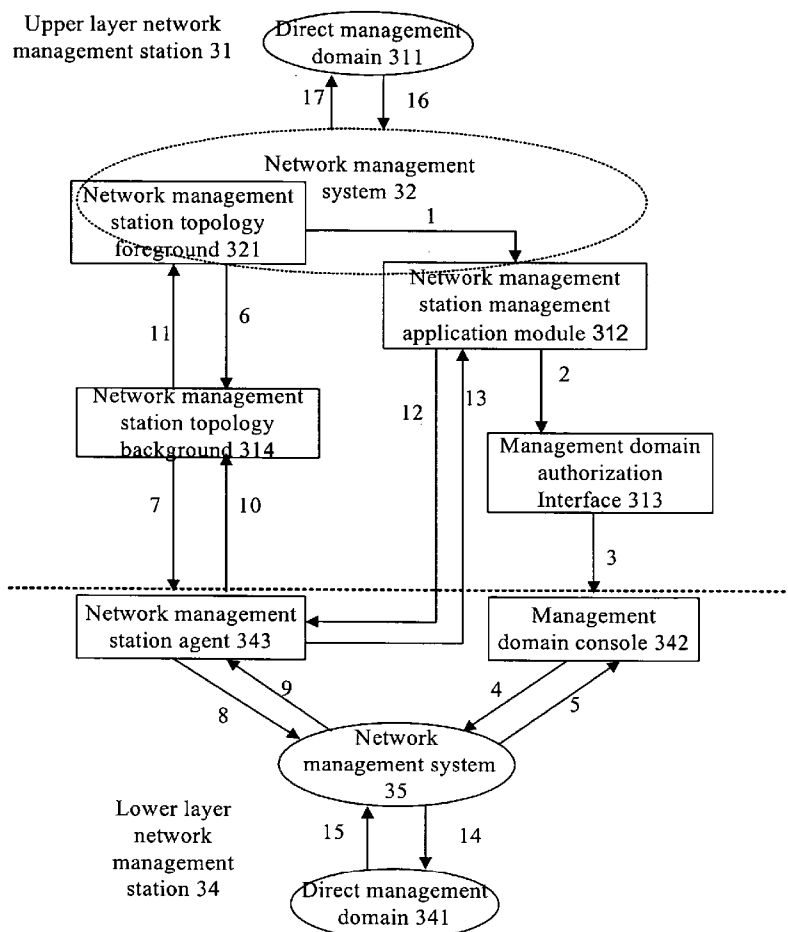**BLOOMFIELD HILLS, MI 48303 (US)**

(57) **ABSTRACT**

The present invention relates to communication network technology, more particularly to a hierarchical network management system on a distributed network management platform. The system is a network management system with multi-layer structure. It can manage large scale network through hierarchical configuration of numerous network management stations and classification of the management domains. For instance, the system may include upper layer network management stations and lower layer network management stations, in which the upper layer network management station has the functions such as configuring and monitoring the lower layer network management stations with help of corresponding devices, while the lower layer network management station provides services of data collecting, reporting and monitoring for the network management via simple network management protocol (SNMP). The hierarchical management system is flexible and expandable, and can reduce network load caused by large scale network management, and improve management performance.

Network
management
station

11

12

12

12

12

Agent

Network device 1

Agent

Network device 2

Agent

Network device 3

......

Agent

Network device N

Fig.1

Upper layer network management station   21

Network management private network   22

23   SNMP   SNMP   SNMP   23

23

24   24   24

Lower layer network management station   Lower layer network management station

Lower layer network management station

Device management domain   25   Device management domain   25   Device management domain   25

Fig.2

Upper layer network
management station 31

Direct management
domain 311

17   16

Network management
system 32

Network management
station topology
foreground 321

1

Network management
station management
application module 312

11   6   12   13   2

Network management
station topology
background 314

Management domain
authorization
Interface 313

7   10   3

Network management
station agent 343

Management
domain console 342

8   9   4   5

Network
management system
35

Lower layer
network
management
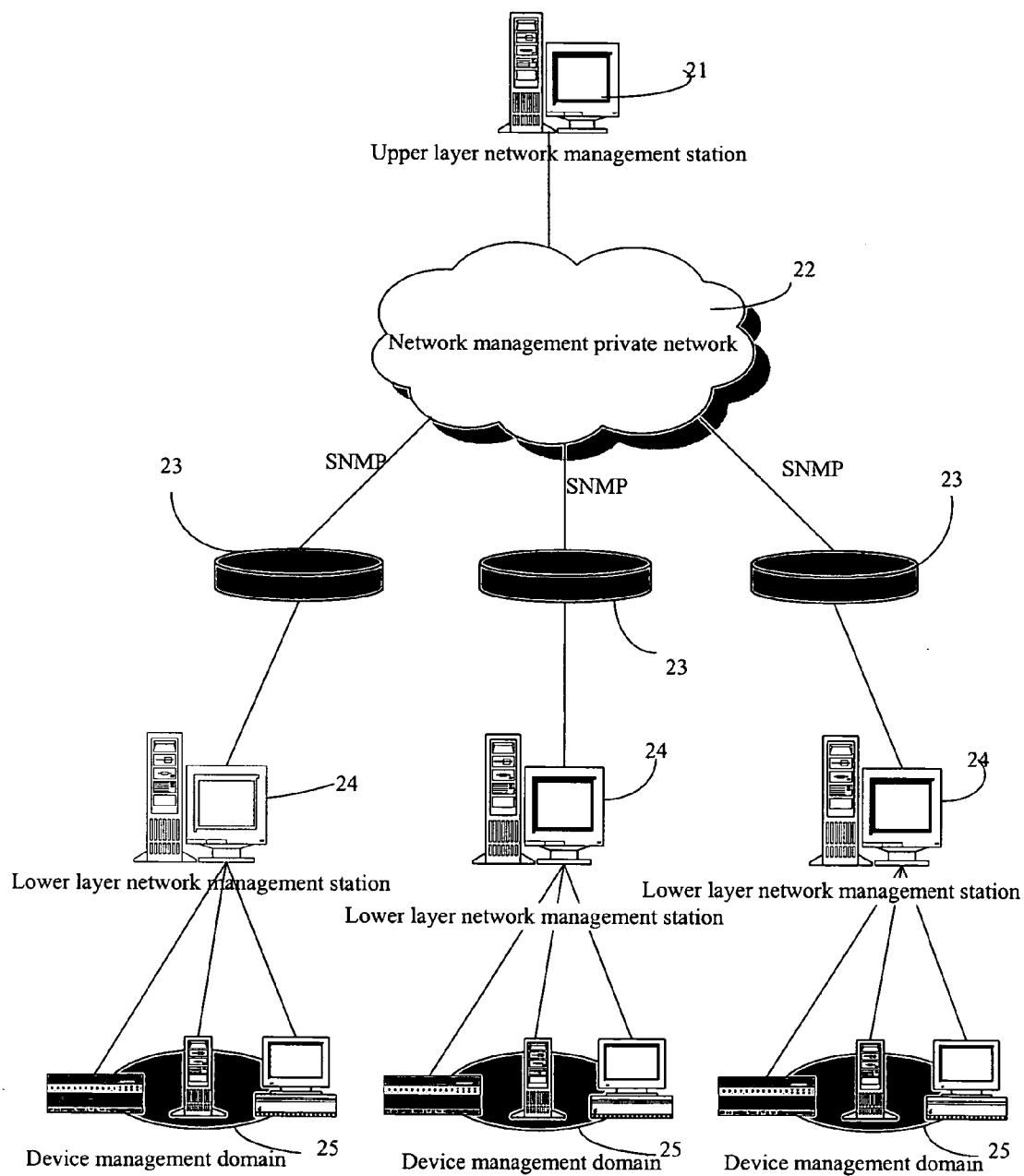station 34

15   14

Direct management
domain 341

Fig.3
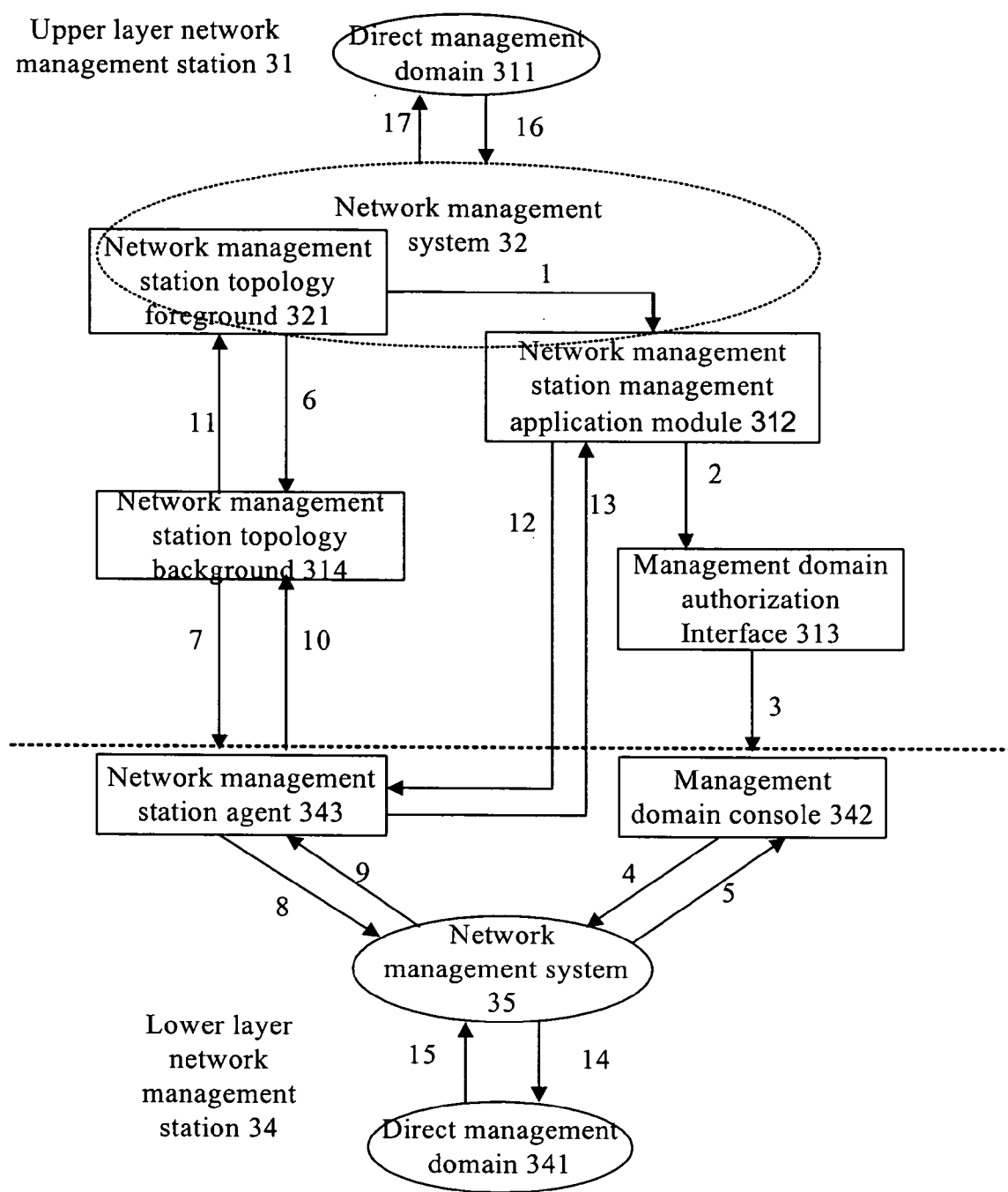
HIERARCHICAL MANAGEMENT SYSTEM ON THE DISTRIBUTED NETWORK MANAGEMENT PLATFORM

FIELD OF THE TECHNOLOGY

[0001] The present invention relates to communication network technology, and more particularly to a hierarchical management system on a distributed network management platform.

BACKGROUND OF THE INVENTION

[0002] Network management is a kind of very important and complicated technique in communication field. The prior network management technique is mostly based on centralized management mode in which a single network management station directly controls several network devices. The network management station accepts operating reports on alarming, configuring and data collecting of network devices and alike from different network devices. Generally, when the network is rather small, for instance Local Area Network (LAN), it is enough for network management and monitoring using centralized network management system. But when scope of the network is wide and the number of network devices is relatively larger, management capacity of the centralized network management system would be unable to meet requirements on network management and monitoring. The reason is that when a plurality of network devices send alarm information to the centralized network management station or the network management station collects data from network devices, the operation will inevitably occupy the network bandwidth, deplete network resources, and even make the network traffic jammed; secondly, in case of managing numerous network devices in relatively larger network, it is necessary for the centralized network management station to possess excellent ability of ensuring to solve the network problems timely and effectively; what is more, this capacity of the centralized network management station directly influences its management scope, making the system difficult to expand.

[0003] With the rapid development of network scale, the traditional network management system is unable to meet the requirements from large networks, thus, it is desirable to provide a new type of network management solution to make network management more flexible and expandable, reduce network load caused by network management, improve management performance, cut response time, satisfy the increasing requirements on network management, especially requirements on MAN and WAN.

SUMMARY OF THE INVENTION

[0004] It should be appreciated that the present invention provides a hierarchical management system on a distributed network management platform.

[0005] In a hierarchical management system on a distributed network management platform according to the invention, the network management stations are classified into upper layer network management stations and lower layer network management stations based on network domains respectively managed by them, one upper layer network management station is connected to a plurality of lower layer network management stations via network management private network and network management agents, the upper layer network management station authorizes the lower layer network management stations and determines network domains of lower layer network management stations so as to implement division of network domains; the upper layer network management station manages the lower layer network management stations and the network domains of lower layer network management stations via the lower layer network management stations; the lower layer network management stations only manage the devices within their respective network domains, and provide information to their respective upper layer network management stations actively or passively.

[0006] The characteristics of the technical scheme according to the present invention is that, the hierarchical management system is a network management system with multi-layer structure, for instance, it may be a two-layer-structure network management system formed by upper layer network management station and lower layer network management station. Through hierarchical configuring of numerous network management stations and division of their management domains, management for a large scale network can be realized.

[0007] The main advantages of the present invention are as follows:

[0008] Easy to expand: adopting object orientated Management Information Base (MIB) definition style to determine available information from the lower layer network management station makes it easy to expand and edit, and suitable for different configure scenario of network management stations;

[0009] Easy to maintenance: agents may manage the network management stations with individual application without any influence for prior functions of the integrated network management platform; once the platform is updated, the operation can be achieved by modifying interior programs, keeping the outbound interface of the agents unchanged;

[0010] Easy to realize: because of relatively independence from the integrated network management platform, the agents can be installed on the platform, and when the system is in use, it is no need to make a good deal of modifications on the original integrated network management platform;

[0011] Easy to inherit: through taking network management stations as a private network device and adopting network management station-agent mode and SNMP protocol, the system may enjoy the management functions for SNMP devices which have been available in integrated network management platform.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a schematic diagram of centralized network management system in prior art.

[0013] FIG. 2 is a schematic diagram of the hierarchical management system on a distributed network management platform in accordance with the present invention.

[0014] FIG. 3 is a schematic diagram for overall architecture of the hierarchical management system on a distributed network management platform in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0015] The present invention will be described in more detail hereinafter with reference to the accompanying drawings.

[0016] Referring to the centralized network management system in **FIG. 1**, a network management station **11** directly manages numerous network devices **12** with agent servers which include network device **1**, network device **2**, network device **3** . . . and network device N. The operations that are carried out by network management station **11** include receiving alarms and configure information from different network devices **12** and collecting data from the network devices.

[0017] **FIG. 2** illustrates a two-layer hierarchical management system on a distributed network management platform. As shown in the figure, an upper level network management station **21** in the hierarchical network management system is connected to agents **23** via a network management private network **22** operating simple network management protocol (SNMP). One agent **23** links a lower layer network management station **24** which directly manages its device management domain **25**. The network management stations, including upper layer network management station and lower layer network management stations, are management servers with network management function, which are the foundation of the distributed network management system and used to manage the devices directly. The network management platform is realized by way of client/server mode. The server end is called network management server, and the server manages malfunction, performance, safety log of the network and network devices, as well as network management system itself. The network management client end monitors and controls the network system via the network management server. The client and the server can operate in different host computers, meanwhile, with help of the network management server, customer can employ the network management client to monitor and control the network system.

[0018] Different network management stations control different network domains which are a subset of all the network devices in the network. Generally speaking, a network management station may manage one network domain individually. There are two kinds of network domains in the present invention: direct management domain and management domain. Direct management domain is a collection of devices directly managed by a network management station, while management domain means a summation of the direct management domain and its lower layer network management station management domains controlled by the network management station.

[0019] As shown in **FIG. 2**, the network management stations of the hierarchical management system on a distributed network management platform are classified into two levels, namely upper layer network management station **21** and lower layer network management station **24**. With help of network management private network **22**, the upper layer network management station **21** is connected to the lower layer network management stations **24** via agents **23**. The network management stations here refer to relatively independent network management systems constituting the hierarchical network management system. Different network management stations supervise different network domains, and the management domains of the lower layer network management stations are pointed by the upper layer network management station. However, lower layer network management station can not exceed its authority to manage other devices beyond its management domain. Besides, there are safety servers in the hierarchical network management system of distributed network management platform to control the management domains.

[0020] The upper layer network management station and lower layer network management stations above possess not only network management function on the integrated network management system, but also many other functions. The detailed function descriptions for the upper and lower layer network management stations **21** and **24** are as follows.

[0021] 1. The functions of upper layer network management station **21**

[0022] providing authorization to each lower layer network management station **24**, determining management domains for each lower layer network management station **24**, dividing management domains;

[0023] examining diagrams on topology structure of the lower layer network management stations **24**;

[0024] managing the devices in management domains **25** of lower layer network management stations **24** directly; and

[0025] through corresponding settings, receiving alarm information on devices and network management stations from the lower layer network management stations **24**, and real time monitoring, recording and taking statistics for the information.

[0026] 2. The functions of lower layer network management station **24**

[0027] implementing the network management function for its device management domain **25** based on the authorization from the upper layer network management station **21**; and

[0028] providing information to the upper layer network management station **21** and carrying out orders of the upper layer network management station **21**.

[0029] The hierarchical network management system above is an example with two-layer architecture, although the system can actually support interactive operations between multi-layer network management stations. The two-layer structure is enough for management in most cases, so all the description here is based on the two-layer hierarchical network management system.

[0030] The invention will be described in more detail with reference to the specific embodiment as shown in **FIG. 3**.

[0031] **FIG. 3** is a schematic diagram illustrating overall structure of a hierarchical management system on a distributed network management platform according to the present invention. In the embodiment, the system manages the network management stations as a type of private network devices in the network system. The upper layer network management station accomplishes functions such as configuring and monitoring the lower layer network management stations via the corresponding network management proto-

col. The upper layer network management station authorizes the lower layer network management stations through a network management station management application module, and appoints different device management domains for each of lower layer network management stations. The upper layer network management station visits agents of the lower layer network management stations via topology foreground/background, acquiring various data of the network devices in the management domains directly managed by lower layer network management stations. The agents of the lower layer network management stations operate the SNMP, and manage the functions such as collecting, monitoring and reporting of the network management station data, and provide data of the network devices in its direct management domains to the network management station management application module of the upper layer network management station. The communication protocol between the upper and lower layer network management stations adopts SNMP.

[0032] The hierarchical management system shown in the drawings includes two layers which are marked with dash line, upper layer network management station **31** and lower layer network management stations **34**. Each layer of the network management stations have respective network management systems **32** and **35** which control their individual direct management domains.

[0033] The specific process in which the upper layer network management station **31** authorizes lower layer network management stations **34** and designates corresponding management domains comprises the following steps.

[0034] In step **1**, the network management system **32** of the upper layer network management station **31** sends an activating signal to the network management station management application module **312** via network management station topology foreground **321**.

[0035] In step **2**, the upper layer network management station management application module **312** initiates management domain authorization interface **313**.

[0036] In step **3**, the management domain authorization interface **313** sends an authorization signal to a management domain console **342** of a lower layer network management station **34**.

[0037] In step **4**, the management domain console **342** sends a confirmation signal to the network management system **35** of the lower layer network management station **34** to ask validity checking for the authorization signal.

[0038] In step **5**, if the authorization signal is valid, the network management system **35** will send a management domain identification signal to the management domain console **342**, in this way, authorization and designation processes of lower layer network management station **34** made by upper layer network management station **31** can be completed.

[0039] The process in which the upper layer network management station **31** acquires data on the network devices in direct management domain **341** of a lower layer network management station **34** comprises the following steps.

[0040] In step **6**, the upper layer network management station **31** sends an inquiry order to a network management

station topology background **312** of the upper layer network management station **31** via the network management station topology foreground **321**.

[0041] In step **7**, the network management station topology background **314** of the upper layer network management station **31** sends an inquiry order to a network management station agent **343** of a lower layer network management station **34**.

[0042] In step **8**, the network management station agent **343** of the lower layer network management station **34** then sends an inquiry order to network management system **35** of the lower layer network management station **34**.

[0043] In step **9**, the network management system **35** of the lower layer network management station **34** returns the inquiry results to the network management station agent **343** of the lower layer network management station **34**.

[0044] In step **10**, the network management station agent **343** reports the inquiry results to the network management station topology background **314** of the upper layer network management station **31**.

[0045] In step **11**, the network management station topology background **314** reports the inquiry results to the network management station topology foreground **321** of the upper layer network management station **31**, that is, reports the inquiry results to the network management system **32** of the upper layer network management station **31**.

[0046] The process in which the upper layer network management station **31** acquires data on network management system **35** of lower layer network management station **34** comprises:

[0047] In step **12**, the network management station management application module **312** of the upper layer network management station **31** sends an inquiry request to a network management station agent **343** of a lower layer network management station **34**.

[0048] In step **13**, after sending an inquiry request to the network management system **35** of the lower layer network management station **34** and receiving the results (step **8**, step **9**), the network management station agent **343** then reports the inquiry results to the upper network management system **32** through the network management station management application module **312**.

[0049] In steps **14** and **15**, the network management system **35** of the lower layer network management station **34** completes the operations such as searching, polling and data reporting for all devices in the direct management domain **341**. And in steps **16** and **17**, distributing and reporting of the information between the direct management domain **311** and the network management system **32** of the upper layer network management station **31** are implemented.

[0050] An advantage of the present invention is that hierarchical management on a distributed network management platform can improve management ability and reduce management workload. For instance, in a network management system which can control N devices, if the hierarchical management system on a distributed network management platform is adopted, then an upper layer network management station can manage N lower layer network management stations each of which in turn manages N devices, in

other words, the whole hierarchical management system on a distributed network management platform can manage N×N devices. What is more, all the operations of searching and polling for the individual devices are completed by the lower layer network management stations, in this way, network load caused by large scale network management is greatly reduced. Moreover, this "plug-and-play" type hierarchical management mode makes network management more flexible, expandable and adjustable.

1. A hierarchical management system on a distributed network management platform, wherein the network management stations are classified into upper layer network management stations and lower layer network management stations based on network domains respectively managed by them, one upper layer network management station is connected to a plurality of lower layer network management stations via network management private network and network management agents, the upper layer network management station authorizes the lower layer network management stations and determines network domains of lower layer network management stations so as to implement division of network domains; the upper layer network management station manages the lower layer network management stations and the network domains of lower layer network management stations via the lower layer network management stations; the lower layer network management stations only manage the devices within their respective network domains, and provide information to their respective upper layer network management stations actively or passively.

2. The system according to claim 1, wherein each upper layer network management station has a network management system controlling its management domain and each lower layer network management station has a network management system controlling its direct management domain.

3. The system according to claim 1, wherein the upper layer network management station authorizes the lower layer network management stations and determines network domains of lower layer network management stations through an upper layer network management station management application module and a management domain authorization interface, the upper layer network manage-

ment station visits the network management station agents of the lower layer network management stations through a network management station topology foreground and a network management station topology background so as to obtain various data of the network devices within the direct management domains of the lower layer network management stations; and the upper layer network management station management application module obtains various data of the network devices within the direct management domains of the lower layer network management stations through inquiring the lower layer network management station agents and the network management system of the lower layer network management stations.

4. The system according to claim 2, wherein said direct management domain is a collection of devices within the network domain directly managed by a network management station; and said management domain is a summation of all the devices within the direct management domain of a network management station and all network domains managed by the network management station.

5. The system according to claim 1, wherein said network domain is a subset of all the network devices in the network, and one network domain is managed by one network management station individually.

6. The system according to claim 1, wherein said network management platform is client/server mode; said server end is a network management server with the functions of network management, the server manages performance, malfunction, safety, log of the network and network devices, as well as the network management system itself; said client end monitors and controls the network management system via the network management server.

7. The system according to claim 6, wherein said client end and said network management station server run in the same or different host computers.

8. The system according to claim 3, wherein said direct management domain is a collection of devices within the network domain directly managed by a network management station; and said management domain is a summation of all the devices within the direct management domain of a network management station and all network domains managed by the network management station.

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