A Collaborative Monitoring System Based on JXTA

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Summary
Integrating P2P networking technology with network management technology. A Collaborative Monitoring System Based on JXTA was designed here. The architecture and specific implementation were proposed. It emphasizes on introducing the method of monitoring the network by collaborative peers applying P2P technology. The implementation method of system is suggested by remote monitoring the CISCO3640 port utilization ratio. The system features on expansibility, usability and interoperability, high performance, decentralization, and robustness.

Key words:
Network management, P2P, Collaborative peer, Monitoring system.

1. Introduction

In order to reduce the burden of network management equipment, the network management function is distributed to each distributed object [1]. CORBA, DCOM, JAVA RMI remote procedure calls, JMX management extensions are wide applied during the remote access to the management station. The distributed access technology can complete distributed network management and monitoring by own mechanisms and architecture, but the central network management server has become the bottleneck of system performance and security. Peer-to-peer network technology (P2P) takes anti-concentration and multiple nodes working in parallel as the main features, and can completely solve the expansion of the network management server, etc. [2].

The solution of P2P network technology and network management technology is presented in this paper. According to the network distribution and management functions, the network management domain is divided into management peer groups where management peer can complete LAN management information monitoring of network equipment supporting SNMP (Simple Network Management Protocol) and RMON (Remote Monitoring Protocol) using AdventNet SNMP API development package, and publish the local management information.

2. SNMP and JXTA

SNMP is an application layer protocol based on TCP/IP, and "inquiry/reply" model is adopted. Remote monitoring (RMON) is a standard monitoring standard, and complete traffic monitoring. We can use the SNMP to operate RMON MIB [4].

P2P is a kind of application model of Internet. Different nodes that are connected by a peer identity on Peer-to-peer network have the same rights and ability, and can cooperate to complete computing tasks, so P2P is a kind of technology of making full use of idle resources in the network [5].

JXTA is a P2P network platform which includes JXTA core layer, service layer and application layer and supports collaborative work system development. The platform has the following main features:(i) the node is relatively independent in order to facilitate role division; (ii) the resource identification is unique, the peer group is responsible for management of resources; (iii) provide various service mechanism, and allow the extended services; (iv) the message is transferred between nodes in XML, easy to design application protocol [6] [7].

Framework for the peer-to-peer Collaborative Network Management System (FP2PNMS) based on JXTA platform has the following characteristics: (i) a dynamic collaboration network consists of each management station in management domain; (ii) the management station is managed by the group as a management unit; (iii) the management station can simultaneously work in collaborative network; (iv) secure authentication and secure communication between and within groups; (v) the request and response which are transferred by the pipeline can pass through the firewall, NAT and other equipment to communicate directly among management station [8][9]. All management stations are equivalent, robust, and efficient; the system has been effectively protected, and achieved load balancing on real significance.

3. System Framework of FP2PNMS

The collaborative monitoring system of multi-level structure based on JXTA is shown in Figure 1.

Each peer (MPeer) in the network monitoring must be added to management peer group (MPeerGroup) of FP2PNMS which is divided by multilevel topology and safety. The local management module in MPeer monitors network equipment, and sends serialization monitor service information to rendezvous peer which can store

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information of MPeer neighbor and inquire about other rendezvous peer by SNMP or RMON. Any MPeer can request the monitoring service or management services to other MPeer according to monitoring strategy. After determining the service provider, the collaborative peer will directly establish pipe, and communicate by P2P. For example, When MPeer1 finds large data flow in local switch port, it can request port aggregation operation from upper layer peer (MPeer2) to improve available bandwidth of MPeer1. In management domain, the Mpeer can find and exploit any monitoring resource, including finding other MPeer services and MPeerGroup, so multiple peers can cooperate to complete network monitoring, and solve traditional problems such as centralized management monitoring, performance bottleneck and failure of single point [10].

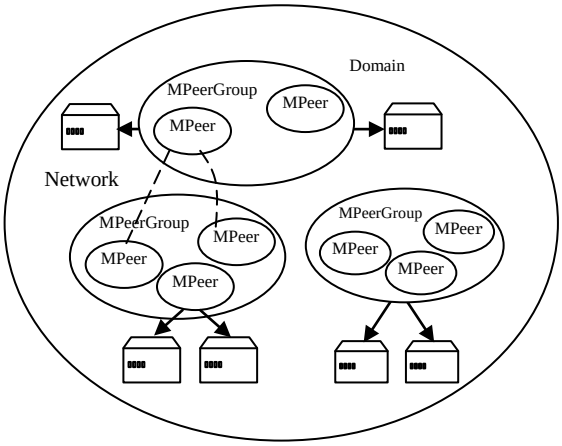

Fig.1. FP2PNMS multi-level

4. System Implementation

The platform of FP2PNMS system is based on JXTA 2.4, and complete monitoring and management of the managed devices by AdventNet SNMP API 4.

4.1 The Basic Steps of Data Processing

The remote monitoring CISCO3640 utilization is as an example, the key steps and the realization method are given. For example, MPeer1 finds that local switch port （Port1） flow is high, thus request port utilization monitoring service that is implemented by MPeer2. The pipeline of the called service is shown in figure 2.

(i) joining the P2P network

FP2PNMS system is a P2P application based on JXTA. They need to start the JXTA platform and obtain the service of the global group before running (such as peer search, service discovery, authentication service). The code framework as follows:

```
private void startJxta() {
try {
group = PeerGroupFactory.newNetPeerGroup();//Using the default JXTA
set       } catch (PeerGroupException ex)
{System.out.println("fatal error : group creation failure");
ex.printStackTrace();
System.exit(1);}
groupAdvertisement =
group.getPeerGroupAdvertisement();//Gett
ing the announcement of default group
discovery=group.getDiscoveryService();//
Obtaning the discovery service for the announcement
pipes = group.getPipeService(); //Obtaining The pipeline service
```

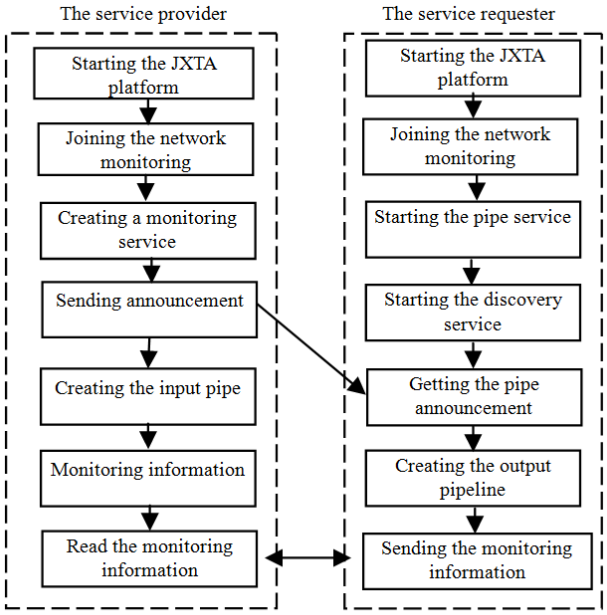

Fig.2.The process of peer to peer service call

(ii) request the peer

First, Management peer (MPeer1) finds 3640 port monitoring service announcement in the local cache. The announcement record is a structured XML documents that is used to descript and announce existing resources, such as peer, peer group or service. Any service must be published. If the announcement doesn't exist in the local, it needs remote asynchronous search by calling the *getRemoteAdvertisements* method. Once it gets the service announcement, the corresponding input pipe (PipeAdvertisement) is obtained and service parameters are sent.

The pipe is the core mechanism of two JXTA applications to exchange messages. The pipe provide asynchronous communication channel which is not directly connected for two peers. Once a peer service receives a message, it needs to create a pipe and bind it to the pipe announcement. Then the announcement is sent out, other peer services can obtain the announcement and establish an output pipe that can send a message to the corresponding input pipeline, to realize the communication between the peers. The parameters of 3640 port

monitoring service are as follows:

"sender : 192.1.1.1| community:****| OperationType: Get3640PortUtility | port: 5";

These parameters are sent by input pipe. Above process is data unidirectional transmission way. The two-way pipe can be constructed by using JxtaSocket which is the extension of the *java.net.Socket* interface.

(iii) corresponding response peer

The management peer (Mpeer2) provides utilization query service. Mpeer2 first publish remote and local announcement that contains all information of connection service. Any peer can use announcement template (*ModuleClassAdvertisement*) to build the announcement. An input pipe is created by *createInputPipe* method of *jxta.pipe packet*, thus makes information transmission possible. Every pipeline is resource, then other peers can find and request pipeline service by announcement. The service pipeline announcement is as follows:

```
<?xml version="1.0"?><!DOCTYPE jxta:PipeAdvertisement>
<jxta:PipeAdvertisement xmlns:jxta="http://jxta.org">
<Id>urn:jxta:uuid-
9CCCDF5AD87A39124E59BE4B888209A2241A4A162A10916074A95
   04</Id>    <Type>JxtaUnicast</Type>
<Name>JXTA-3640PortUtility-DaQingPtro-CN</Name></jxta:PipeAdv
      ertisement>
```

The interception module of management peer (Mpeer2) monitors service request from other peers. The code framework is as follows:

```
while (true) {
 try {msg = myPipe.waitForMessage();}
 catch (Exception e) {……}
 String strRequest = null;    // Reading the send message by Mpeer1
 String strResult    = null;
 try {
  Message.ElementIterator en = msg.getMessageElements();
  MessageElement      msgElement          msg.getMessageElement(null,
      "DataTag");
 if (msgElement.toString() != null)
       {    strRequest = msgElement.toString();}}
           switch (strRequest)
           {    case "GetPortUtility"
                   // calculating Cisco3640 port utilization rate by Calling
the local monitor module
strResult =new PortUtilityBean().GetPortUtility(strRequest);
                 break;
               case "GetEPUtility"
                  ……
                 break;
default:// Management method is not found, will be error handling
                  ……
} catch (Exception e) {……}}
```

According to the managed equipment whether to support the RMON function, local monitoring module *PortUtilityBean* (JAVA BEAN) determines corresponding data collection strategy. For example, the port utilization rate is computed as following formula:

$$\frac{(ifInOctests + ifOutOctests) \times 8}{ifSpeed \times time} \times 100\%(bps) \qquad (1)$$

The above service implementation and response mechanism are transparent to the peer (Mpeer). After the requesting peer (Mpeer) obtains monitoring results, they can perform data analysis, then we can make correct judgment of network operation. For example: the damaged relaying device caused increased error packet; The device buffer bug caused increasing loss rate, etc. Figure 3 shows the port dynamic data utilization rate curve which the MPeer2 obtained from MPeer1.

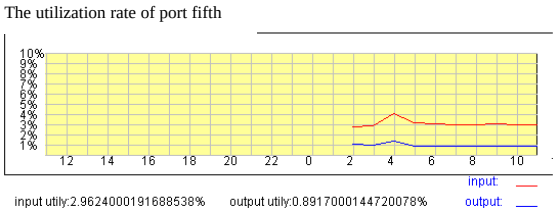

Fig.3. Port utilization rate curve

4.2 Data Transmission Efficiency and Safety

It's not enough to recognize identity by community. In order to ensure the safety of information transmission, the method of message compression and digital signature can make the system more efficient and safe. At the same time, the peer joined in group should adopt authentication, since the implementation of secure peer group environment can improve safety and reliability of collaborative work between peers.

5. Conclusion

The trend of network management and monitoring system is integrated, distributed and intelligent. In this paper, we combine the network monitoring system and peer-to-peer technology, and make monitoring system more extendible by taking full advantage of high efficient service discovery, data transmission, resource management mechanism on the peer-to-peer network application development platform JXTA core layer and business layer. The experimental results show that this strategy improves the performance and assures the load balance on real significance. Moreover, the robustness, security and efficiency of the system are guaranteed.

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