1G－4

Management Policy and Task for Hierarchical Network Management

Yu GUO Yukio HIRANAKA Takao AKATSUKA
Dept. Elec. & Info. Engi., Yamagata Univ.

1. Introduction

For today's network management, the centralized and distributed management architectures are well used. Along with more and more network devices coming to be connected with the network, using one management station to monitor the whole network isn't an appropriate way. On the other hand, because of some limited management functions, the distributed management method, such as RMON, isn't a best choice to manage a large-scale complex network either.

In this paper, we present our solution, namely SNMP-based Hierarchical Network Management. The purpose is to develop a flexible and scalable management method to manage large-scale distributed network efficiently. We use the developed SNMP PDU (Protocol Data Unit) to transfer management policy to the sub manager. The management policy, which consists of a set of operations, can be created to the management task on the sub manager for monitoring the sub network and processing the management information with SNMP or RMON method according to the specified start time and execution interval. A great variety of combinations of operator and operand achieve various goals of management we expect.

2. Network Management Policy and Task

As shown in Fig. 1, the basic view of the method the Hierarchical Network Management is, the main management station (main manager) only assigns the management policy to the mid-level manager (sub manager) and then waits for the result sent from the sub manager. The management task, which achieves concrete management activities on side of the sub manage, is created and executed according to the management policy. It takes 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.

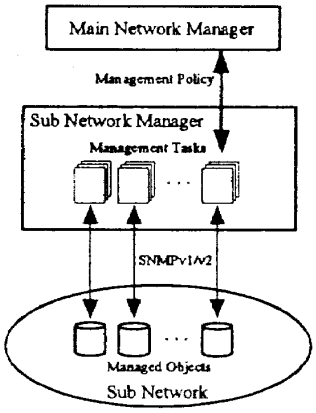

Fig. 1 Hierarchical Network Management Framework

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. Fig. 2 gives the structure of management policy.

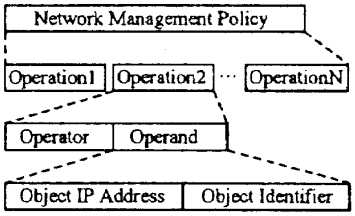

Fig. 2 The Structure of Network Management Policy

3. Management Policy MIB

We define a new MIB for sub manager, called MPMIB, and put the management policy into it. The MPMIB operation that inserts or deletes a row also follows the operation rule of normal MIB. Similarly, the MRMIB used to store the management result can be configured in the same way.

The definition of the MPMIB is shown in Table 1. Some policy control parameters, such as execution

start time, execution interval and execution times of the management policy are also defined. This can help the main manager for reusing the policies.

Table 1. MPMIB Object Definition

Object Tables	MPMIB Objects	SYNTAX in SMI
smOperator table	smCtrlIndex	INTEGER (1..65534)
	smExecStart	INTEGER (0..65535)
	smExecInterval	INTEGER (0..65535)
	smPolicyTimes	INTEGER (0..65535)
	smPolicySize	INTEGER (1..255)
	opCode1	OCTET STRING
	opCode2	OCTET STRING
	:	:
	opCodeM	OCTET STRING
smOperand table	smOperandIndex	INTEGER (1..65534)
	smOperandSize	INTEGER (1..255)
	smOperandIntSize	INTEGER (1..255)
	ipAddress1	IpAddress
	object1	OCTET STRING
	ipAddress2	IpAddress
	object2	OCTET STRING
	:	:
	ipAddressN	IpAddress
	objectN	OCTET STRING

* All objects have "read-write" in ACCESS of SNMPv1-SMI

4. Management Task

The sub manager always listens on the SNMP port to capture the SNMP packet (UDP type) that comes in. Then, expands the captured packet and analyzes if it is a SNMP PDU carrying the policy. A fork system call wakes up management task after the management policy is written into MPMIB. The management task creates GetRequest / GetNextRequest or SetRequest / InformRequest PDU by GETOPR (or GETNEXTOPR) / SETOPR operator to get/set the management information from/to the agents locating in the sub network, and then calculates the result which main manager wants. The operator including the arithmetic operations, the logical operations, and some other operations such as SQUARE, ROOT, and LOAD, WAIT, STORE, etc. controls the calculation and processing. The calculated result is stored into the MRMIB, which could be accessed by the remote main manager via GetRequest / GetNextRequest / InformRequest PDU for retrieving result values, or SetRequest PDU for deleting certain of result values that is considered valuable no longer.

5. Implementation Example

The implementation example, shown in Fig. 3, is to monitor the interface's current bandwidth of specified 20 nodes (ipAddress=A, B,⋯, T) in the remote network. The Trap PDU will be sent to the main manager if the estimate of any interface's bandwidth is lower than the specified threshold in advance.

To Operator Table of MPMIB

opCode	operator	1st operand ← 2nd operand
#01	GETNEXTOPR	OperandTableRow
#50A0	LOAD	Variable0 ifSpeedA (object value)
#41A0	JUDGELAG	Variable0 integer1
#04A0	TRAPOPR	Variable0
#51A0	STORE	Variable0
#43	SPACE	
#43	SPACE	
:	:	:
#50A0	LOAD	Variable0 ifSpeedT (object value)
#41A0	JUDGELAG	Variable0 integer1
#04A0	TRAPOPR	Variable0
#51A0	STORE	Variable0
#43	SPACE	
#43	SPACE	
#53	STOP	

To Operand Table of MPMIB

ipAddressA ifSpeedA (object identifier ="1.3.6.1.2.1.2.2.1.5")
:
ipAddressT ifSpeedT (object identifier ="1.3.6.1.2.1.2.2.1.5")
non-ipAddress integer1 (=low-limit threshold)

Fig. 3 Management Policy and its Operand

6. Conclusions

In this paper, we presented a scheme of Hierarchical Network Management through using free-designed management policy to distribute the most of management task to sub manager. Management tasks are accomplished in local sub network. The high-level management results could be obtained from a sub manager directly. Certainly, proposed method could help us to manage a large-scale network more easily and efficiently with now popular SNMP, SNMPv2 or the upcoming SNMPv3.

In the future work, we are going to develop this support method which can hand off the privilege of the main manager to a certain sub manager to manage the network continuously. These can enhance reliability and fault tolerability of entire hierarchical network management system itself.

References

[1] W. Stallings, SNMP, SNMPv2 & CMIP, Addison-Wesley Inc., 1993.

[2] M. Miller, Managing Internetworks with SNMP, M&T Books, 1997.

[3] CCITT X.409, Abstract Syntax Notation One, 1984.