

---

# Chapter 12. Network Management - 2

## Table of Contents

Introduction to Network Management - 2 .....	1
Context .....	1
Introduction .....	1
Objectives .....	2
An architecture for network management .....	2
The hardware point of view .....	2
The software point of view .....	3
What to chatter about .....	3
When to chatter .....	3
How to chatter .....	4
Standards for network management .....	4
SNMP .....	4
OSI network management .....	6
Activities> .....	7
Activity 1 - Network Management Centre .....	7
Activity 2 - Management Style .....	7
Activity 3 - Proactive Management .....	7
Activity 4 - Status Report .....	7
Activity 5 - Status Report Reduction .....	7
Activity 6 - Network Management .....	7
Review Questions .....	7
Review Question 1 .....	7
Review Question 2 .....	8
Review Question 3 .....	8
Review Question 4 .....	8
Discussion Topics .....	8
Answers and Comments .....	8
Activity 1 .....	8
Activity 2 .....	8
Activity 3 .....	8
Activity 4 .....	9
Activity 5 .....	9
Activity 6 .....	9
Review Question 1 .....	9
Review Question 2 .....	9
Review Question 3 .....	9
Review Question 4 .....	9

## Introduction to Network Management - 2

### Context

This chapter continues the treatment of network management begun in chapter 11. As such, it extends that chapter, and relates to the rest of the module in the same way as that unit.

### Introduction

The general architecture for network management introduced in the previous unit is described first from the point of view of the hardware and then from that of the software. The two points of view

interact with each other, and provide a clear framework within which to design or to evaluate a network management system.

The two main standards for network management are then described, and the ways in which they relate to this framework can be seen. The standards described are the Internet's Simple Network Management Protocol (SNMP), and the OSI network management protocol. The two styles of network management not only provide interesting case studies, but also illustrate the contrast between manual and automatic means of achieving network management.

Finally, the ways in which some of the specific examples of network problems introduced in the previous unit are handled by these widely-used systems will be examined.

## Objectives

At the end of this module, you should be able to:

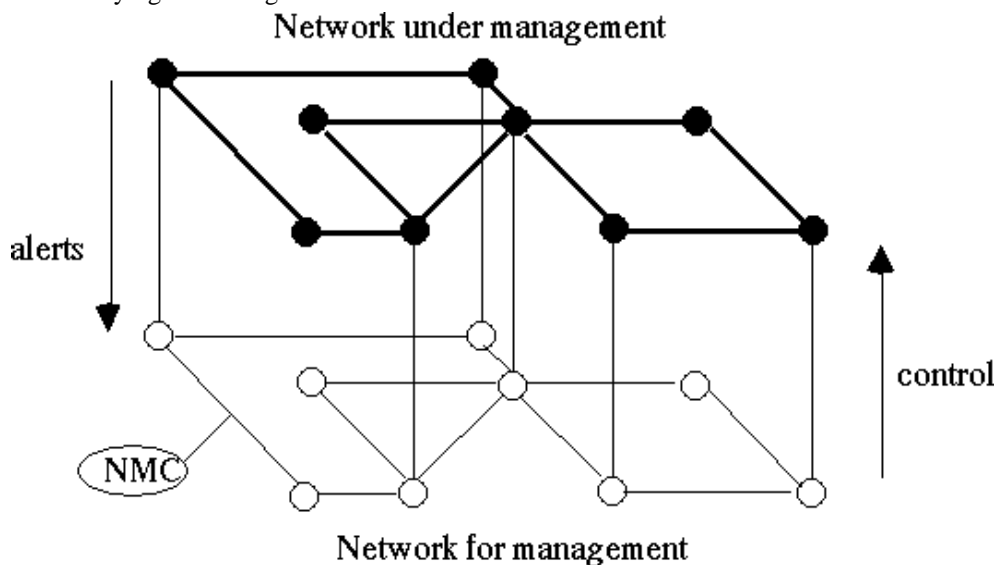
- introduce and contrast two views of an architecture for network management;
- describe and contrast the two main standards for network management.

## An architecture for network management

In parallel with this topic and the remaining topics in this unit, you should read relevant chapters from your textbooks.

### The hardware point of view

An architectural conception of network management can be based on the separation of the network hardware into a network under management and a 'shadow' network for management. The separation is based on the nature of the traffic, with one network carrying the information-bearing traffic and the other carrying the management traffic. The situation is illustrated below:



The network under management is 'shadowed' by a network for management with identical structure. Alerts are raised by components on the network under management, but flow directly to the shadow network, where they are routed to the Network Management Centre. At the Network Management Centre, the information in the alerts is consolidated and, in one way or another, is used to determine the necessary control actions. Return messages carrying this information are routed through the shadow network to the shadow computer with a link to the network under management nearest to the intended destination computer. In this way, the management traffic is retained by the network for management for as long as possible.

## To Do

Do Review Question 1.

## The software point of view

Now consider the software-driven management traffic. The alerts that make up this traffic can be metaphorically considered as an example of 'chatter' in that the network components chatter about their own state, the state of their neighbours or that of some other part of the network, essentially for the overall benefit of the network in much the same way as the people in a community chatter about themselves, their neighbours and others in the community for the general benefit of the community.

The network chatter is all addressed to the Network Management Centre. It collects and consolidates the information conveyed by the chatter, and in this way builds up a picture of the overall state of the network. This overall picture should enable it to determine any problems that need to be dealt with so that the network will run smoothly in all circumstances, and provide essential services to both its users and its operator.

The generation and transmission of alerts as they are needed is the basis of one style of chatter to provide the information needed for problem management. Other styles of chatter are possible, as may be seen by considering the issues that arise with any style of chatter. They include:

- what to chatter about,
- when to chatter,
- how to chatter, and
- who to chatter to.

## To Do

Do Review Question 2.

## What to chatter about

The purpose of chatter is to provide the Network Management Centre with sufficient information about the state of the network to be able to manage the network. With this in mind, we can think in more detail about the issues listed above for each of the categories of problem management. With fault management, for example, if the network computers chatter about the state of their incoming links and neighbouring computers, including whether they are faulty, then the Network Management Centre will receive enough information to identify any faults that have occurred in the network.

We have seen that sending alerts whenever a fault is detected is one way of implementing this scheme.

## To Do

Carry out Activity 1.

## When to chatter

One way of answering the question of when to chatter is, as we have seen, to use alerts, and alerts are sent only when it is necessary to do so. In fact, up to this point, we have relied entirely on the use of alerts.

When alerts are used to draw attention to the existence of a problem, they carry information about something that has already happened. For this reason, they lend themselves to a style of management

that is necessarily reactive in that it can only operate by reacting to events that have already occurred. This style of management can be replaced by one that is rather less concerned with 'fire-fighting', and a little more capable of preventing problems from developing, by allowing alerts to draw attention to the symptoms of a problem rather than to the problem itself. It is, however, also possible to develop a quite different style of management simply by giving a different answer to the question of when to chatter.

One way to find a different answer to the issue of when to chatter is to go back to the analogy between the components of a network and the members of a community, and to note that some of the people in a community chatter all the time (whereas the more taciturn chatter only when they need to). So, one alternative answer to the question is that network components can chatter all the time.

## **To Do**

Carry out Activities 2 and 3.

## **How to chatter**

Chatter is, like any other form of information exchange on a network, carried out by sending messages. When alerts are used, the message is formatted to identify the sending computer and a problem that is known to exist or is suspected to exist. When chatter goes on all the time, rather than only when needed, the message must provide a status report. The report should contain information to assist each type of problem management, so that it ought to be formatted into five main sections.

## **To Do**

Carry out Activities 4, 5 and 6.

# **Standards for network management**

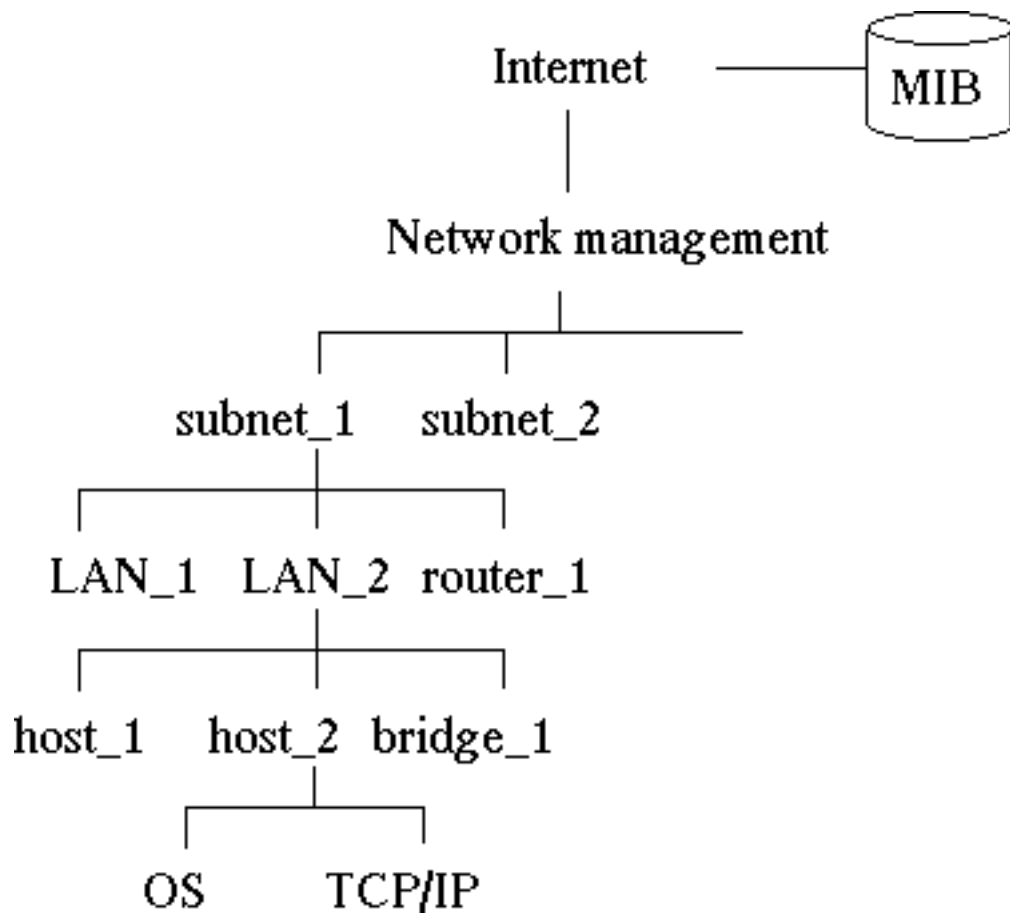
There are two main standards for network management. The Internet uses the Simple Network Management Protocol (SNMP). OSI has its own separate standard. In this section we present simplified accounts of these contrasting standards.

## **SNMP**

SNMP has three components which are known as:

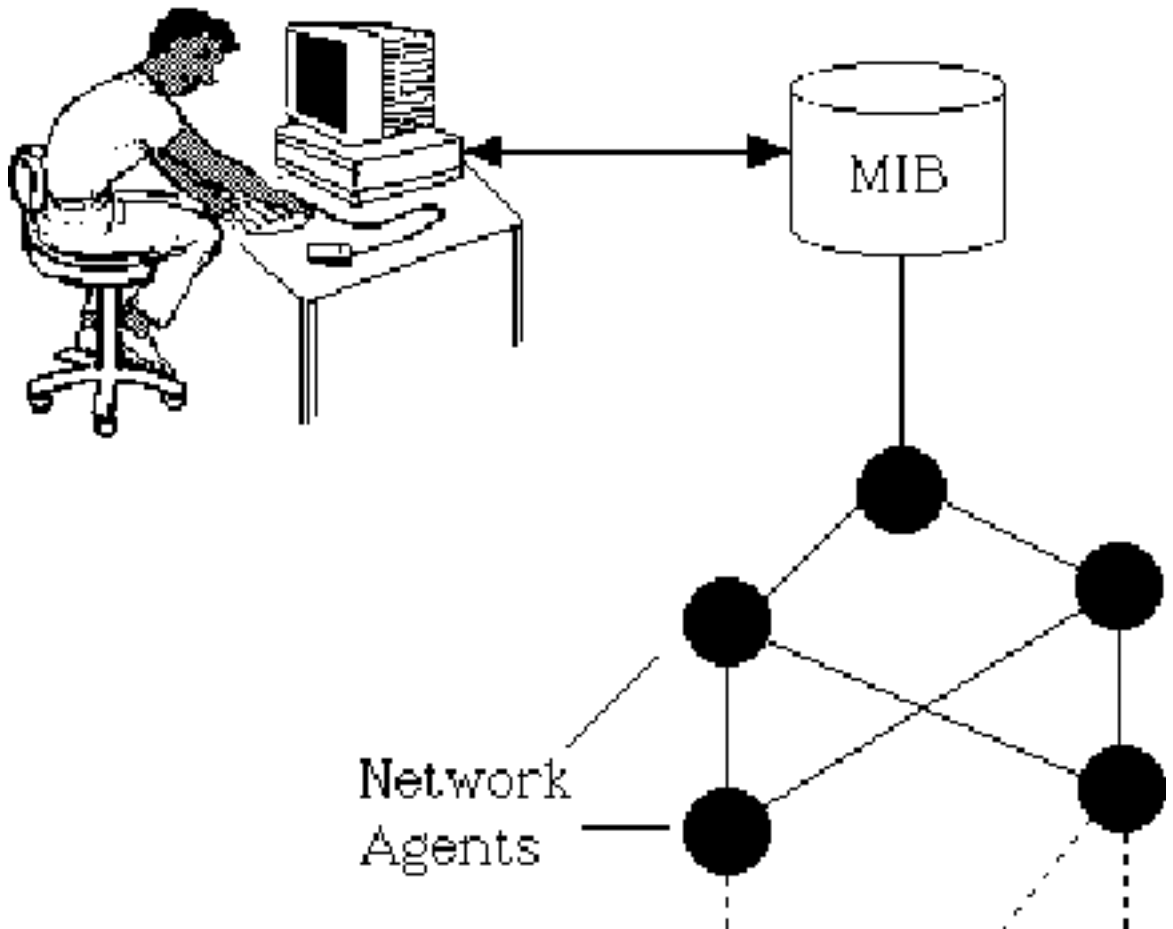
The Network Management Station	This monitors and controls the so-called Network Agents which are the network components that can send alerts and respond to enquiries about their status. It also maintains the Management Information Base (MIB), a database that contains the information obtained from the Network Agents and can be queried by the network manager.
The Network Agents	These are typically bridges, routers, host computers and other network components that can send alerts when necessary and respond to enquiries from the Network Management Station.
The Management Information Base	This contains information about the network components (including Network Agents) and their status, recorded in a consistent way.

The network components form a hierarchy such as that illustrated below. Requests for information come from the MIB at the root of the hierarchy's tree structure; alerts from items anywhere in the tree, including the leaves. This structure makes it possible to collect information at intermediate levels to deal with queries more quickly, and to deal with local problems locally.



The overall relationship between the components of SNMP can be illustrated as follows:

## Network Management Station



### To Do

Do Review Question 3.

## OSI network management

OSI network management conforms to the same basic arrangement as SNMP but, in contrast to SNMP, is automatic. A station on the network will be designated as a Network Management Centre: it maintains a Management Information Base, and carries out automatic network management with the aid of the network management application in its Application layer. The presence on this machine of the same seven-layer OSI software as that on all the other machines ensures that information arriving at the Network Management Centre, and commands sent from it, will be understood.

### To Do

Do Review Question 4.

## Activities>

### Activity 1 - Network Management Centre

Show that by chattering about the right things, the Network Management Centre can be provided with sufficient information to carry out each of performance management, configuration management, accounting management and security management.

You can find a discussion of this activity at the end of the chapter.

### Activity 2 - Management Style

Show that allowing network components to chatter all the time can provide for a style of management that is proactive rather than reactive.

You can find a discussion of this activity at the end of the chapter.

### Activity 3 - Proactive Management

Discuss the proposition that proactive management is preferable to reactive management.

You can find a discussion of this activity at the end of the chapter.

### Activity 4 - Status Report

Determine the essential contents for each of the five elements of a status report to be sent as the chatter in a system that chatters all the time.

You can find a discussion of this activity at the end of the chapter.

### Activity 5 - Status Report Reduction

Find a way of reducing the size of the status reports sent as the chatter in a system that chatters all the time.

You can find a discussion of this activity at the end of the chapter.

### Activity 6 - Network Management

Discuss the proposition that network management is most effective when it is least needed and least effective when it is most needed.

You can find a discussion of this activity at the end of the chapter.

## Review Questions

### Review Question 1

A network under management could be shadowed by a separate network for management, but this would be an expensive way to support network management. More usually there is a single network which can, conceptually, be separated into two. Describe the way in which a single (actual) network can be conceptually separated into a (virtual) network under management and a (virtual) network for management.

You can find an answer/comment for this review question at the end of the chapter.

## Review Question 2

What do network components chatter about? When do they chatter? How do they chatter? Who do they chatter to?

You can find an answer/comment for this review question at the end of the chapter.

## Review Question 3

Identify the components of SNMP with the items described during the general treatment of the architecture for network management systems.

You can find an answer/comment for this review question at the end of the chapter.

## Review Question 4

What are the names of the OSI items corresponding to SNMP, MIB and network agents? (Refer to your textbooks if necessary)

You can find an answer/comment for this review question at the end of the chapter.

## Discussion Topics

1. Show that "network chatter" can be used to support the various aspects of network management, that is, performance, configuration, fault, security and accounting management.

Take each aspect in turn and explain in some detail how chatter can be used to support it.

Do your five systems have enough in common to allow them to be merged into a single system?

2. Elaborate on the possibilities for local management within the Internet's SNMP.
3. What are a network manager's requirements of the interface to a network management system. What sort of information needs to be displayed, and how should it be displayed?

## Answers and Comments

### Activity 1

Show that by chattering about the right things, the Network Management Centre can be provided with sufficient information to carry out each of performance management, configuration management, accounting management and security management.

### Activity 2

Show that allowing network components to chatter all the time can provide for a style of management that is proactive rather than reactive.

### Activity 3

The basis of the proposition is that 'prevention is better than cure'. It can be more efficient in many different senses to anticipate a problem and prevent its occurrence than to wait until the problem occurs and then have to deal with it and with all its consequences.



## Activity 4

The segment carrying information for fault management needs to contain information about any local faults or fault symptoms. The segment with information for performance management needs to contain information about local queue lengths. The segment with information for configuration management needs to contain information about local changes to the configuration. The segment with information for accounting management needs to contain information about local customers' activities. The segment with information for security management needs to contain information about local security matters such as requests for security facilities, attempts to breach security and so on.

## Activity 5

Rather than sending a complete status report each time, it is possible to send a report that contains only the changes in status that have occurred since the previous report was sent. The list of changes may be shorter than a complete list, which leads to shorter messages and less congestion in the network.

## Activity 6

This rather cynical view is true in certain respects. For example, a network's performance is likely to be satisfactory when it is carrying very little traffic but, in these circumstances, it is likely that the Network Management Centre will have a good picture of the traffic situation on the network while there is also plenty of otherwise unused capacity to carry the network management traffic needed to remediate any performance problems. On the other hand, when the network is very busy, the Network Management Centre is unlikely to have a good picture of the traffic situation on the network and there will be little or no otherwise unused capacity to carry the network management traffic needed to remediate performance problems.

## Review Question 1

The actual network carrying its user-presented traffic can be regarded as the network under management, while the actual network carrying the traffic for management can be regarded as the network for management. Thus the separation is in terms of the function of the traffic carried. The structure of the two virtual networks is clearly the same.

## Review Question 2

They chatter about the state of the network. As described so far in this and the previous unit, they chatter when they need to; they chatter by sending alerts; they chatter to the Network Management Centre.

## Review Question 3

The Network Management Station is the computer dedicated to network management at the Network Management Centre. It is used by a person. It contains or controls the MIB, which is the database in which the information recording the status of the network resides. The Network Agents are the network components capable of sending an alert.

## Review Question 4

CMIP (common management information protocol), MIB and managed object.