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A Mechanism of Multi-Manager Supporting in Hierarchical Network Management System

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1. Introduction

Recently, more and more network devices have been coming to connect with a network, To use one management station system to monitor the whole network, which is usually called centralized management method, is not an appropriate solution obviously. In order to settle this issue, a distributed network management method was proposed to manage complex network. However, there are also some deficiencies associated with this network management solution. The main deficiencies include the followings. (1) The managed objects in MIB (Management Information Base) have been defined in advance, so that the function of management is restricted within narrow selections. (2) It is impossible to get the detail management information of any remote devices or high-level management results from remote management stations. (3) Any coordination mechanism, which is an essential function for multi-manager network management architecture, doesn't exist between several management stations.

For the first and second issues, we have approached our solutions in reports [1][2]. In this paper, we present a scheme, namely Multi-Manager Supporting Mechanism based on SNMP-driven Hierarchical Network Management, to settle the third

issue. The purpose is to develop a flexible and reliable method to manage large-scale distributed network efficiently.

2. Hierarchical Network Management

2.1 Overview

At first, we take an overview of multi-level network management architecture, namely Hierarchical Network Management Architecture. It was designed in our reports[1][2] to attempt to avoid the deficiencies of the existing centralized or distributed management architectures.

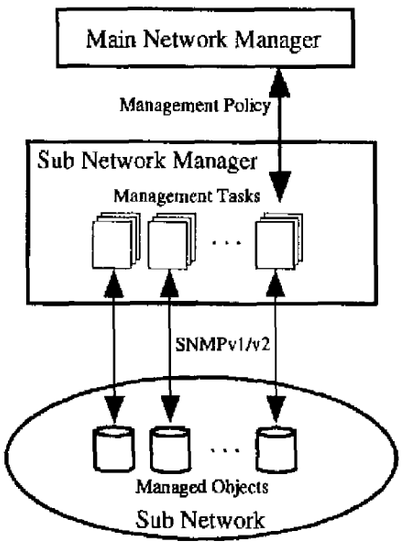

Fig.1 Hierarchical network management architecture

The Hierarchical Network Management method is illustrated as shown in Fig. 1. A root of the hierarchy could delegate network management policy to distributed management nodes, and then just aggregates the essential information and allows limited access from the network. The management node would convert the management policy into management task functioning as a child in the hierarchy, and achieve the management function. The management node may belong to either the root directly or another management node.

2.2 Configuration Elements

Two important conceptual entities in the hierarchical network management architecture are main manager and sub manager. The operations of the main manager and the sub manager are main constituent of the hierarchical network management.

As the role of high-level management, the main manager translates the demand from the human network manager into the management policy and sends the policy to the sub manager. Then it will wait for the advanced result modified and arranged by the sub manager. After understanding the whole network conditions, the main manager is ready for sending the next management policy.

Note that a new mid-level sub manager can be inserted between the main manager and current mid-level sub manager or between the current mid-level sub manager and low-level sub network.

The management task can take advantage of SNMP to access both normal MIB II and RMON MIB maintained by not only the sub manager itself but also other devices including RMON probes, which can be set in the lowest-level sub networks if necessary. Some calculated results can also be obtained by the management task.

The management policy consists of a queue of operations. Every operation includes an operator that represents the management command, and an operand

that represents the managed object also including IP address and object identifier/string ASCII code. Fig. 2 gives the structure of management policy.

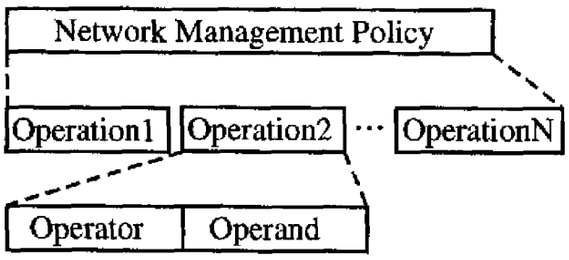

Fig.2 Structure of network management policy

3. Multi-Manager Supporting Method

The purpose of Multi-Manager Supporting is to provide the means for coordination between multiple management stations. In other words, one management station can request management services from another management station. This function is essential in large-scale network management, especially for the case that any sub manager is out of order.

A hierarchical network management system can be considered as shown in Fig. 3. Management station "A" is a main manager, and others are sub managers belonging to the "A". Sub manager "B", which locates on the second layer in this multi-level management system, is responsibility for one area network management, and "C" is for one department.

First of all, every sub manager, who desires to hand off the management authority to another manager, sends a management policy with the community name and IP Address to the MPMIB (Management Policy MIB) held by upper-layer manager. The same information is transferred to one more upper-layer sub manager only by the upper-layer sub manager. For example, "D1" and "D2" send their community names and IP Addresses to "C2". "C2" sends its community name and IP Address and the same information come from "D1" and "D2" to "B1". "B1" just send its information and "C1""C2" information to "A". By the way, the community name is essentially a password with associated management rights and privileges [3][4].

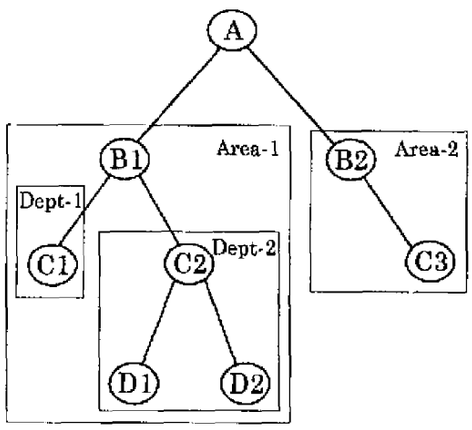

Fig.3 Example of a hierarchical network management system

Secondly, the upper-layer sub manager reads out the management policy from MPMIB and creates the management task to monitoring the sub manager, who sent off the management policy, to understand if it has troubles to work. If "yes", the upper-layer manager will accept the management authority of the sub network, which belongs to the sub manager with failure in working, by using the community name of the sub manager. If the upper-level manager is busy in doing some management tasks else, it can delegate the management authority to

anther management candidate by transferring the community name and IP Address of the failed sub manager to that management candidate by management policy.

If the trouble is solved, the sub manager sends a new management policy to the upper-layer manager to cancel the prior policy. The upper-layer manager will disable the management task by delete a record (row entry) in the MPMIB.

4. Implementation

4.1 SNMP Developing

How to take advantage of SNMP to realize the Hierarchical Network Management is an important theme in our approach, because the SNMP is simply implemented within almost every end-to-end internetworking device and acts as a basic tool for current network management [5]. SNMP is based on the manager/agent model, and its agent requires minimal software. Many vendors of both agent and management system implement SNMP, and continue to enhance it [6]. From the standpoint of the interoperability, the SNMP-based implementation is a sensible choice.

According to the IETF documents RFC1157 [3], RFC1448 [4], RFC1908 [7] and RFC2273 [8], we developed the SNMPv1/ v2/v3 as a backward-compatible protocol for hierarchical network management, namely Extended SNMP [1]. The PDU (Protocol Data Format) is shown in Fig. 4 and Fig. 5.

Two identifiers are inserted to the Error-Status & Error-Index Field of SNMP PDU to identify that the content within this PDU is a management policy.

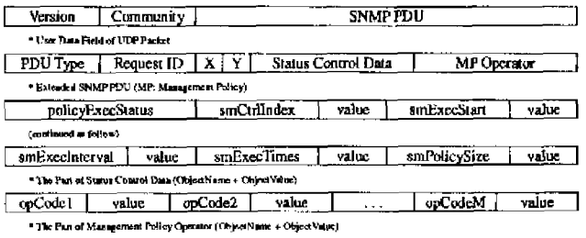

Fig.4 Extended SNMP PDU
(for operator of management policy)

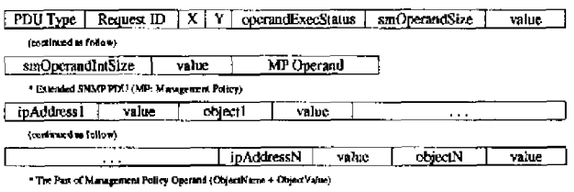

Fig.5 Extended SNMP PDU
(for operand of management policy)

4.2 Sub Manager Construction

For implementing the hierarchical network management system on a real TCP/IP network, the sub manager based on SNMPv2 is recommended, because several agents on different ports of one machine can be run at the same time under SNMPv2 environment. The SNMPv2 agent also has a strong function (RowStatus SYNTAX [9]) on MIB table operation in addition.

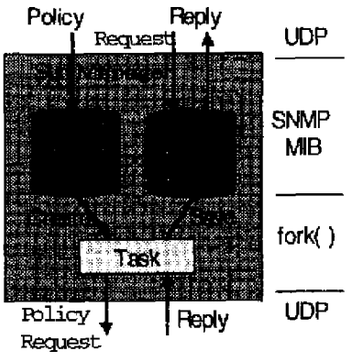

Fig.6 Sub manager construction

4.3 Policy Example

Next, we present an implementation example of multi-manager supporting (B1 to C2) which is designed on hierarchical network management based on extended SNMP. The policy description language refers to Ref. (1).

To Operator Table of MPMIB

opCode	operator	1st operand ← 2nd operand
#01	GETNEXTOPR	OperandTableRow
#50B1	LOAD	String1 CommunityName (string ASCII code)
#50B2	LOAD	String2 ifSpeed (object value)
#01■B2	GETNEXTOPR	String2
#50A0	LOAD	Variable0 ifSpeed (object value)
#01	GETNEXTOPR	OperandTableRow
#50B0	LOAD	String0 CommunityName (string ASCII code)
#50B0	LOAD	String0 ifSpeed (object value)
#41A0	JUDGELAG	Variable0 integer1
#04A0	TRAPOPR	Variable0
#51A0	STORE	Variable0
#01B0B2	GETNEXTOPR	String1 String2
#43	SPACE	
#53	STOP	

To Operand Table of MPMIB

ipAddressC2	CommunityName (string ASCII code ="C2")
ipAddressC2	ifSpeed (object identifier ="1.3.6.1.2.1.2.2.1.5")
non-ipAddress	integer1 (=low-limit threshold)
ipAddressD1	CommunityName (string ASCII code ="D1")
ipAddressD2	CommunityName (string ASCII code ="D2")

Fig.7 Management Policy and its Operand

5. Conclusions

In this paper, we presented a scheme of Multi-Manager Supporting in Hierarchical Network Management based on Extended SNMP to coordinate several mid-level sub manager to achieve to goal of flexible and reliability management for complex network. The implementation examples showed the way to use the free-designed management policy to implement the supporting mechanism on the most-watched IETF network. As an emerging technology, several unsolved issues exist in multi-manager supporting method so far. For example, (1) the lower-edge sub manager is too difficult to supporting because it holds many IP Addresses (managed devices), which can't be transferred to upper-manager easily; (2) two connecting upper-lower sub managers' failure has no way to support sometimes. All these will be our future work.

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