Network Management Basics

This chapter describes functions common to most network management architectures and protocols. It also presents the five conceptual areas of management as defined by the International Organization for Standardization (ISO). Subsequent chapters in Part 7, "Internet Access Technologies," of this book address specific network management technologies, protocols, and platforms in more detail.

What Is Network Management?

Network management means different things to different people. In some cases, it involves a solitary network consultant monitoring network activity with an outdated protocol analyzer. In other cases, network management involves a distributed database, auto-polling of network devices, and high-end workstations generating real-time graphical views of network topology changes and traffic. In general, network management is a service that employs a variety of tools, applications, and devices to assist human network managers in monitoring and maintaining networks.

Background

The early 1980s saw tremendous expansion in the area of network deployment. As companies realized the cost benefits and productivity gains created by network technology, they began to add networks and expand existing networks almost as rapidly as new network technologies and products were introduced. By the mid-1980s, certain companies were experiencing growing pains from deploying many different (and sometimes incompatible) network technologies.

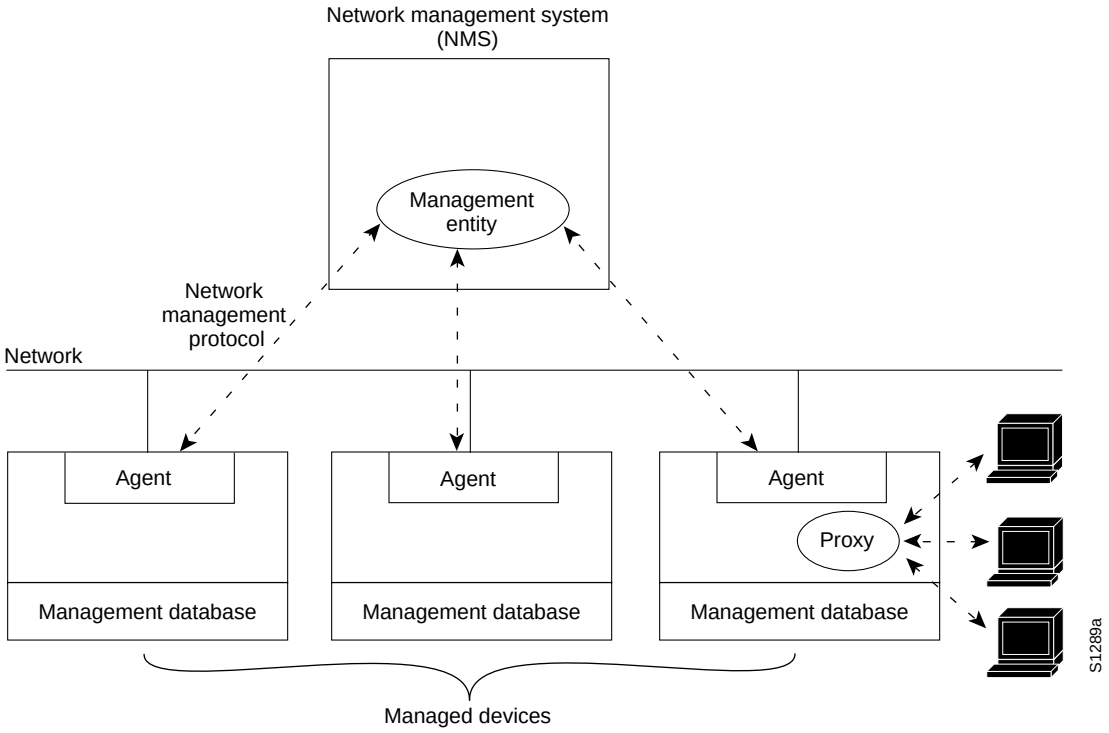
The problems associated with network expansion affect both day-to-day network operation management and strategic network growth planning. Each new network technology requires its own set of experts. In the early 1980s, the staffing requirements alone for managing large, heterogeneous networks created a crisis for many organizations. An urgent need arose for automated network management (including what is typically called *network capacity planning*) integrated across diverse environments.

Network Management Architecture

Most network management architectures use the same basic structure and set of relationships. End stations (*managed devices*), such as computer systems and other network devices, run software that enables them to send alerts when they recognize problems (for example, when one or more user-determined thresholds are exceeded). Upon receiving these alerts, *management entities* are programmed to react by executing one, several, or a group of actions, including operator notification, event logging, system shutdown, and automatic attempts at system repair.

Management entities also can poll end stations to check the values of certain variables. Polling can be automatic or user-initiated, but *agents* in the managed devices respond to all polls. Agents are software modules that first compile information about the managed devices in which they reside, then store this information in a *management database*, and finally provide it (proactively or reactively) to management entities within *network management systems* (NMSs) via a *network management protocol*. Well-known network management protocols include the Simple Network Management Protocol (SNMP) and Common Management Information Protocol (CMIP). *Management proxies* are entities that provide management information on behalf of other entities. Figure 6-1 depicts a typical network management architecture.

Figure 6-1 A typical network management architecture maintains many relationships.



ISO Network Management Model

The ISO has contributed a great deal to network standardization. Their network management model is the primary means for understanding the major functions of network management systems. This model consists of five conceptual areas:

- Performance management
- Configuration management
- Accounting management
- Fault management
- Security management

Performance Management

The goal of *performance management* is to measure and make available various aspects of network performance so that internetwork performance can be maintained at an acceptable level. Examples of performance variables that might be provided include network throughput, user response times, and line utilization.

Performance management involves three main steps. First, performance data is gathered on variables of interest to network administrators. Second, the data is analyzed to determine normal (baseline) levels. Finally, appropriate performance thresholds are determined for each important variable so that exceeding these thresholds indicates a network problem worthy of attention.

Management entities continually monitor performance variables. When a performance threshold is exceeded, an alert is generated and sent to the network management system.

Each of the steps just described is part of the process to set up a reactive system. When performance becomes unacceptable because of an exceeded user-defined threshold, the system reacts by sending a message. Performance management also permits proactive methods: For example, network simulation can be used to project how network growth will affect performance metrics. Such simulation can alert administrators to impending problems so that counteractive measures can be taken.

Configuration Management

The goal of configuration management is to monitor network and system configuration information so that the effects on network operation of various versions of hardware and software elements can be tracked and managed.

Each network device has a variety of version information associated with it. An engineering workstation, for example, may be configured as follows:

- Operating system, Version 3.2
- Ethernet interface, Version 5.4
- TCP/IP software, Version 2.0
- NetWare software, Version 4.1
- NFS software, Version 5.1
- Serial communications controller, Version 1.1
- X.25 software, Version 1.0
- SNMP software, Version 3.1

Configuration management subsystems store this information in a database for easy access. When a problem occurs, this database can be searched for clues that may help solve the problem.

Accounting Management

The goal of accounting management is to measure network-utilization parameters so that individual or group uses on the network can be regulated appropriately. Such regulation minimizes network problems (because network resources can be apportioned based on resource capacities) and maximizes the fairness of network access across all users.

As with performance management, the first step toward appropriate accounting management is to measure utilization of all important network resources. Analysis of the results provides insight into current usage patterns, and usage quotas can be set at this point. Some correction, of course, will be

required to reach optimal access practices. From this point, ongoing measurement of resource use can yield billing information, as well as information used to assess continued fair and optimal resource utilization.

Fault Management

The goal of fault management is to detect, log, notify users of, and (to the extent possible) automatically fix network problems to keep the network running effectively. Because faults can cause downtime or unacceptable network degradation, fault management is perhaps the most widely implemented of the ISO network management elements.

Fault management involves first determining symptoms and isolating the problem. Then the problem is fixed, and the solution is tested on all important subsystems. Finally, the detection and resolution of the problem is recorded.

Security Management

The goal of security management is to control access to network resources according to local guidelines so that the network cannot be sabotaged (intentionally or unintentionally) and sensitive information cannot be accessed by those without appropriate authorization. A security management subsystem, for example, can monitor users logging on to a network resource, refusing access to those who enter inappropriate access codes.

Security management subsystems work by partitioning network resources into authorized and unauthorized areas. For some users, access to any network resource is inappropriate, mostly because such users are usually company outsiders. For other (internal) network users, access to information originating from a particular department is inappropriate. Access to human resource files, for example, is inappropriate for most users outside the human resource department.

Security management subsystems perform several functions. They identify sensitive network resources (including systems, files, and other entities) and determine mappings between sensitive network resources and user sets. They also monitor access points to sensitive network resources and log inappropriate access to sensitive network resources.