Chapter 11
Network Management

Networking in the
Internet Age
by Alan Dennis

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Chapter 11. Learning Objectives

• Understand what is required to manage the
day-to-day operation of networks
• Be familiar with the network management
organization
• Understand configuration management
• Understand performance and fault
management
• Be familiar with end user support
• Be familiar with cost management

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contained herein.
Introduction

Network management means monitoring and controlling the network so that it is working properly and providing value to its users.

A lack of planning and organization can mean that network managers spend most of their time firefighting - dealing with breakdowns and immediate problems.

The four main areas of network management are:

- configuration management
- performance and fault management
- end user support
- cost management
Organizing the Management Function

The Shift to LANs and the Internet
- Since the 1980’s networks have moved from using mainframes and terminals to PCs, LANs and the Internet.
- Mainframes are still important, but network management now focuses more on LANs, BNs and Internet resources.
- Currently, a critical issue is the integration of organizational networks and applications. The two main problems are:
  - the technical compatibility of technologies and protocols.
  - cultural differences in personalities and management styles of network managers. WAN & mainframe managers prefer more highly structured and controlled environments than do LAN and Web managers.

Integrating Voice & Data Communications
- Traditionally, voice and data networks were separate, i.e., the telephone system and the organizational LAN, respectively.
- Separate networks mean higher network costs as well as additional staffing requirements.
- Integrating voice and data simplifies the network, and can lower network costs.
- Most organizations will likely integrate voice and data within the next 5 years.
Configuration Management

Configuring the Network and Client Computers

- Configuration management means configuring the network’s hardware and software and documenting that configuration.
- Two common configuration activities are:
  - adding and deleting user accounts.
  - updating the software on the client computers attached to the network.
- Electronic software delivery (ESD) can be used to manage costs by eliminating the need to manually update programs on each and every client computer.

Documenting Hardware and Software

- Configuration documentation includes information on network hardware, software, and user and application profiles.
- Net hardware documentation uses a set of maps (see Figure 11-1).
- These must be supplemented with lists of hardware, details on each component such as serial number, vendor, date of purchase, warranty information, repair history, phone number for repairs, etc.
- Documenting network software is similar, but includes other information such as the network OS, software release date and site license details.
Documenting User and Application Profiles

- The third documentation type is the user and application profiles, which should be automatically provided by the network operating system or outside software agreements.
- Other network documentation that must be routinely developed and updated include software, standards and operations manuals, vendor contracts, and licenses.
- Documentation should include details about performance and fault management, maintenance guidelines, disaster recovery plans, end user support and cost management.
Performance and Fault Management

- **Performance management**: ensuring the network is operating as efficiently as possible.
- **Fault management**: preventing, detecting, and correcting faults in the network circuits, hardware, and software.
- The two are interrelated. Both require *network monitoring*, i.e., tracking the operation of network circuits and devices to determine how heavily they are being used and ensure they are operating properly.

Network Monitoring

- Most organizations use network management software to monitor and control their networks.
- The parameters monitored by a network management system fall into two distinct categories: *physical network statistics* and *logical network information*.

Network Monitoring Parameters

- *Physical network statistics* come from monitoring the operation of modems, multiplexers, and circuits linking hardware devices.
- *Logical network parameters* are monitored by performance measurement systems that track user response times, traffic volume on a specific circuit, the destinations of network packets, and other indices showing the network’s service level.
- *Performance tracking* is important since it enables net managers to be proactive and respond to problems before users complain, otherwise network management can revert to firefighting.
Failure Control Function

- Failure control requires problem reporting, often handled by the help desk.
- A central troubleshooting group should also be responsible for contacting hardware, software vendors or common carriers.
- To aid in network monitoring, managed devices are now being installed that record data on the messages they process and send this information back to a central management database.
- Numerous software packages are available for recording fault information. These produce reports called trouble tickets.

Handling Network Problems

- Managers use trouble tickets to do problem tracking, enabling them to systematically address problems, tracking who is responsible for problem correction and how it is being resolved.
- This also allows problem prioritization ensuring critical problems get higher priority.
- Finally, maintaining a trouble log is helpful for reviewing problem patterns on the network and can be used to identify which network components are the most problematic.

Performance and Failure Statistics

- The main performance statistics are the number of packets moved on a circuit and the response time.
- Another factor is availability; the percent of time the network is available. Downtime is the percent of time the network is not available.
- Failure statistics include:
  - Mean time between failures (MTBF) indicates the reliability of a network component.
  - Mean time to repair (MTTR) equal to the mean time to diagnose plus the mean time to respond plus the mean time to fix a problem.

\[
MTTR\text{Repair} = MTTDiagnose + MTTRespond + MTTFix
\]
More on MTBF and MTTR

- Service level agreements for the MAN/WAN include MTBF and MTTR for their circuits.
- MTTR is typically 2-4 hours.
- For LANs, MTBF depends on the manufacturer; typically 3-5 years for low cost hardware and 10 years for high cost equipment.
- MTBF for network software embedded devices is about 3-6 months (meaning a system crash will occur ~2-4 times per year).
- The average MTTR for such a software failure is about 2 hours, depending on network staff.

End User Support
End User Support

• Supporting end users means solving the problems users have using the network.
• End user support can be grouped into three areas:
  – Resolving network problems
  – Resolving software problems
  – Training

Resolving Problems

• Problems stem from three major sources:
  – Hardware device failures
  – A lack of user knowledge on proper operation
  – Problems with software, software settings or software compatibility
• Problem resolution in large organizations is organized at three levels:
  – The help desk handles basic questions
  – If this is not enough, staff members with specialized skills specific to the problem at hand are brought in
  – If second level specialists are still not enough, technical specialists with an even higher level of training are contacted to look into the problem.

Providing End User Training

• End-user training needs to be an ongoing part of network management.
• Training programs are also important since employees often change jobs within an organization and so the organization can benefit from cross-training.
• Training is usually conducted using in-class or one-on-one instruction or online or using training materials provided online.
Cost Management

• Because of its large and rapidly growing budget, network management must carefully monitor network costs and will likely be called upon to justify cost increases.
• This requires measuring the cost of supporting users, allocating networking department budgets between hardware, software, personnel and other costs and understanding how these costs are changing.

Total Cost of Ownership

• The total cost of ownership (TCO) is a measure of how much it costs per year to keep one computer operating.
• TCO studies indicate it can cost up to five times the price of the computer to keep it operational.
• The TCO for a typical Windows computer is about $8-12,000 per computer per year.
• Although TCO has been widely accepted, many organizations disagree with the practice of including user “waste” time in the measure and prefer to focus on costing methods that examine only the direct costs of operating the computer.
Net Cost of Ownership

- *Net Cost of Ownership (NCO)* is an alternative to TCO that measures only direct costs, leaving out so-called “wasted” time.
- NCO costs per computer are between $1500-$3500, meaning that the network management for a 100-user network would require an annual budget of between $150,000-$350,000.
- Using NCO, the largest network budget items are:
  - 1. Personnel cost, accounting for 50-70% of costs
  - 2. WAN circuits
  - 3. Hardware upgrades and replacement parts.

Network Personnel Costs (Figure 11-3)

- Since the largest item in any network budget today is *personnel time*, cost management needs to focus on ways to reduce personnel time, not hardware costs.
- The largest use of personnel time is in *systems management*.
- The second largest use of personnel time is *user support*.

![Fig. 11-3 Network management personnel costs](image)
Managing Network Budgets

- Network managers can find it difficult to manage their rapidly growing budgets.
- Some organizations use charge-back policies for WAN and mainframe use as a cost accounting mechanism.
- Charge-back policies attribute costs associated with the network to specific users.
- Charge-back policies are difficult to implement on LANs, however.

Fig. 11-4. Reducing Network Costs

Five Steps to Reducing Network Costs:
1. Develop standard hardware and software configurations for client computers and servers.
2. Automate as much of the network management function as possible by deploying a solid set of network management tools.
3. Reduce the costs of installing new hardware and software by working with vendors.
5. Move to thin client architectures.

End of Chapter 11