NETWORK MANAGEMENT

USER NEEDS AND REQUIREMENTS

INPUT

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Network Management—User Needs and Requirements

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Abstract

The management of a network is a complex and time-consuming task. While many telecommunications managers believe that they perform the numerous tasks well, the information systems managers, to whom telecommunications increasingly reports, do not necessarily agree.

In many organizations, there can be a number of tools available to aid in accomplishing the various tasks; however, many are not extensively used, resulting in networks that are less effective than they should be.

Network Management —User Needs and Requirements examines the numerous tasks associated with network management and identifies key areas that are problems for both users and providers of network management products and services.

A properly managed network has clear strategic benefit to an organization. The report identifies a number of conclusions and recommendations for users, to increase management effectiveness, and for vendors, to improve use of products and services.

This report contains 84 pages, including 46 exhibits.

Table of Contents

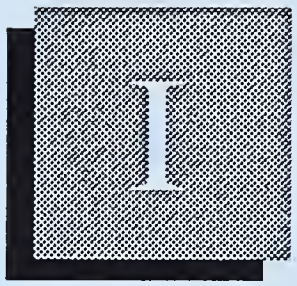
Table of Contents (Continued)

Table of Contents (Continued)

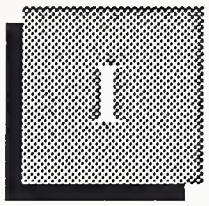
Table of Contents (Continued)

Exhibits

Exhibits (Continued)



Introduction



Introduction

A Background

Network Management—User Needs and Requirements has been prepared as part of INPUT's Market Analysis and Planning Service. It examines the management of networks from the user point of view.

A companion report, *Network Management—Vendor Initiatives*, examines the management of networks from the vendor point of view.

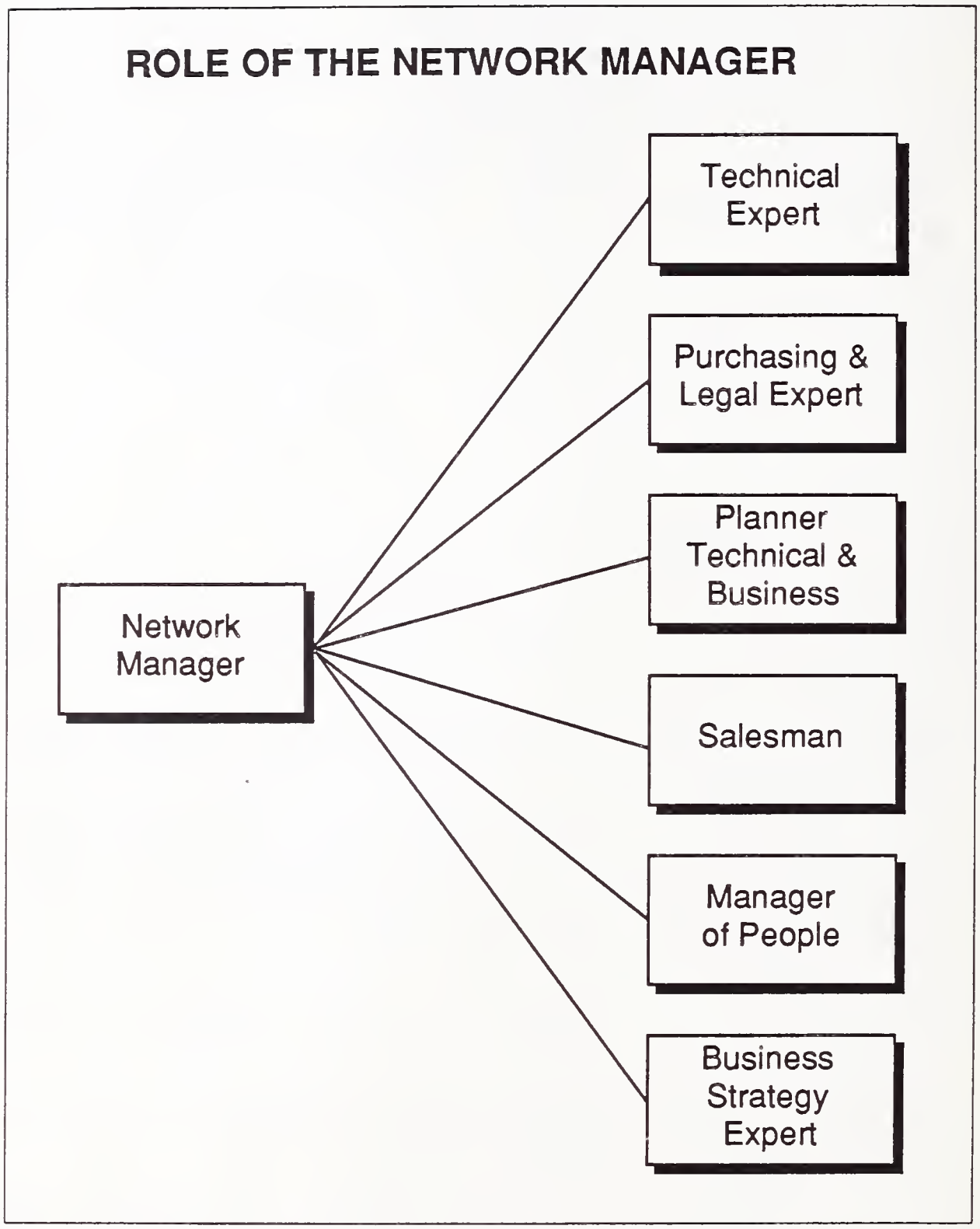
For the purpose of this report, network management is defined in the broadest sense. It includes tasks that are necessary to create and manage a network, and to incorporate the network into the company's information systems.

Major areas of network management to be discussed in this report include:

- Organization of the telecommunications department and how it relates to the rest of the company
- The network management process of design of the network
- Management of the operating network, including usage, quality control, and problem control
- Some specific key issues involved in network management
- User requirements of vendors

The tasks of the network manager (telecommunications manager) are quite complex (Exhibit I-1). The network manager must be:

EXHIBIT I-1



- A technical expert to design the network and to choose equipment and services that make up the network
- A purchasing and negotiating expert to implement decisions, since services and equipment are obtained from other companies
- A technical planner to ensure that the network does not become obsolete and that it fits the needs of the information system, as well as a business planner to ensure that the network is managed within budget and schedule constraints

- A sales manager to convince management and customers that the network is fulfilling their needs.

- A manager of people to ensure the integration of a wide range of skills

Increasingly, the network manager must also be a business strategist, since the network is viewed as a tool to implement business strategy and as a source competitive advantage.

A network is viewed differently by telecommunications planners and managers and by users.

Users consider a network to be "a means to get information from one place to another." Exhibit I-2 illustrates a network as seen by an outsider.

- Large sites contain computers that usually access the network directly and a PBX that connects telephones, fax units, etc. to the network. The high bandwidth of video conferencing usually requires a direct connection.

- Small sites and medium sites may have the PCs and fax units connect directly to the network, while telephones use a keysystem for access.

- There are also many geographically dispersed local sites as well as sites where LANs use the network for local communication.

- The network must connect to external networks to reach customers and suppliers.

To users, a network is an "invisible black box." They have little awareness of its existence, construct, or technical aspects.

Exhibit I-3 represents the telecommunications department's view of a network. There is complete visibility of the insides of the network. However, a network can consist of subnetworks with less visibility. For example:

- Satellite networks can be obtained as a service or turnkey.

- Public networks such as packet switching and the DDD system are used as part of the overall corporate network.

- Private networks are used where they are appropriate.

Network managers have the task of reconciling these two very different viewpoints (users of IS and telecom managers) of the network world. It is not a simple task.

EXHIBIT I-2

NETWORK DEFINITION FROM THE OUTSIDE

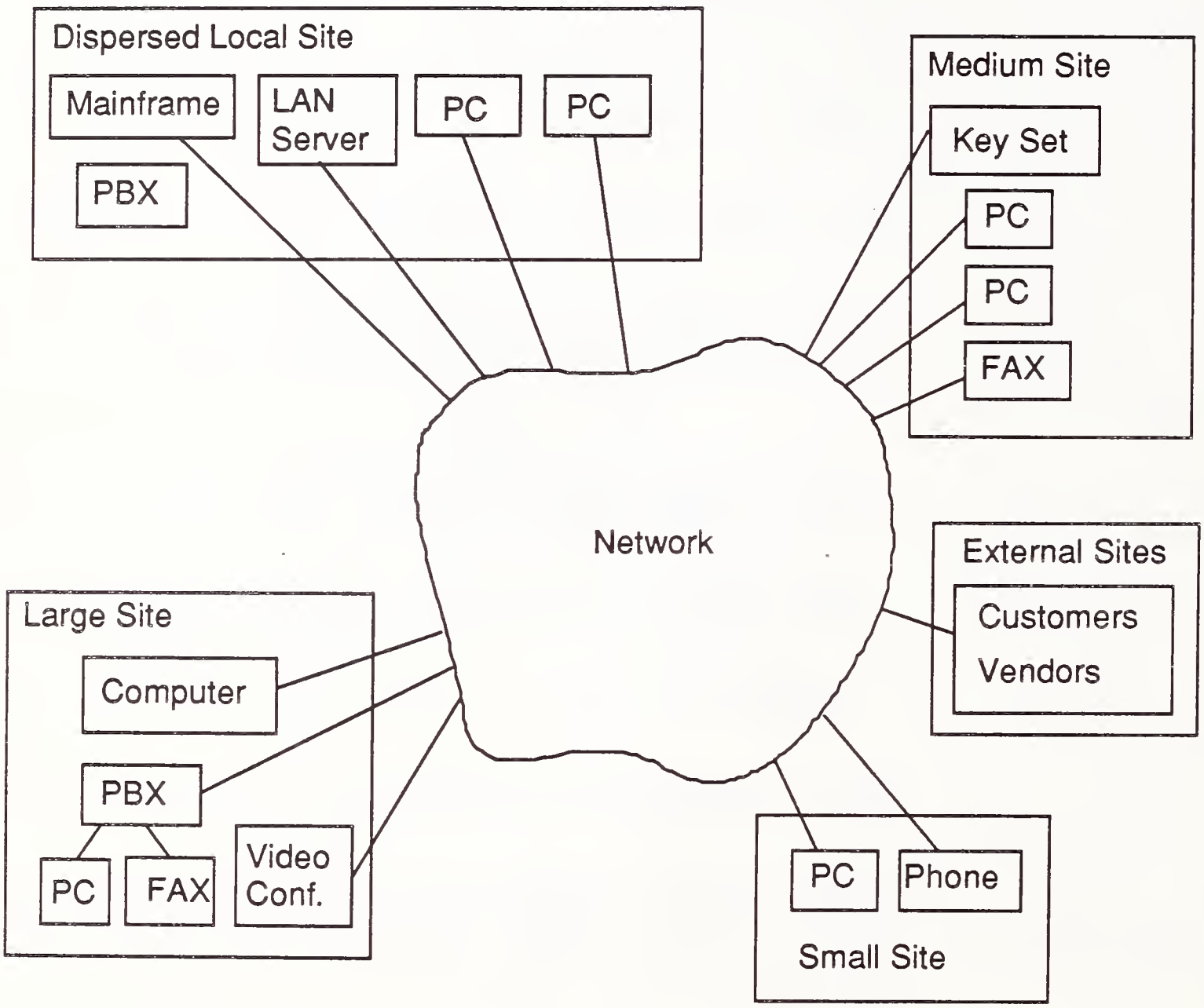
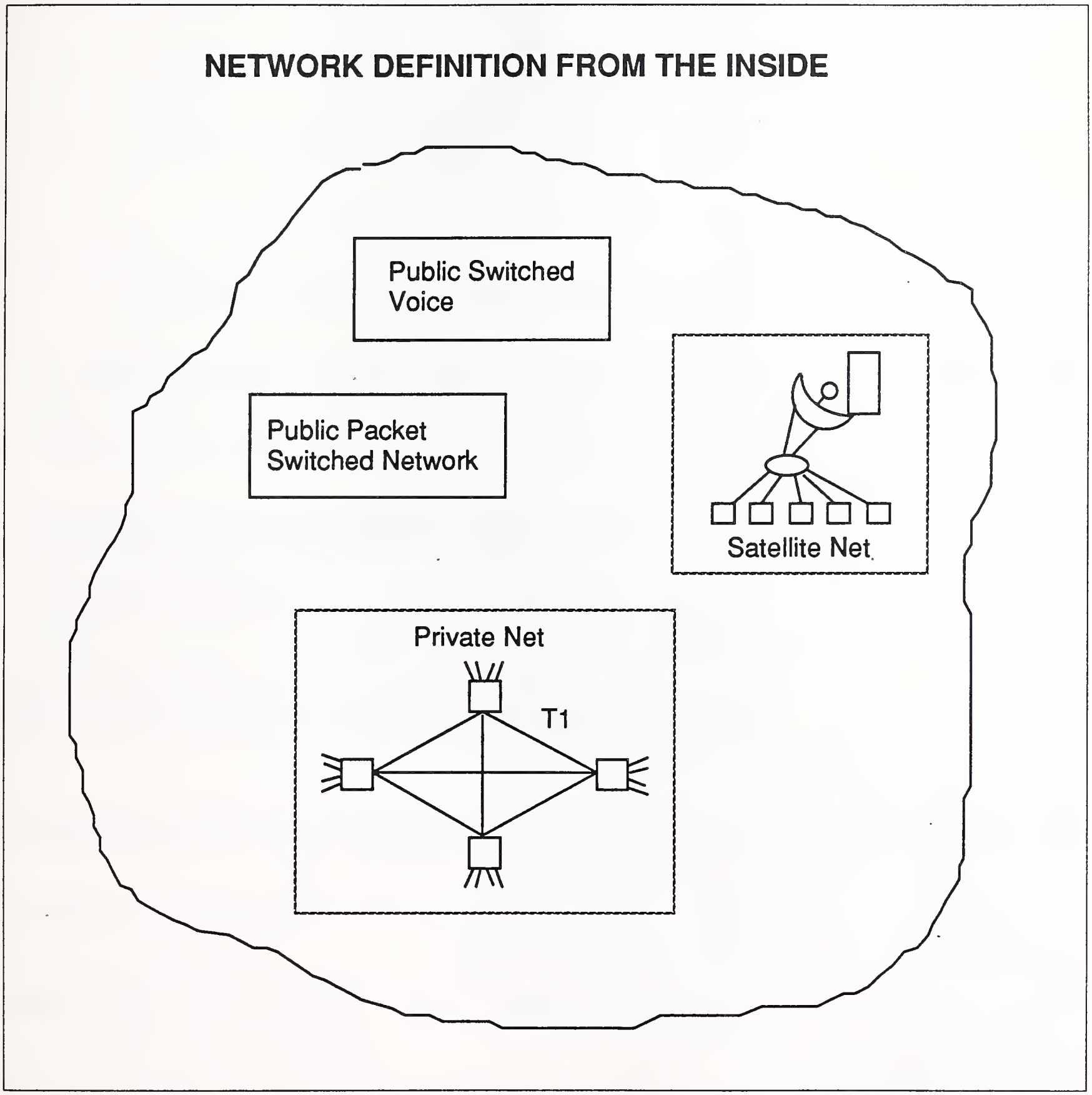


EXHIBIT I-3



B

Scope

This report discusses the issues and topics suggested above. More specifically:

- Chapter II provides an executive overview of the report.
- Chapter III discusses the network management organization, functions, user issues, and products and requirements.
- Chapter IV projects user needs and the market size.
- Chapter V provides a number of conclusions and recommendations for participants in network management (users and vendors).

C

Methodology

Information for this report was derived from a number of sources.

- An extensive search of professional literature and discussions with clients started the process.
- A total of 35 users (network managers) in large companies were interviewed in depth by telephone. Each interview took at least 30 minutes.
- Product literature from 35 vendors was obtained, and 18 of these vendors were also interviewed in depth.

Vendors and users with different points of view were deliberately sought so that the widest possible selection of information and viewpoints would be available for the report.

D

Purpose

The purpose of this report is to determine trends in network management from the user's point of view. The report will:

- Assist users by showing them how network management is handled by a range of companies (users)
- Assist vendors by pointing out opportunities for them in this important communications area

E

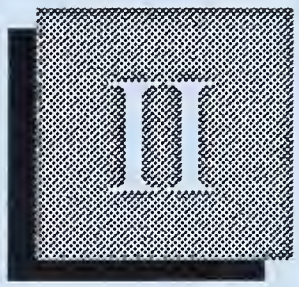
Related Reports

Other related INPUT reports include:

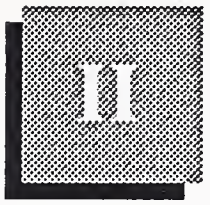
- *Network Integration, 1987*, which discusses the integration of voice, data, image, and video on networks.

- *Emerging Network Based Information Service Markets (1988)*, which investigates opportunities for vendors in the information processing and information provider markets that have been created by new communications technologies

In addition, INPUT's report, *Asia/Pacific Telecommunications Service Trends, 1988-1993*, provides a comprehensive assessment of user requirements and national developments in telecommunications services in eleven key Asia/Pacific countries.



Executive Overview



Executive Overview

A Network Management Is Complex

Network management is a complex set of tasks. Networks are large, and requirements and technology are continually changing. The goal of network management is to ensure that the network operates reliably and economically despite these changes.

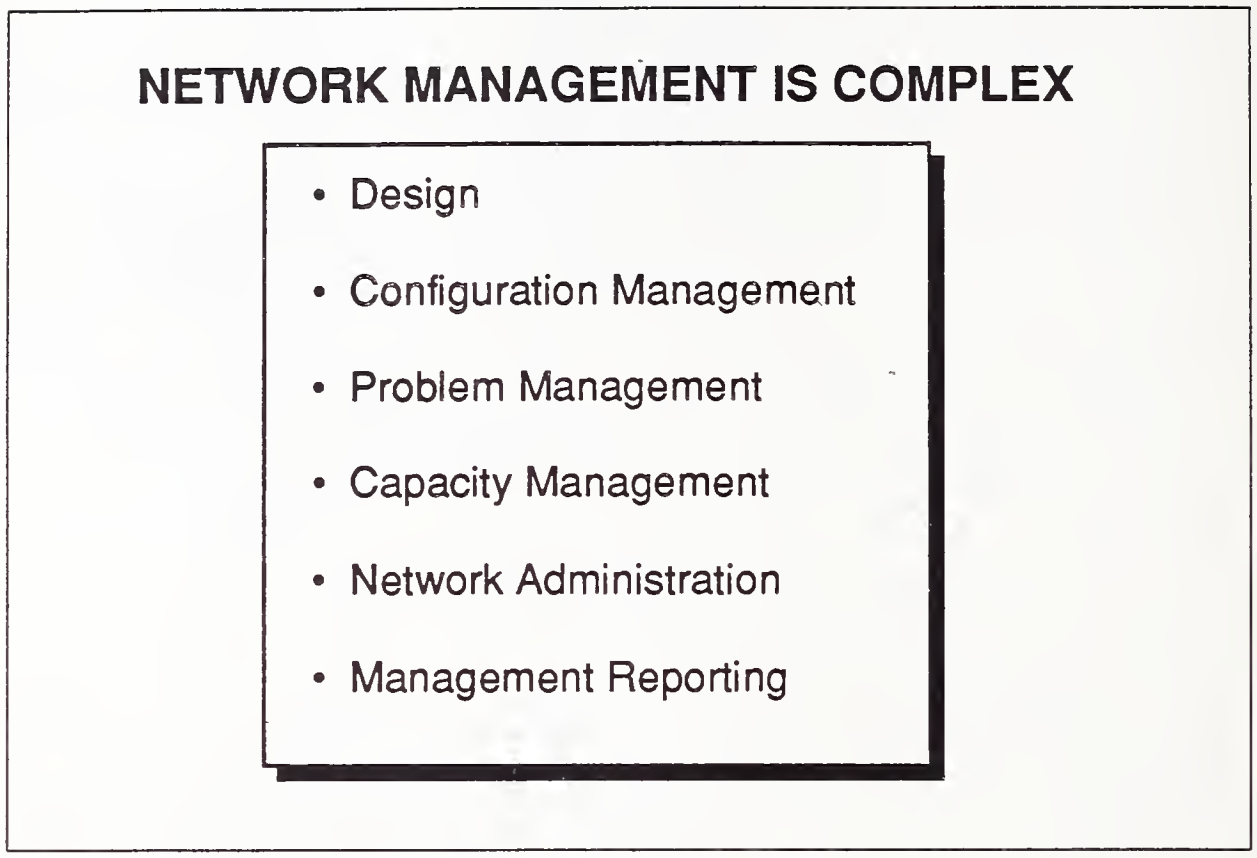
Change is caused by many forces. A number of key reasons for the continuous changes include the following:

- New corporate needs for information or newly installed equipment that must be connected to the network
- Changing corporate geography
- Better ways to implement the network due to communications offerings changed by new technology
- Changed carrier rates and optimization rules

As shown in Exhibit II-1, network management consists of many different tasks. The tasks are interrelated, creating a continual process of balancing network design solutions.

- Network design must react to a changing environment as corporate needs and communications offerings change.
- Configuration management reacts to the change in equipment connected to the network and to line failures.
- Problem management is a continuous reaction to failures and capacity overloads.

EXHIBIT II-1



- Capacity management requires that the network be able to handle user needs despite the fact that they generally are not well forecast.

- Network administration requires billing the user very much as a utility bills. Bills have to be correct, errors must be corrected, the users may have questions about their bills, etc. Orders for new services (from users) must be handled quickly.

- Management reporting involves budgeting in a time of rapidly changing rates and offerings. Users and management must be told what they are getting for their money, and the are not always satisfied or understanding.

B

Organization Issues Are Significant in Network Management

Exhibit II-2 shows that there are really three levels in the user organization that have an effect upon network management.

Corporate management and the using departments need information transmitted accurately. They are concerned about business advantages, costs, and return on investment.

The telecommunications department must satisfy their needs. However, since the telecommunications department and corporate management view a network differently, education is a continual process.

Since telecommunications management is junior to corporate management, it is the telecommunications department that has to "translate" its

EXHIBIT II-2

ORGANIZATION ISSUES ARE SIGNIFICANT

Corporate Management and Departments
- Need Information
- Look for Business Advantages
- Keep Costs Down
- Expect Benefits for Investment

MIS Management
- Keep Information Moving
- Not Satisfied with Telecom Management
- Buying Network Management Tools
- Buying Managed Networks

Telecommunications Management
- Satisfied with Operations
- Want More Staff
- Think They Are Responding in a Strategic Sense

actions into a form that corporate management understands and approves. To do this, telecommunications management must understand corporate goals, which are very hard to understand without a corporate-level background.

MIS management is usually closer to corporate management; the telecommunications department usually reports to MIS management. The relationship in many cases is not smooth.

MIS management is frequently not satisfied that telecommunications management has things under control. As a result, MIS management is purchasing network management tools and buying managed network services.

Telecommunication management thinks that it is doing a good job and wants more staff.

However, this does not match the perception that MIS management is looking in other places for solutions. Telecommunications management

often says that it is managing the network in a strategic sense. However, the lack of detail in how this is accomplished, and the distance of telecommunications management from corporate management, does not give one confidence that strategic management is actually happening.

C

There Is Much Room for Improvement in Network Management

Some of the problems (challenges) in the area of network management as it is practiced now are shown in Exhibit II-3.

- Training of telecommunications managers and planners is often less than adequate. Training is frequently considered a low priority.

EXHIBIT II-3

THERE IS MUCH ROOM FOR IMPROVEMENT

- Training
- Not Using Network Management Tools
- Few Disaster Recovery Details
- Tools Don't Handle All Portions of the Network—Limited in Scope
- Fault Diagnosis/Correction Not Integrated
- User Data Not Available
- Budgets Have Met with Unexpected Price Increases
- Local Loops Are Vulnerable
- Network Management Products Are Too Complex to Use

- Network management tools are not used because they are too complex and the staff is not trained.
- Tools for network management are limited in scope so that they don't help solve the whole problem.
- Fault correction is not integrated with diagnosis so that it is hard to know what to do when there is a problem.
- User data is not available for planning future network changes.
- It has been difficult to forecast carrier price changes and the budget has suffered.
- Local loops are vulnerable to disaster failure at a network center.
- Etc.

These challenges show that there is much work left to do in network management.

D

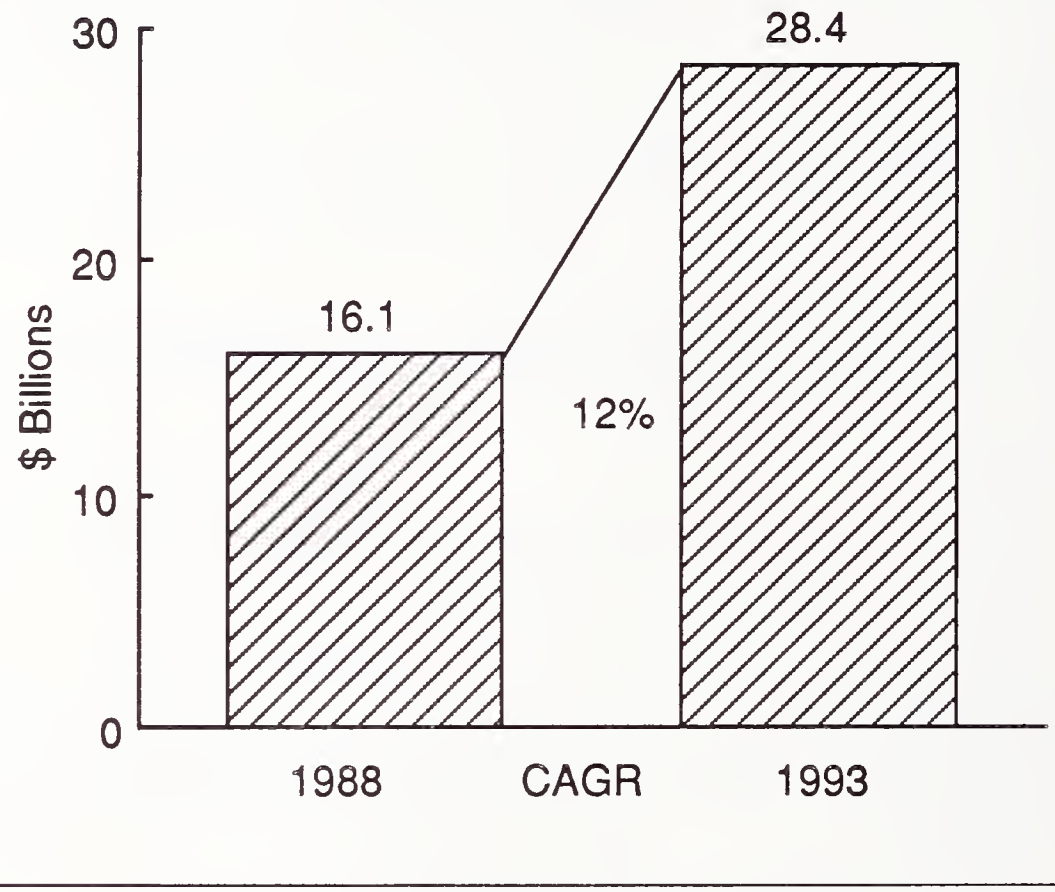
Expenditures for Network Management Are Large

The total expenses for network management staff and equipment in large companies (over 500 employees) in the U.S. are shown in Exhibit II-4 to be $16.1 billion in 1988. This figure will rise to $28.4 billion in 1993. A significant portion of these expenses are for salaries in the telecommunications department.

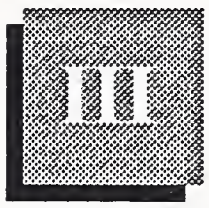
This large amount of expenditures shows the importance of network management. It also shows that there are numerous opportunities for vendors to provide solutions for unsolved problems.

EXHIBIT II-4

TOTAL EXPENDITURES IN COMPANIES OF OVER 500 EMPLOYEES—NETWORK MANAGEMENT PRODUCTS AND STAFF EXPENDITURES



Networks and Users



Networks and Users

A
Network Defined

1. Common Definition

For purposes of this report, a network is considered to be a telecommunications network consisting of transmission lines and/or services (i.e., leased from another company); terminal devices such as telephones and data terminals; as well as switching, multiplexing, and other equipment (computers) used for transporting information in electronic form from one location to another.

A network can be private (that is, used by only one organization) or public (that is, used by any subscriber). A network may also use a combination of private and public transmission and switching systems.

When defining a network, differences in perspective must be kept in mind. Technical planners do not view networks the same way that a business user does. Managers of voice service view networks differently from the way managers of data services do. Vendors, who frequently have responsibility for or interest in a single component, view networks differently from users, who must consider the integrated whole.

2. Business versus Technical

From the viewpoint of the ultimate end user (salesperson, manager, accountant, etc.), a network is simply a means of getting information to or from somewhere else fast. To that end user it is one of a number of means of moving information, but one with special characteristics of speed, convenience, and ubiquity.

From the viewpoint of the network manager, a network is more a collection of discrete parts that must fit together into a single delivery highway. At least as importantly to such a manager, those parts are located over a

wide area and are, therefore, physically inaccessible in any reasonable period of time.

3. Voice versus Data

Another view of the network is from the perspective of managers responsible for the kinds of information that flow over it.

Traditionally, managers of voice services have had to consider types of operating requirements that managers and planners of data services do not. The difference in perspective leads to a difference in how the definition is viewed.

Although there is a growing convergence in the placement of voice and data services under one management structure, a need remains to recognize that the requirements of managers of voice services are different from the requirements of data services.

4. Vendor versus User

The user's view of the network is a holistic one in which the individual devices are simply elements of the entire network—at least until they fail. The user's view is of the entire picture and what it represents. No one device is of interest except as it contributes to, or detracts from, the whole.

The vendor's view of the network is more like a partially filled jigsaw puzzle in which there are places where devices fit. The vendor is not involved in the entire picture, except in shaping the empty spaces, nor in the other pieces of the puzzle, except that the vendor's piece must fit between them.

The differences in perspective between business and technical planner, between voice and data technology, and between vendors and users creates a complex environment to manage. The difference in needs and requirements creates conflicting priorities and conflicting demands for products and services.

B

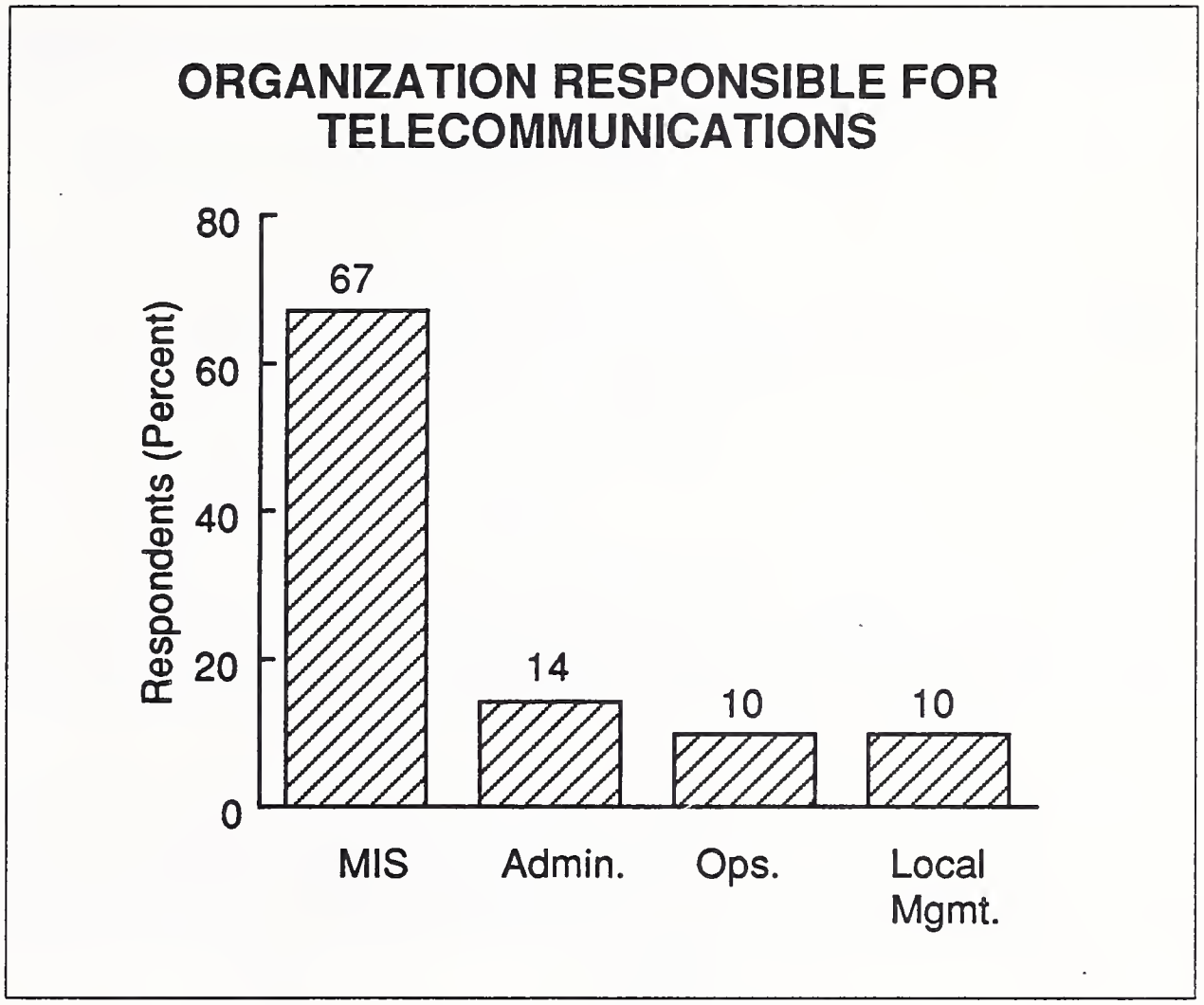
Network Management Organization

1. Organization Structure

Telecommunications is increasingly a responsibility of information systems. As shown in Exhibit III-1, over two-thirds of the telecommunications operations are part of the MIS (or equivalent) department.

Differences from this pattern are typically due to one of two primary reasons. The first is that voice is frequently still handled by an administration department. Second, in a number of organizations, telecommu-

EXHIBIT III-1



nications is a distributed responsibility, with each plant or division handling its own telecommunications.

There are a number of considerations related to the organization of the network management function.

a. Staffing Is a Budget Problem, Not a People Problem

As a result of deregulation and the resulting layoff of staff by many of the telcos, there is a large labor pool of qualified staff to perform network management functions. However, in most organizations, budgetary considerations remain the primary reason for not increasing the staff.

In many organizations, the quality of available staff is an additional concern. Individuals trained in the rigid structure of a telco operations center frequently do not adapt well to a corporate environment.

b. Big Organizations Gaining on Telcos

Large organizations are building staff, equipment, and procedures to manage their own networks as effectively as the telcos. Telcos, hampered by regulatory constraints and by an increasing array of CPE equipment, have not been able to respond effectively to the user need for

management in a complex environment. Many users believe they have been forced to become increasingly self-sufficient.

c. Small Organizations Losing Ground

Many smaller organizations, without the resources of a larger organization, are increasingly unable to keep pace with the changing array of services and equipment available to them. In addition, it is increasingly difficult for them to deal effectively with the complexities of service integration. Although this situation could change with the emergence of ISDN-based services, the problems will remain for some time.

d. Inadequate Network Control Space

Traditionally, the network management function has been allocated only minimal space in a corner of the DP center. The space has frequently been crowded and subject to frequent disruptions.

This situation has begun to change in larger organizations as the telecommunications functions have become integrated into systems operation. However, in medium-sized and smaller organizations, the management of a network is viewed as an ancillary activity and relegated to secondary facilities.

e. Network Segmentation

Most networks are functionally, and often physically, categorized into many different segments. In most cases the rationale for the segmentation is related to the business operations of the organization. Whatever the reason, segmentation of services frequently forms the basis for the structure of the organization that manages the network.

Technology - The most common segmentation of networks is on the basis of technology, particularly between voice and data communications. Increasingly, technologies such as LANs and T-1 networks are becoming distinct and separately managed network segments.

Geographic - Another common form of segmentation is geography. This segmentation is important because of the logistic requirements of getting people and equipment to remote locations. Large retail operations are frequently segmented geographically to meet distribution and regional/local marketing requirements.

Line of Business - A more critical segmentation is that of the business operations of the user organization. Divisions of multiindustry firms are often decentralized in their management structures and their communication networks follow the management structure, at least to some degree.

Application - Frequently network operation is organized around a specific application. For example, in the airline industry the reservation networks are separate from networks used for internal management.

2. Training and Education

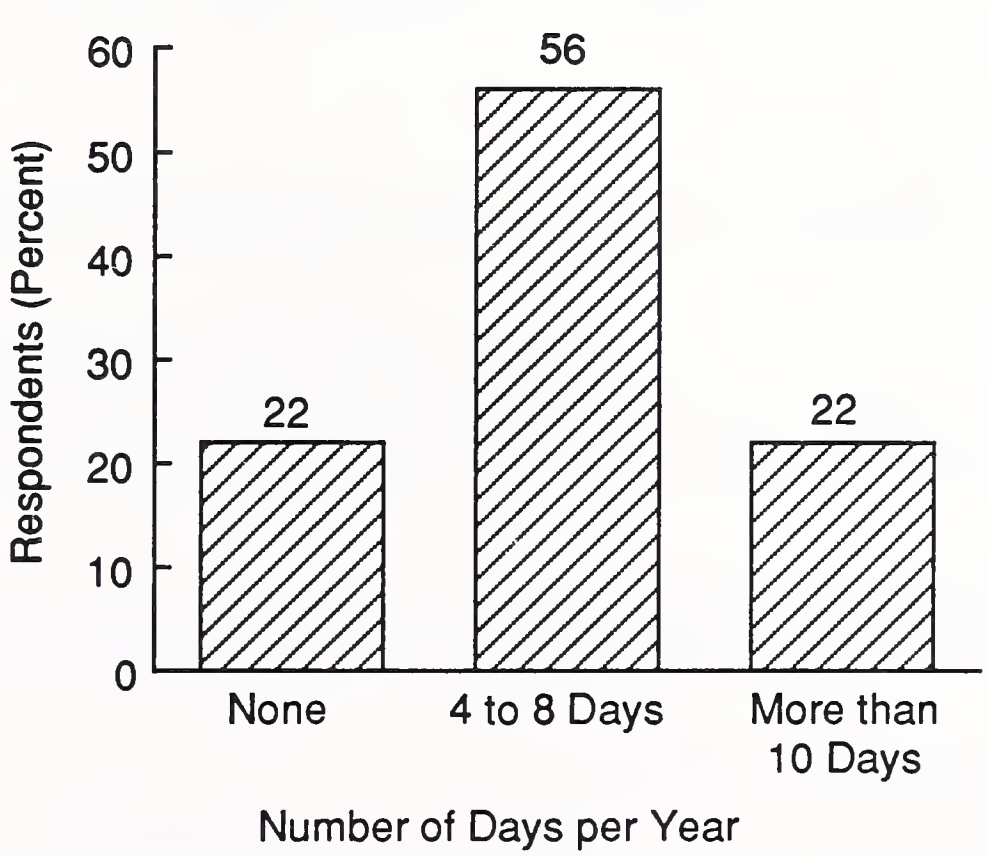
Although network managers frequently believe that this is not a problem, the amount of time spent on any kind of formal or semiformal training is a major deterrent to the application of advanced technology or even utility in the networks.

a. Little Time Spent on Training

The average amount of time spent by the respondents on training is less than 2%. As shown in Exhibit III-2, most of the companies spend fewer than two weeks per year per individual in training, and nearly twenty-five percent of companies spend no time at all.

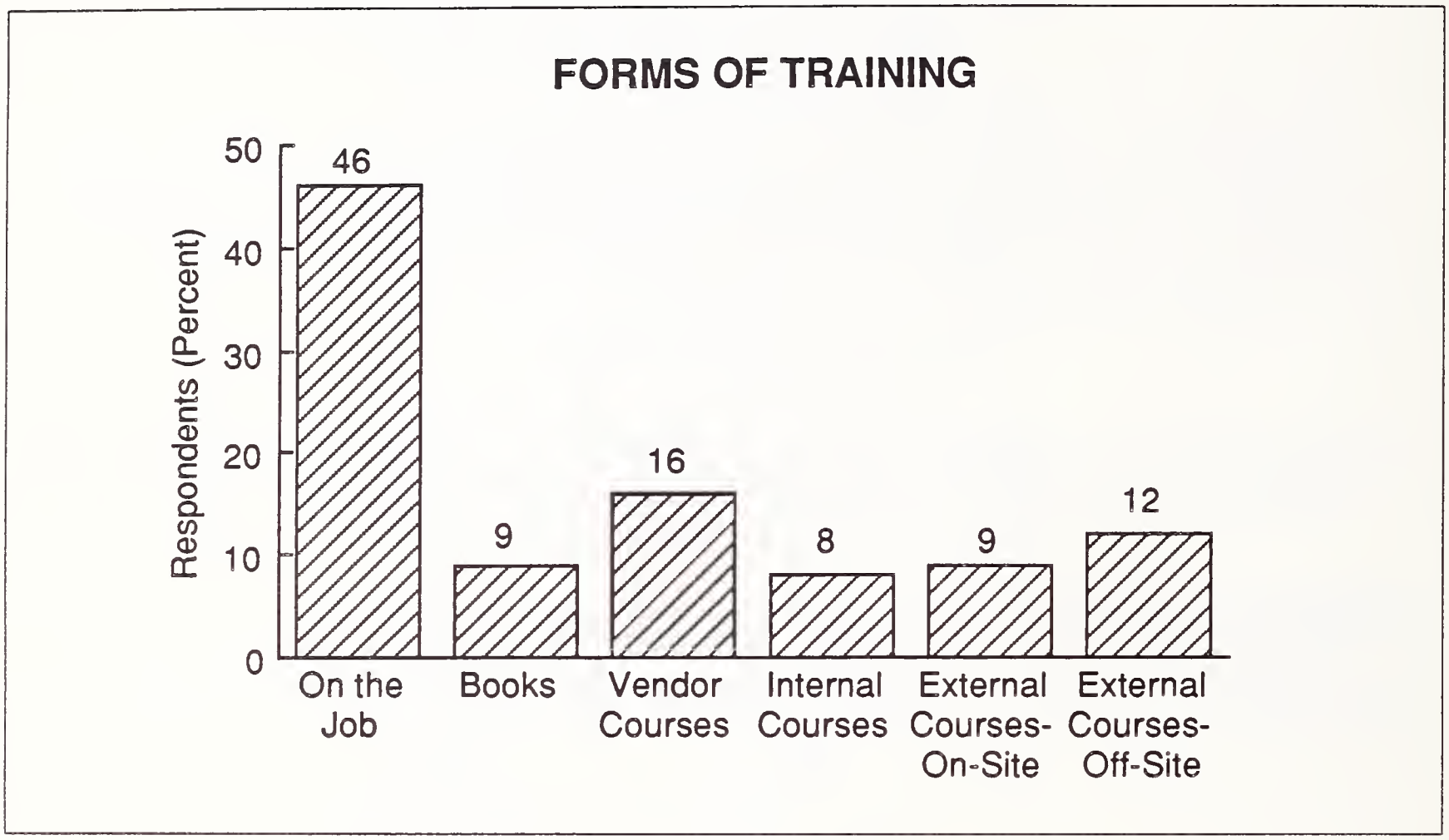
EXHIBIT III-2

LEVEL OF TRAINING OF TELECOM STAFF



As also indicated in Exhibit III-3, on-the-job training is the predominate method of training in most organizations.

EXHIBIT III-3



b. Tools Available but No One Trained to Use Them

Among those surveyed, users frequently have network management tools available, some of them very sophisticated, but were unable to use them because they had not been adequately trained.

c. Urgent Preempting Important

Frequently, inadequate training is directly related to personnel turnover, but more often it is the result of insufficient time. Time could not be spared from the urgent problems of the moment.

User comments on training problems are illustrated in Exhibit III-4. The comments indicate that there is a wide divergence of opinion on the priority and proper role of training.

3. Integrating Voice and Data

Although the integration of voice and data is an important issue, few user organizations are truly set up to handle such a task. Although most network management organizations report, directly or ultimately, to the

EXHIBIT III-4

TRAINING ISSUES—RESPONSES

- Company very difficult in this area. Building this year.
- Training is usually cut first when it comes to cost cutting.
- People are developed in-house. Hire at entry or appropriate level, then train in-house using formal, on-the-job, and all other resources.
- As problems arise, training is implemented.
- Do not believe in this.
- Nothing. Don't do a very good job here.
- Only as required by new technology or changes in system by new products.
- It's an ongoing process—nothing formalized.

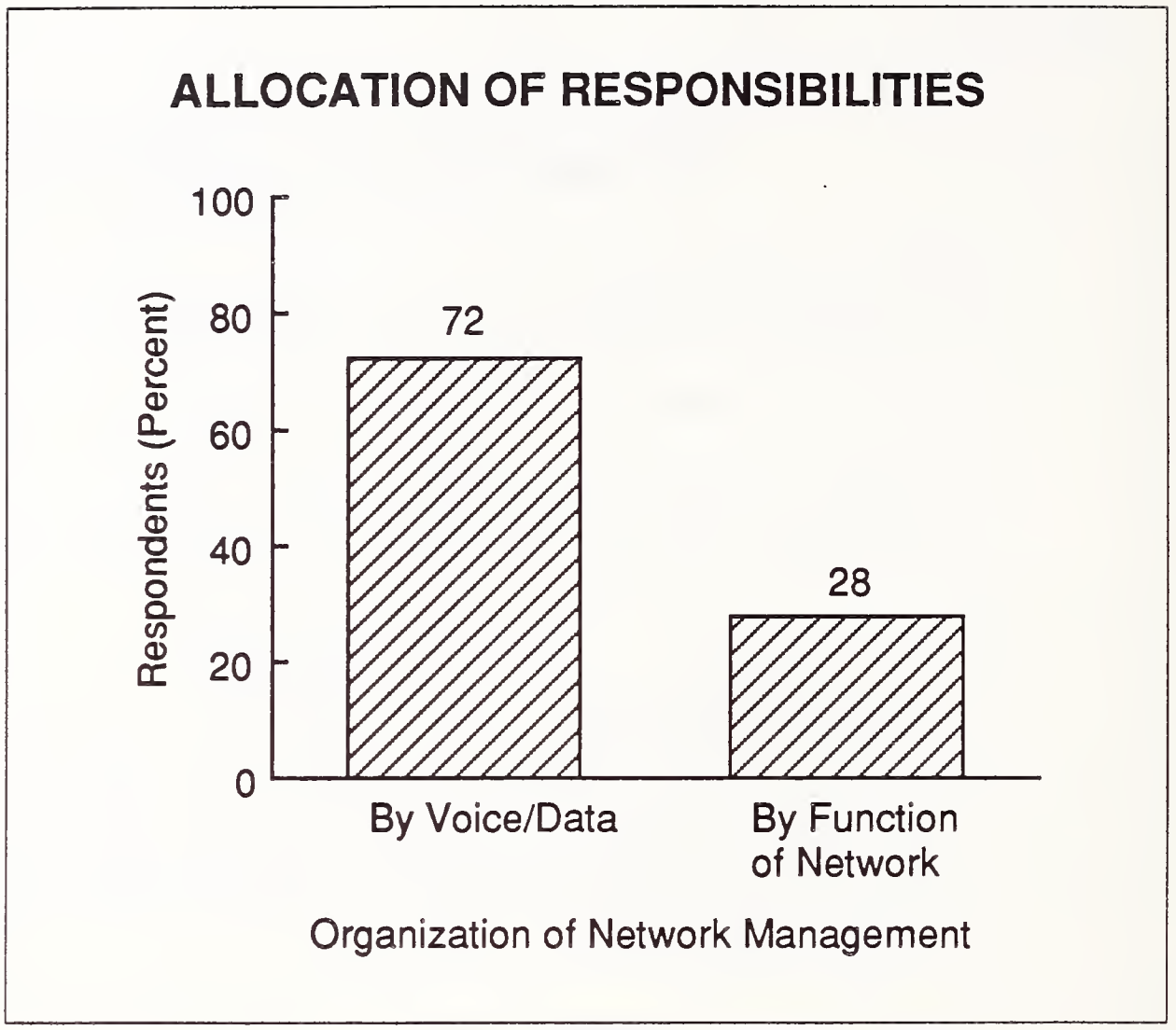
head of information systems, the functions of network management are still largely allocated according to the traditional voice and data technologies.

Exhibit III-5 shows the proportion of user organizations where the basic division of responsibility was divided along the lines of voice and data, as opposed to some other, typically functional, division.

In organizations where the voice function is still part of an administration group, the voice/data division is even more distinct.

Nevertheless, the issue of integrating voice and data is not a burning question in most user organizations. The broader subject of multinetwork, multivendor management of user networks is a much more critical consideration for most users.

EXHIBIT III-5

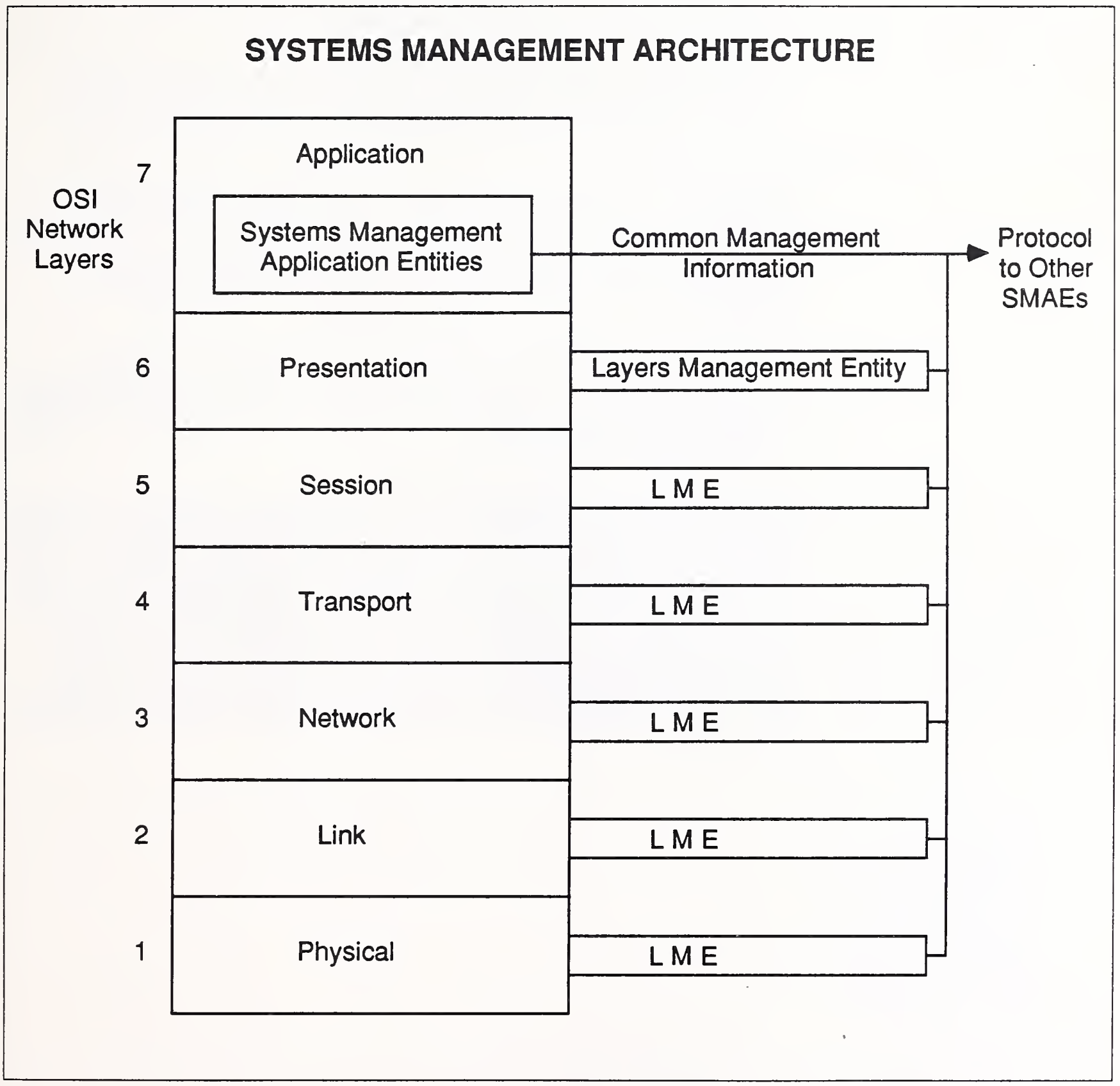


- *OSI Standards* - International standards organizations are in the process of developing a set of standards for the management of user networks. This work, now underway, is expected to be visible in network management products in about two years.

  The standards work is following closely the pattern set by the OSI network model with its layered structure. As shown in Exhibit III-6, there are Layer Management Elements at each of the seven defined layers of the OSI model. The controlling element is a set of management functions (Systems Management Application Entities) that operate in the application layer and a communication protocol (Common Management Information Protocol) that enables the interconnection of these elements.

- *Vendor Standards* - A number of vendors have established network management concepts or architectures of their own. This is partly in response to user needs and the lack of an in-place OSI standard. It is also in response to the need to protect their own product lines in the face of the clear trend toward multivendor networks.

EXHIBIT III-6



The earliest of these vendor standards were set primarily by the modem vendors, including AT&T. These early network management systems used the increased intelligence of modems to monitor lines as well as their own operations and then transmit the information over a secondary channel on the same circuit to a central monitoring system. Due to the unique nature of the information transfer protocols on these secondary channels, the systems were capable of operating only with their own modems.

In some cases wraparound boxes were used to bridge both sides of other vendors equipment to provide the same information. These devices never found a significant market.

More recently, many of these vendor standards have been directed toward interconnection with other vendors' network management systems. The most notable and successful has been IBM's Netview.

- *Netview* - Netview is IBM's collection of various network management packages, including NCCF, NPDA, NPM. Netview/PC is IBM's interface to other vendors' network management systems. Netview/PC is primarily a data collection and protocol converter and display mechanism. An outline of Netview is shown in Exhibit III-7.

- *UNMA* - Unified Network Management Architecture is AT&T's version of a network management system. It is more of an architecture than a product (in the same sense that SNA is an architecture). UNMA is illustrated in Exhibit III-8.

One of the key features of UNMA is the segregation of network management functions into individual systems, each of which manages a defined set of network elements such as modems, switches, etc. UNMA ties all of these, both carrier systems and CPE, into a single presentation. Many of these systems already exist, such as Accumaster for AT&T's PBXs and Dataphone II for AT&T's modems. This integration of existing products into a single NMS provides vendors with wide product lines—such as AT&T and IBM—with a significant running start on a major user requirement.

EXHIBIT III-7

IBM'S NETVIEW

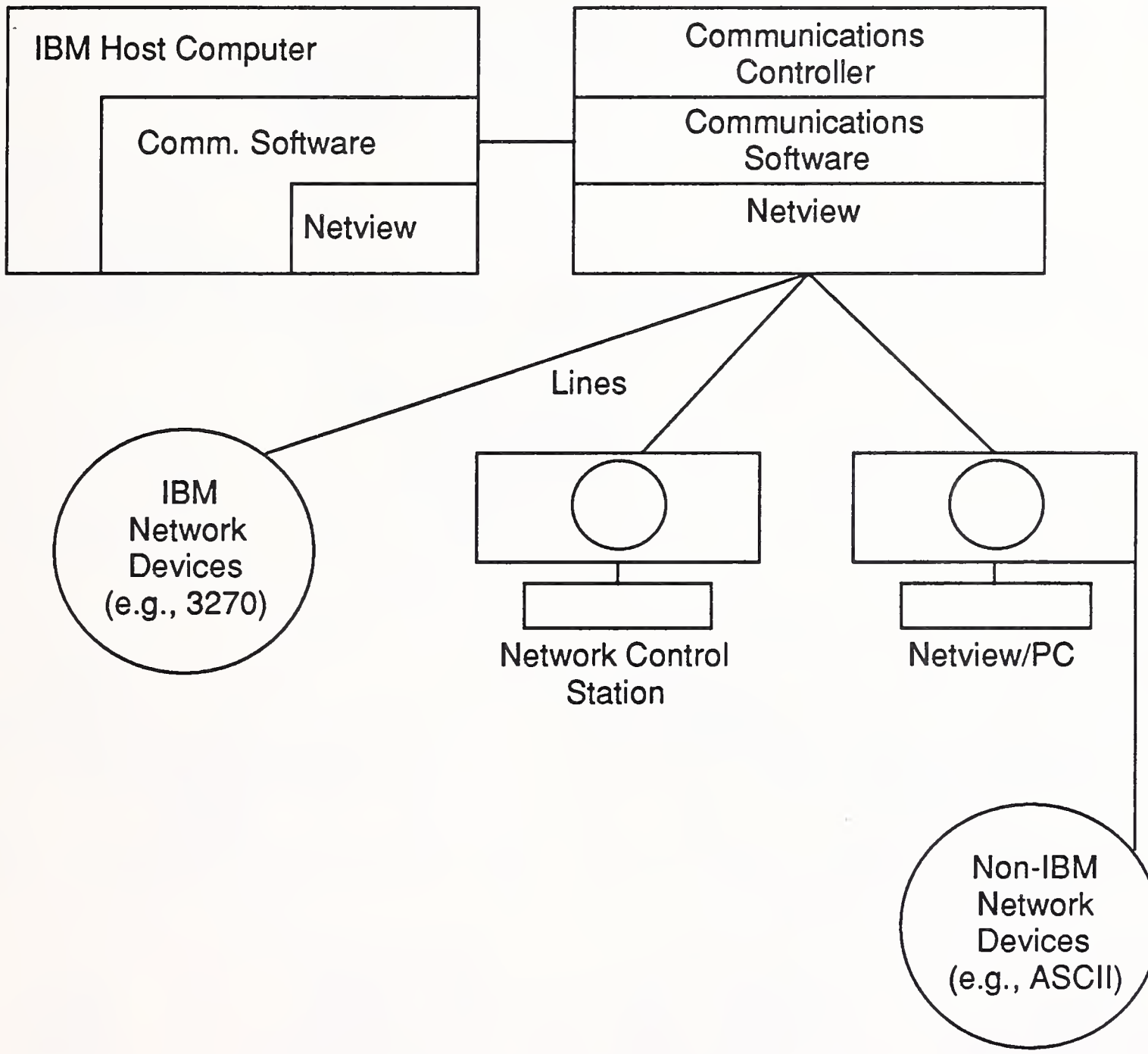
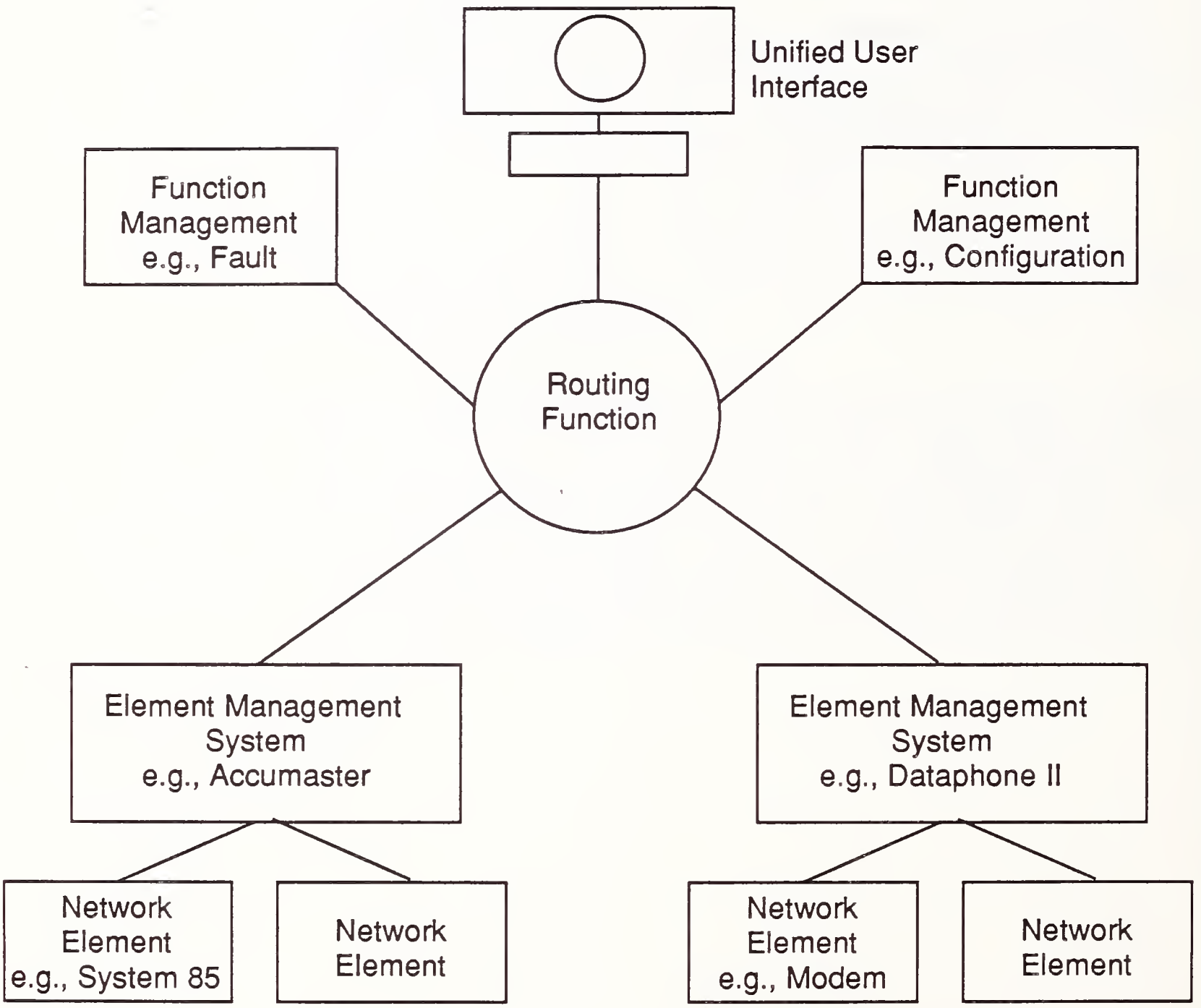


EXHIBIT III-8

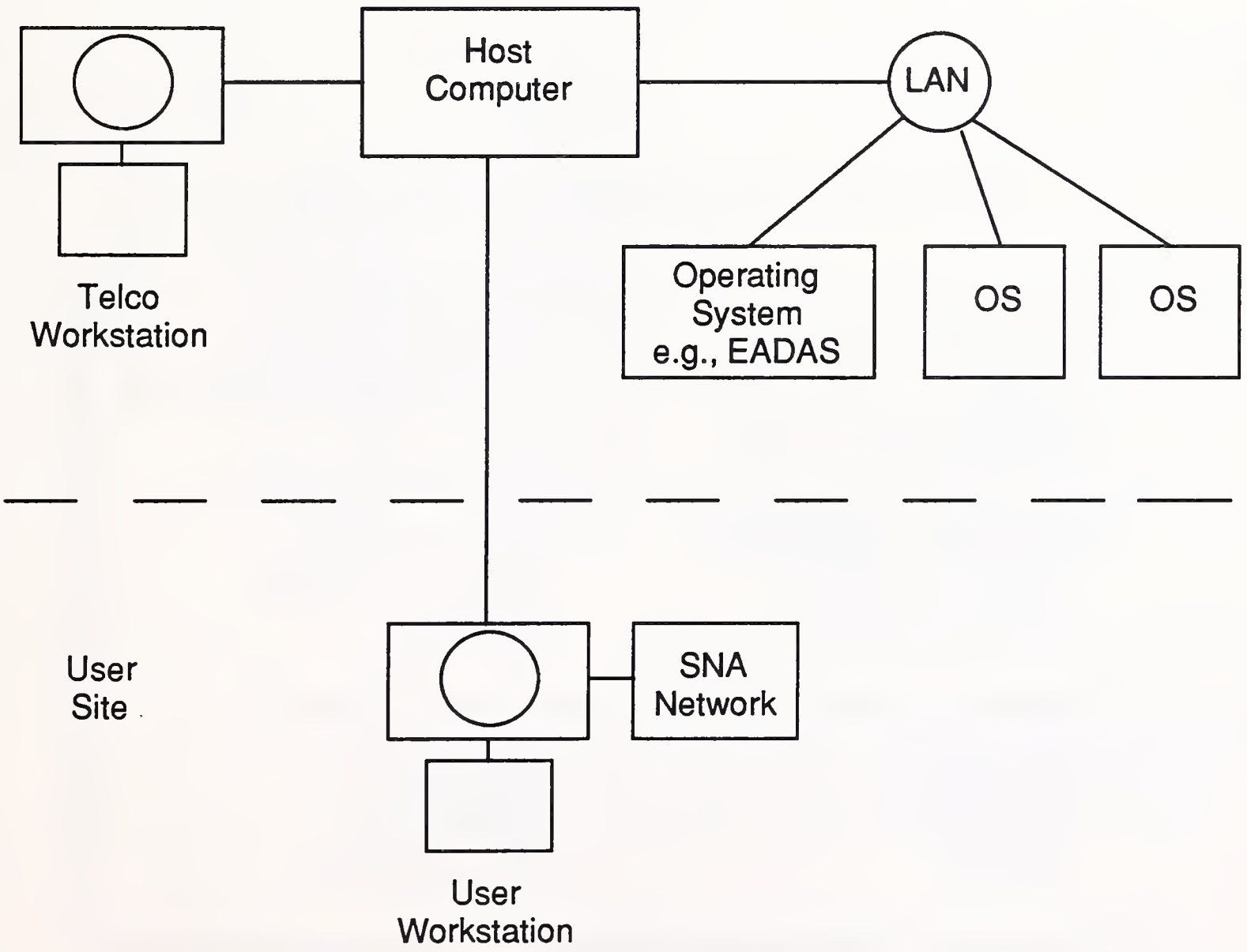
AT&T'S UNIFIED NETWORK MANAGEMENT ARCHITECTURE



- *Net Partner* - This is another AT&T system contained within 3B600 computers in a telco central office. It allows users to gain controlled access to the operations systems of the telco. These operations systems include EADAS (Engineering & Administrative Data Acquisition System), SCCS (Switching Control Center System), LMOS (Loop Maintenance Operations System), and others. Access to these operations systems allows users to obtain information on the transmission portion of their networks directly from the systems that monitor those facilities, rather than through a human interpreter or end-of-the-month reports (See Exhibit III-9).

EXHIBIT III-9

AT&T'S NET PARTNER



- *Others* - Other vendors such as DEC and HP have introduced systems aimed at the network management market with similar objectives.

Probably the major problem facing network users is the reality of a multivendor environment. Few of the existing network management systems, including Netview and UNMA mentioned earlier, have real multivendor capabilities.

For example, Netview/PC, IBM's multivendor interface, depends on the other vendors delivering data in an IBM-defined format for presentation. Although Netview/PC is obviously an improvement over multiple displays, the correction of problems is still the responsibility of the individual systems.

C

Network Management Functions

As used in this report, the term "Network Management" covers a wide range of activities. As illustrated in Exhibit III-10, these activities can be divided into six major categories.

EXHIBIT III-10

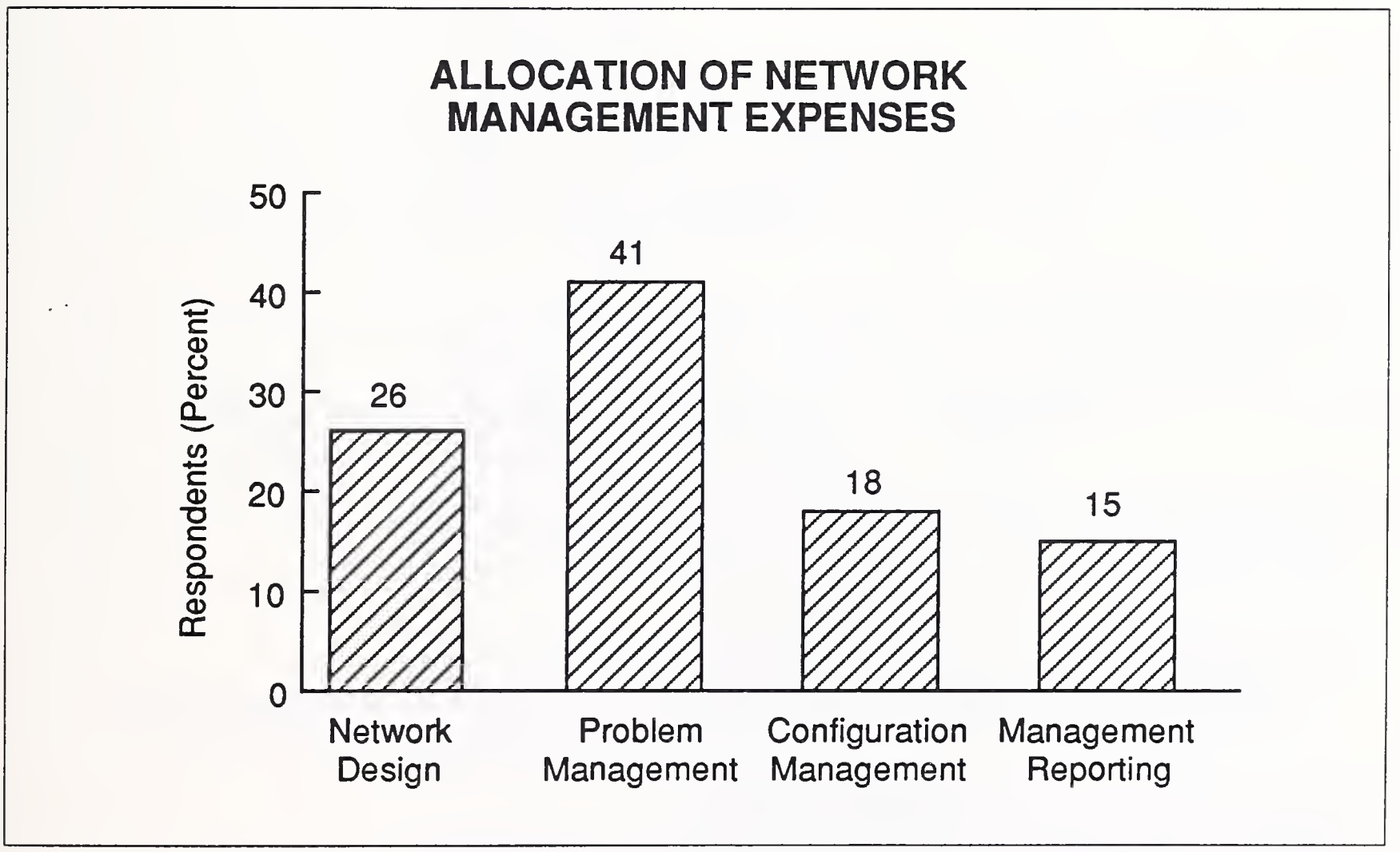
NETWORK MANAGEMENT FUNCTIONS

- Network Design
  - Strategic Plan
  - Design
  - Optimization
  - Disaster Plan
- Configuration Management
  - Network Inventory
  - Alternate Routes
- Problem Mangement
  - Monitoring
  - Diagnosing
  - Bypassing
  - Restoral
- Capacity Management
  - Traffic Measurement
  - Performance Measurement
  - Forecasting
- Network Administration
  - Order Handling
  - Equipment Catalog
  - Directory
  - User Billing
- Management Reporting
  - Expense
  - Organization
  - Training
  - User Assistance

Although these categories can be neatly separated in the exhibit, they are, in fact, closely interwoven in the day-to-day activities of network management. Forecasting, for example, is an integral and important element of network design. Network inventory is an integral element of user billing.

Users indicate that they typically spend about 10% of their telecommunication budgets on the various tasks of network management. The distribution of this 10% is shown in Exhibit III-11.

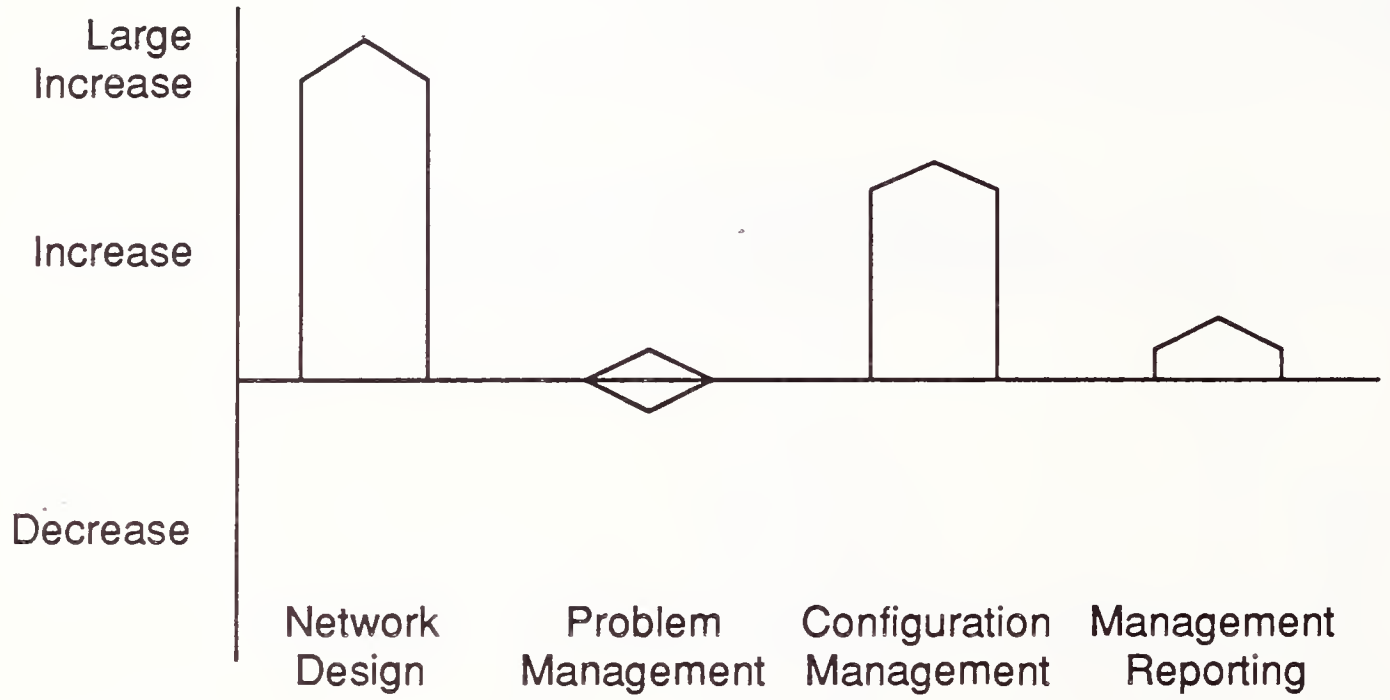
EXHIBIT III-11



Almost half of the budget is spent on managing problems. However, as shown in Exhibit III-12, users expect the costs of problem management to remain relatively constant, while the costs of network design will increase substantially. The cost of configuration management is also expected to increase.

EXHIBIT III-12

CHANGING PATTERN OF NETWORK MANAGEMENT EXPENSES



1. Network Design

There are a number of considerations related to corporate network design. Key elements of network design include the following:

a. Strategic Planning

In theory, network design activities start with a strategic plan that incorporates both telecommunications and information systems requirements. In practice, this is seldom the case.

An increasing number of organizations have developed strategic telecommunications plans, but the plans are seldom comprehensive. Telecommunications plans are frequently narrow in focus, oriented to the application of current technology (T1, Fiber, Matrix Switches, etc.), and not directly based on a current information systems plan.

Users indicate that there has been only limited effort directed to ensuring the integration of telecom and IS plans. Telecommunications requirements have traditionally been an afterthought in IS planning and not considered in depth until plans become implemented.

In addition, few telecommunications plans are followed. To date, the nature of telecommunications has necessitated focus on daily activities and crisis management rather than comprehensive planning.

However, this is beginning to change. As telecommunications are accepted as a strategic asset, increased emphasis will be placed on ensuring that the transport mechanisms are in place to meet future needs.

b. Network Design

As shown in Exhibit III-13, users indicate that design activities are the major area of growth in network management. Users indicate that large networks are growing at a rate of about 25% or more annually.

There are several reasons for the increased emphasis on design activities.

- Users are placing increased emphasis on the application of new technology that can provide improvements in cost effectiveness. The ability to use wideband circuits' multifunctionality can offer significant economic opportunities.

- There is an increasing need to integrate LANs into the corporate network. Developed as standalone islands, LANs are becoming a corporate asset and need to be managed in the same manner as other assets.

- Users are devoting an increased amount of time to planning for the use of public services that will enhance the value of their corporate networks. Services such as EDI and electronic mail are receiving increased attention.

- In addition to the development activities, there is a continuing need for assessing least-cost routing alternatives for leased circuits. With the increases in competition in IXC services, additional emphasis is being placed by a number of organizations on assessing alternative services and design.

c. Optimization

As networks grow and improved technologies and equipment become available, opportunities arise to improve the performance of the network. Most users interviewed have a continuing process of network optimization planning.

EXHIBIT III-13

NETWORK DESIGN PROBLEMS

- Having accessibility to vendors
- Dealing with vendors. Inexperienced people on vendor's staff
- Main problem seems to be who pays for the design (budget problems)
- By the time the data are collected and analyzed, the data are old
- Very dynamic operations. Presently don't have a method of projections
- Data networks offer most problems in connectivity of the different devices on the system
- Dealing with the telephone industry
- Mainly standards, understanding some of the new technology
- Not knowing what load to expect in the near future
- People
- What we are doing in the future
- How to keep it all up and running at times. How to have it all tie in together. Who we should use as a vendor
- Money
- Attempting to use advanced technology. There is not the level of expertise in the organization to make the installation. In new technology many things are not written, a lot is self-taught, and you learn by doing
- Accurate input data—and matching that with the pace which the company is moving (merger, acquistion, etc.)

The frequent changes of prices and structure of existing services, and the introduction of new products and services, require a similarly frequent examination of the network to optimize costs and service performance.

d. Disaster Plan

Few organizations have an actual disaster plan. Typically they have some limited plans for management of component failure situations, but nothing that would address a major failure, particularly the failure of their communications center or that of the serving central office.

To date, particularly for major users of leased circuits, there have been few alternatives available to meet disaster recovery needs.

- For the largest users, alternate local-access routes could reduce the risk of a central office outage, and multiple routings for long-haul circuits could provide backup for major circuit paths, but few organizations could afford the costs associated with totally redundant operating sites and networks.

- For the medium-size user, there have been few alternatives available to provide disaster backup. The costs of redundant networks were too high and services provided by the computer-oriented disaster recovery centers were not able to adequately meet telecommunications needs.

As ISDN and software-defined networks become more widely implemented, the opportunities to provide disaster recovery alternatives will grow; however, recovery will remain a problem for at least the next several years.

e. Network Design Tools

There is a wide range of network design tools available from an increasingly wide range of vendors. In all cases, the starting point is the input of traffic data. The tools range from simple models that address a single line and can be operated on a personal computer, to large models that address an entire network and are run on a large mainframe.

In all cases the starting point is the input of traffic data. Usually the tool applies carrier tariffs and develops costs for various network configurations and presents an optimized solution.

Another type of tool, usually separate from the costing models, is a performance simulator. This tool, also driven by the input of traffic data, establishes the likely performance for various configurations and levels of traffic. Such a tool is particularly useful in establishing the impact of alternate routing strategies.

Many telecommunications consultants are available to address these network design issues for users. Although this is a sizeable business, most users contend that they use consultants sparingly or not at all, as shown in Exhibit III-14. Their comments on the use of consultants is shown in Exhibit III-15.

EXHIBIT III-14

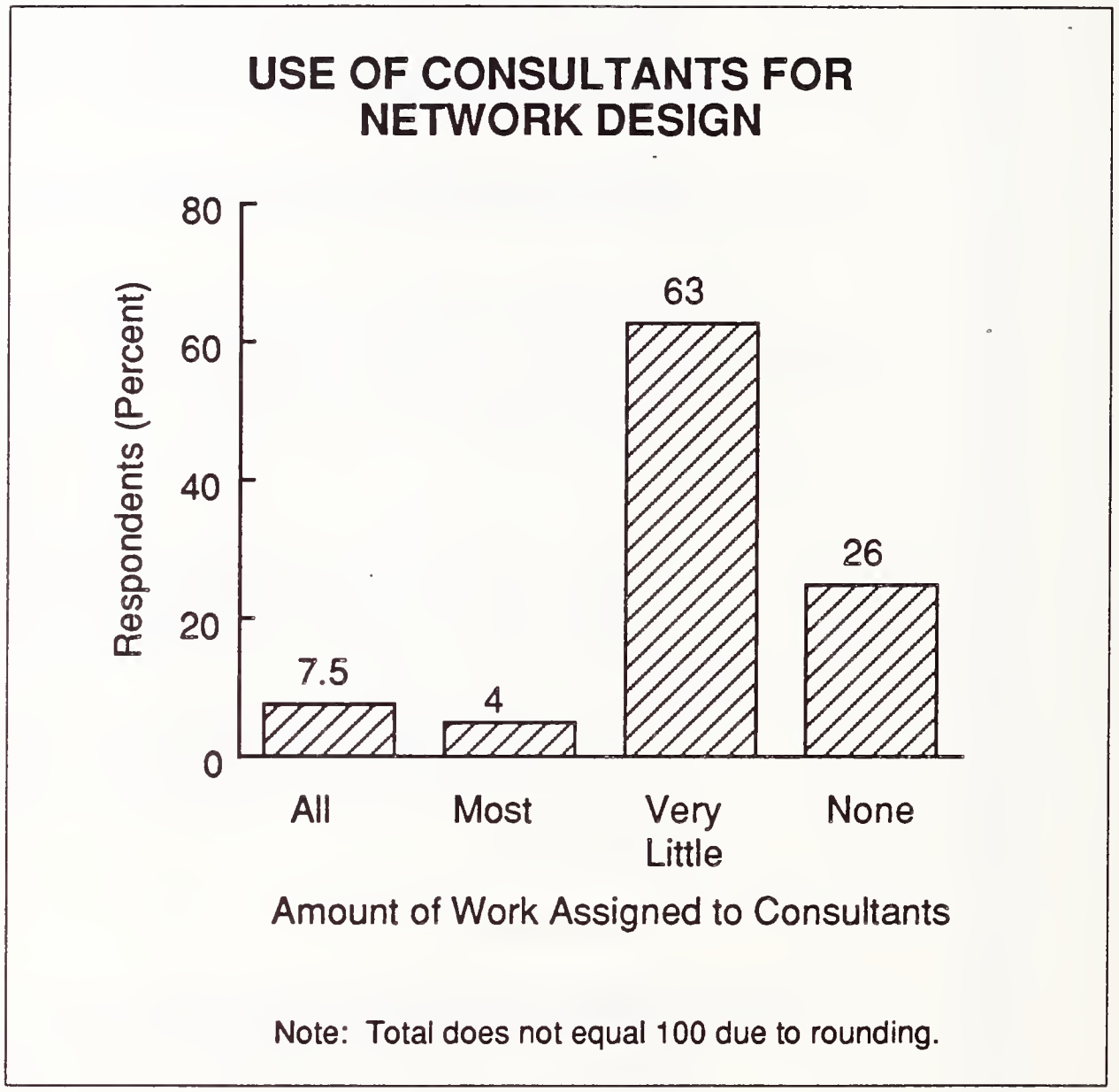


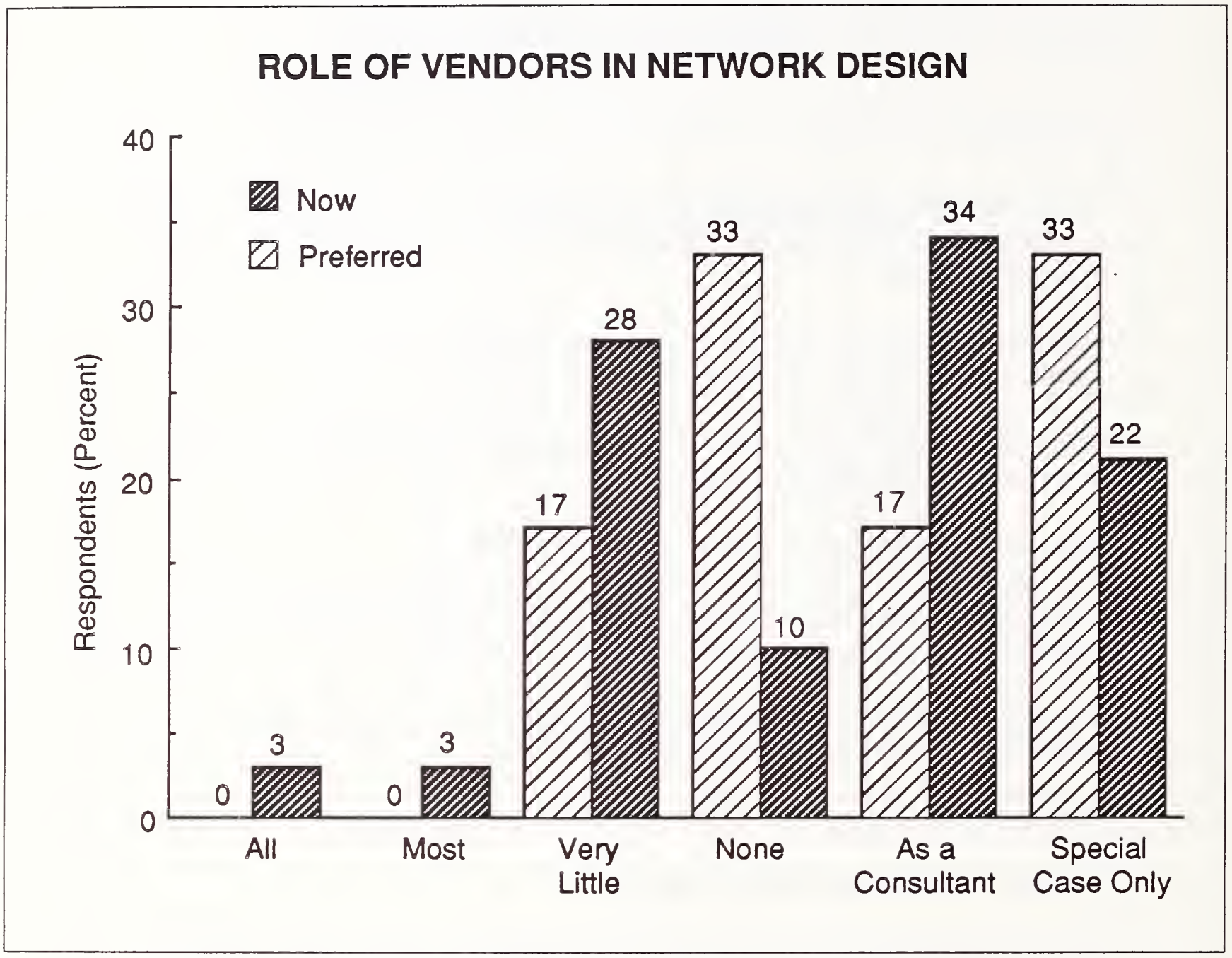
EXHIBIT III-15

USE OF CONSULTANTS

- It's easier and cheaper to go this route. Currently, we're satisfied
- Up to now we have used vendor to design net for us. Changing to doing it ourselves with consultants as much as possible. We will still rely on AT&T to a great extent
- We use consultants in areas of new technology when our people are not familiar with the subject and to support our staff
- We use consultants very little. They are called in sometimes to audit work in some areas of new technology
- We use both external and internal consultants 50/50
- We have in-house consultants (state employees) who help the various agencies do design work when required
- We use consultants only when we are forced to because of lack of knowledge in new technology areas
- Our corporate philosophy is that we do our work in-house
- We do everything we can do internally
- We buy as much as we can that's standard and customize as necessary
- Of all the outside work done, this represents the largest proportion

Vendors also provide network design assistance to their customers or potential customers. Users tend to be equally leery of using vendors for this task, although the assistance is "free." Obviously the vendors are offering this assistance with a biased viewpoint and expecting to gain customer advantages through the provision of assistance. Users' existing and preferred use of vendors for the network design task is shown in Exhibit III-16.

EXHIBIT III-16



2. Configuration Management

Configuration management is composed of two major elements that can frequently come into conflict. Both "static" and "dynamic" configuration management are important.

- *Static Configuration* - A static configuration is a picture of a network as it exists at a given time. Used frequently as planning tools, static configurations are frequently out of date shortly after they are produced.

- *Dynamic Configuration* - A dynamic configuration is the actual configuration at any given time. It reflects changes that have been made to accommodate line and equipment outages and plans for pending changes in the network.

Maintaining the two types of configuration requires a number of activities.

a. Network Inventory

A starting point for establishing or modifying a network configuration is a knowledge of the equipment and other components that make up that network. This knowledge includes what these devices are, where they are, and what their performance parameters are. Most new network management systems today include extensive capabilities to handle inventory data.

Network inventory is an extremely important tool for problem management. Network inventory includes information on the who, what, where, and why questions that need to be answered in the event of a problem. Typical information required in a network inventory is shown in Exhibit III-17.

EXHIBIT III-17

NETWORK INVENTORY DATA

- Equipment
  - Model
  - Manufacturer
  - Maintenance Vendor
  - Service History
  - Installation Date
- Connection
  - Address
  - Path
  - Alternate Path
  - Circuit Number(s)
- Operation
  - User Identity
  - Application
- Administration
  - Physical Address
  - Billing Address
  - Directory Listing

b. Alternate Routing

In the event of a failure or an overload, traffic needs to be rerouted to another path. This rerouting creates two major problems, both related to the network design function.

The first is the creation of an alternate path. For small to medium-size organizations, this path is often a dial backup route. With large organizations, alternate routing is a rerouted channel on a multichannel network such as a T-1-based network.

The second problem is the design of the alternate path in such a way that the additional traffic coming from a failed route will not overload the alternate route. To ensure that the alternate route will handle the traffic volume, statistics about circuit volume are necessary.

An additional consideration related to alternate routing is the criticality of the data on the alternate circuit. To ensure that the effect of the failure is minimized, organizations need to have policies that permit prioritization of service during the outage period.

c. Configuration Management Tools

The tools available for configuration management fall into two categories:

The first is the set of tools that allows the network manager to maintain the information required to manage the network configuration. These tools are usually a part of the problem management systems, which will be discussed in a later section.

The second type of tool does the actual reconfiguration of the network. Frequently, these tools involve some sort of switch, most commonly on the customer's premises but increasingly becoming accessible on carriers' premises.

d. Matrix Switches

These are network reconfiguration components used at the data processing centers or other major nodes in a data communications network. They are circuit switches that can interconnect various components of the network. Common uses for matrix switches are the rerouting of data lines to spare front-end processors or to test equipment.

e. T-1 Multiplexers

The availability of new generations of T-1 multiplexers capable of rerouting traffic among interconnected paths has created a new form of network reconfiguration capability.

The most common configuration is a triangular network in which trunk lines can be routed onto another path in the event of a failure.

f. Customer-Controlled Reconfiguration

This is another relatively new capability available to users of AT&T and other carriers. It is also based on a form of T-1 multiplexer, usually called a Digital Cross-Connect System or, in AT&T terminology, a DACS. It allows customers the ability to directly control the DACS equipment at the telco premises. This allows the customer to reroute lines between carrier locations.

3. Problem Management

Problem management is the most common perception of network management, but it is only one of many tasks that make up network management.

As was shown in Exhibit III-11, problem management is the largest part of the cost of network management today, but users do not expect the cost to rise significantly in the future. This expectation is largely due to increased automation of the network equipment as well as the increased reliability of digital circuits and devices.

However, even with the increases in automated processes, problem management is still a highly manual operation using highly skilled individuals. This situation is exemplified by the users' comments in Exhibit III-18.

a. Monitoring

Monitoring is the continuous or frequent measurement of the status of network components. Since most network operations are performed without the active participation of network management personnel, network monitoring can and has become a highly automated function. In earlier times such monitoring would have been performed by telephone operators or by terminal operators.

EXHIBIT III-18

PROBLEM MANAGEMENT NEEDS

- Finding the right people who have the expertise to correctly get the job done is essential
- Sometimes working with vendors is frustrating. Our own people are no problem
- Network control—In the past, has worked exclusively with data problems, since voice is integrated. The voice side is very poorly managed. Data will always carry the primary spot in the way of things
- The current system is much more labor-intensive than we would like; it's not automated enough. We're fooling with artificial intelligence to see if this will help. We get a lot of raw data but getting it to a useful level is the main problem
- We're always upgrading almost every part of the center
- Not many problems. We do a pretty good job
- Problems aren't a reality here—we are small and solve what we need to —each person can handle a problem
- We'd like a tool to consolidate for single-point monitoring on a network
- We need better tools. We have various scopes and line monitors, but none is sufficient
- We need more people to help us
- Some kind of simple system that is not cumbersome to make entries but is sophisticated enough to be comprehensive is a good idea
- We have two major networks. Their management is not tied together
- We need more dial backup equipment

The areas that can be usefully monitored can be grouped into a number of major categories. These are shown as the Measurement Sources in Exhibit III-19. Each of these sources of monitoring information can present a somewhat different picture of the health of the network.

EXHIBIT III-19

TELECOMMUNICATIONS MEASUREMENTS

		Sensors				Test Access		
Sources	Measurements	Self	LIU	Tester	Host/ SW	Patch	Bridge	Loopback
Lines	Level, noise other impairs		x	x		x	x	x
Interfaces	Lead status		x	x		x	x	
DCE	Component status, config. status, protocol	x	x					
DTE	Status, protocol	x	x		x			
Traffic	Volume, delays, errors, protocol		x	x	x		x	
Test Patterns	Errors, delays		x	x	x	x		x

- *Line Quality* - The monitoring of lines is itself a two-stage process, the first being a measure of the level of degradation of the line and the second being the outright failure of the line. Degradations come in many forms and their impact on the network and the manner of their resolution varies with the form. For example, in voice networks, more noise can be tolerated than in data networks.

Lines can be monitored by various types of Line Interface Units (LIUs), such as modems, digital service units, and bus interface units. They can also be monitored by a tester but this is usually for only a specified period of time.

- *Equipment Performance* - The monitoring of equipment is even more complex than the monitoring of lines, primarily because of the wide range of equipment attached to networks.

  An increasing number of devices are becoming self-monitoring with built-in intelligence. They can also be monitored by the attached LIUs.

- *Traffic Volume* - Many network problems are caused by the growth of traffic to the point of network saturation or by peak-volume traffic. Monitoring of the volume and the routes of traffic is a key element not only in identifying potential future problems but also in presenting allowable courses of problem solutions.

- *Test Access* - Since most equipment being monitored is located remotely from the problem management location, there is a sometimes-difficult requirement to provide test access to the device being monitored and to return the monitor information to the center.

  Ideally the test access would be a bridge that is nondisruptive to ongoing traffic.

  Ideally the resulting information would be returned without occupying significant network capacity. The three basic forms of transmission of this information are shown in Exhibit III-20.

EXHIBIT III-20

TRANSMISSION OF REMOTE MEASUREMENT DATA

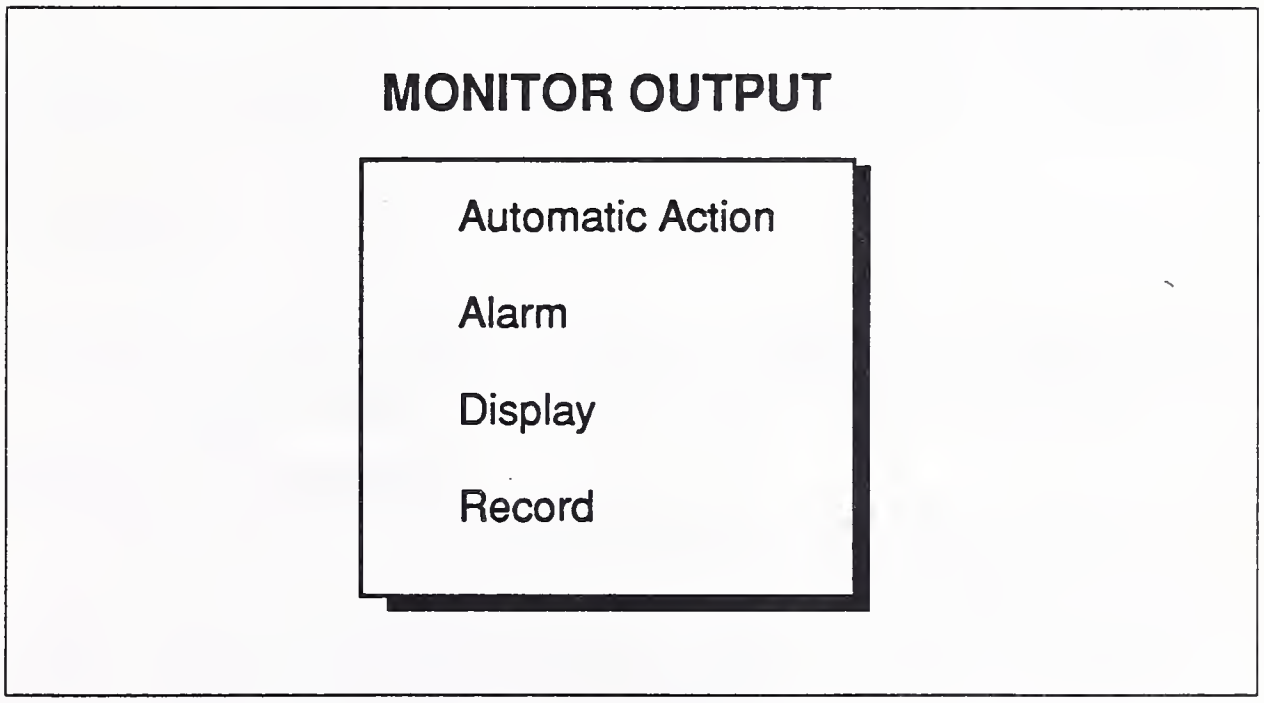
- In-Band Signaling
- Secondary Channel
- Separate Circuit

The increasing intelligence of network equipment is approaching both of those ideals but the cost is nontrivial. The most common limitation is the continuing presence of earlier-generation equipment in the network.

- *Alarms and Thresholds* - The continuous monitoring of a network is a two-edged sword. Although it can speed up the response time to network problems and also eliminate a considerable amount of drudgery, it can, if improperly set up, also generate a huge number of unnecessary alarms.

The output of the monitoring system can go in four distinct directions, as shown in Exhibit III-21.

EXHIBIT III-21



Automatic action is generally not acceptable to network managers because they need to know the basic status of the network. Often automatic actions are taken and the network manager does not notice the change until another conflicting action is required.

Alarms are also a two-edged sword. Too few alarms defeat the purpose and too many alarms create an unmanageable situation. Proper thresholds of alarms must be planned. These are frequently required to be changed during the course of a day as the traffic volume and the network configuration changes.

Like alarms, displays are extremely useful, but can also be overwhelming.

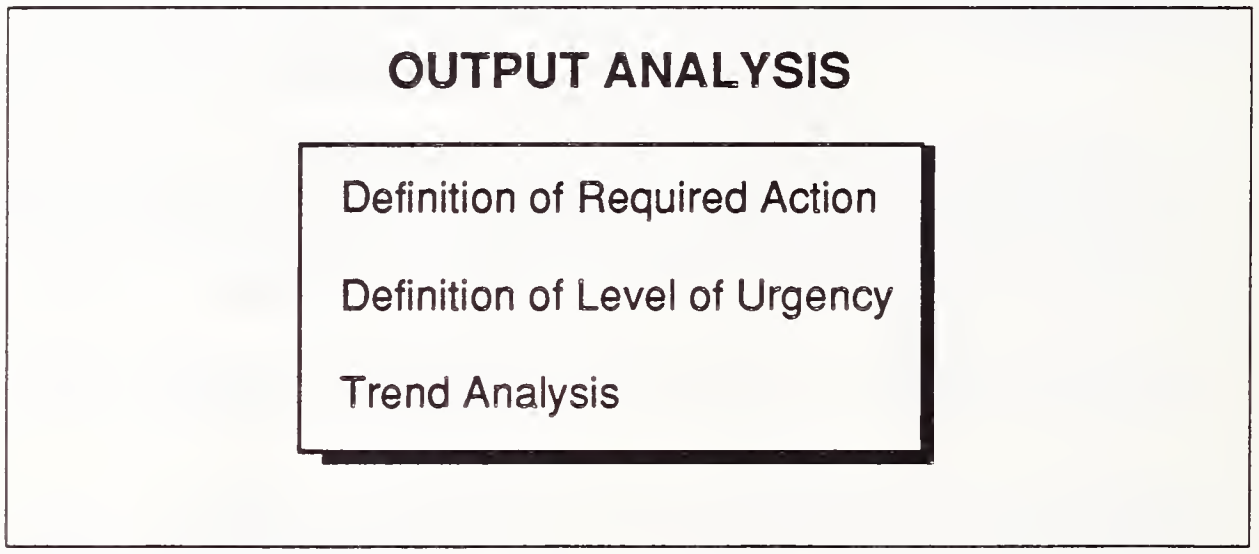
A record of the information monitored is a valuable tool for later trend analysis. This analysis then presupposes the existence of a set of data reduction and analysis tools.

b. Diagnosing

In the event of a degradation or failure, the problem then becomes one of establishing the cause. In many cases the problem is a transient one that requires a reconstruction of the environment.

The starting point for the diagnosing task is the information obtained from the monitoring system. The three basic diagnostic tasks of analyzing the monitor output are shown in Exhibit III-22.

EXHIBIT III-22



In most cases the solution of choice is the simple technique of replacing components until the problem disappears. More-sophisticated diagnostic routines are necessary if the problem is elsewhere, especially if a number of possible vendors might be involved.

c. Bypassing

In some cases the problem can be corrected immediately. In most cases the problem cannot be found immediately, and the failed component or link must be bypassed in order to maintain service.

Obviously some applications are much more sensitive to downtime than others. For example, in many voice applications trunk circuits are grouped, and the loss of one circuit is hardly noticed. In dedicated circuit data applications, the loss of the circuit may put many critical stations out of service until restored.

It is at this bypassing step that the network inventory information becomes critical.

- *Alternate Routing* - The most common form of bypassing of a failure is alternate routing. This routing may be in the form a a dial backup line or it may be another channel on a different circuit path.

- *Automatic versus Manual* - A major user concern in relegating control to automatic equipment is that the user may not be told that the equipment is now operating in a fallback mode and therefore his margins for further error are not what he believes them to be. The example usually given is the failure of trunk lines in a trunk bundle, the existence of which frequently becomes known only when the service degrades in peak hours.

There are, however, numerous situations where some automated assistance is highly welcomed by network managers. For example, when a multidrop line goes down and the bypass strategy is to convert to dial backup, multiple dialed connections must be established. An automated dialing system would speed the bypass process and would save considerable network management time.

d. Restoral

Bypassing is usually a temporary solution. Ultimately, the failed circuit or other component must be returned to service. This means repair or replacement.

- *Tracking* - The tracking of trouble tickets, that is defining who is supposed to do what and when, has become much more complicated as result of multivendor networks and the rapid growth of network sizes. The tracking or management of these outages is essentially a production control task.

e. Problem Management Methods

Almost every vendor of network equipment or services has some form of problem management method. In most cases, it involves some combination of hardware software and service, the actual mix depending on the vendor's primary area of business.

f. Hardware Systems

Problem management systems based on hardware fall into three categories, based primarily on the business of the vendor supplying the system.

- *Modem Based* - Most of the vendors of modems build a network management system to operate with their equipment. In most cases, the NMS operates with intelligence built into the modems and the communication between the modems, and the central monitoring system is carried over a secondary channel derived on the modem links.

- *T-1 Based* - NMS capabilities are now being provided extensively by vendors of T-1 multiplexers. These are primarily oriented toward reconfiguration of trunks links between T-1 nodes.

- *Packet Based* - The vendors of packet switchers provide NMS capabilities, which are functionally very similar to those of the T-1 MUX vendors in their orientation toward reconfiguration rather than detailed testing of lines.

g. Software Systems

Most mainframe computer vendors, as well as many of the software firms that develop communications software for these computers, have also developed network monitoring systems to operate on these mainframes. The most popular of these systems are Netview from IBM and NetMaster from CinComm.

h. Service Systems

The third form of problem management systems is the functional services being provided by the telecommunications service vendors. In some cases these are specific and somewhat unrelated functional capabilities, such as the Customer Test Service for DDS users or the Customer Network Control Center for EPSCS customers. In an increasing number of cases, these unrelated capabilities are being drawn together in a package for use by customers. The AT&T UNMA architecture is such a package.

An increasing number of vendors are offering network management support to customers in the form of vendor personnel located at the user's site and operating as a member of the customer's own staff.

4. Capacity Management—Traffic Data

As networks grow in both size and numbers of applications supported the need also grows to manage the available capacity. The task is two-fold; management of today's information and planning for tomorrow's information.

The major problem here is obtaining forecast data. Lacking such forecasts, most of the effort is on analyzing traffic trends and traffic data.

- *Voice* - Voice traffic data is relatively easy to obtain, although massive in volume. These are measured in SMDR equipment, usually at a customer premises PBX. This traffic data is used not only for planning but also for charging back to the users.

- *Data* - Data traffic is not usually measured as such. Total number of messages or transactions are measured but the primary measure of traffic capacity is response time.

5. Network Administration

a. User Billing Is Like Major Utility

The process of billing end users for use of the network creates essentially the same billing problem that the telcos themselves have with their residential customers.

b. Allowable Equipment Catalog

One of the problems being faced increasingly by telecom managers is the proliferation of equipment purchased by end users and connected to the network without prior advice or consent. A practice being implemented by many network managers is to publish a catalog of equipment that the telecommunications operation can and is willing to support.

c. Directory

A major activity in all large establishments is the maintenance of a listing of user stations. Two of the coming changes resulting from technology are on-line directories and automatic station identification.

d. Order Handling

Again, as in billing, the process of managing the orders for all of the new and moved stations and other logistic functions is very similar to that of the telephone companies themselves.

6. Management Reporting

a. Budgeting

Budgeting for telecommunications has been a difficult task over the last few years. Expected price increases from carriers have been grossly underestimated by most users. The mix of costs for various components of the network, such as local versus long-distance and switched versus private lines has created major planning problems for most users, as well as credibility problems in relations with upper management.

b. Expense Reporting

The other end of budgeting is the reporting of expenses. Here most of the users are billing the high-cost items, particularly voice telephone charges, back to the user departments. However, there is little to suggest that all costs are being charged.

D

User Issues

1. Products and Services

a. In-House Capability

A key determinant of what users can do in managing their networks, and also in what vendor capabilities they are able to utilize, is their in-house capability. Generally speaking, the largest users tend to be the best equipped, primarily in terms of having specialized and trained people available to work on network management tasks.

- *Staff Levels* - Few organizations, even the largest, are truly adequately staffed to be able to do network management. There are a number of reasons for this situation. One is that until recently telecommunications was not a major business factor and therefore did not get much top management attention or budget. Secondly (and also until recently), the telcos, that is AT&T, took care of most of the network management tasks for the users.

- *Training* - There are few formal training paths for the management of networks. Most of the existing network managers have developed their skills through on-the-job training. Vendors provide some level of training classes, but these classes are almost exclusively on their own equipment.

  There are no signs that user training will be expanded to any great degree in the future. A basic cause for the insufficient level of user training is the inadequate level of staffing of network management. Most network managers are too busy solving problems to be able to spend any time on training.

  This lack of training has immense implications for users and vendors of network management systems. Basically the lack says that network management products must be simplified or they will not be utilized.

- *Available Tools* - Most of the tools presently in use in the management of user networks are either accessories to other network equipment, such as modems or communications controllers, or test instruments, such as break-out boxes or line-content monitors. True network management systems that address more than a narrow range of network problems are rare. Sophisticated test equipment is frequently beyond the capability of user staffs.

b. Vendor Bias

Some level of network management assistance is available from vendors. This assistance is highly variable in terms of the vendors and in terms of

the amount of time following purchase that the assistance remains available. The support is typically more available prior to the sale and at initial installation.

More importantly, vendors recognize network management as one of the support functions that they can and do utilize to promote product sales. Network management frequently exists to the extent that it supports a product. This bias is particularly apparent in the network design support available from vendors of equipment or services.

- *Switched versus Private-Line Service* - For switched services, much of the network capability remains in the hands of the vendor. Network management tasks are also in the hands of the vendor. In the case of private line networks the user is much more on his own.

  The nature of switched services necessitates that network management remain in the hands of the vendor; users are traditionally reluctant to permit vendors to manage their private-line services.

  Although the basic philosophies of vendors and users are not expected to change, the growth of high-speed digital switched services can be expected to drive vendors to take a greater role in providing network management information.

- *CPE versus Network* - There are very few vendors in the telecommunications market able to provide both CPE and communications services, primarily because of regulation.

  To date, the BOCs have been largely unsuccessful in developing products to provide CPE services. In cases where specific products have been developed, regulations have precluded service provision. However, this is expected to change.

  Over the next several years, interpretation of the "Modified Judgement" will become more liberal, permitting BOCs to provide a wider range of CPE services through the nonregulated subsidiaries. Coupled with the growth of specialized tariffs for large users, the BOCs and IXCs can be expected to be a more competitive force in network management services.

- *Data versus Voice* - Data are generally believed to have more-stringent network performance requirements than voice. The key difference is related to the differences in error tolerance level between computers (data) and humans (voice). Humans can accept a much higher level of error than computers.

Today, most organizations are more dependent on voice communications than they are on data communications. However, this is expected to continue to change. The volume of voice traffic, relative to data, is dropping and many expect that data volume will exceed voice volume within the next few years.

As a singular consideration, the shift is not terribly important. However, as networks become more integrated, network managers will need to be able to identify methods to integrate the planning processes and resolve some of the inherent conflicts that exist between the way voice and data services are planned, measured, and managed.

c. Vendor Scope

Telecommunications vendors are generally limited in the scope of their offerings, particularly in the network management area. Their equipment or services are typically designed to interface with one or two selected products or services and provide limited, specific information.

- *Hardware Vendors* - Generally speaking, hardware vendors provide network management systems that support their own products. This has begun to change as vendors recognize the need for their customers to interface with a wide variety of other vendors' equipment. This trend is expected to continue.

- *Service Vendors* - Vendors of telecommunications services have extensive experience in network management through the necessity of managing their own networks. The impact is starting to become visible to users in two areas:

  - Vendors are beginning to provide mechanisms that allow customers visibility into some elements of their own network management systems. Customer-controlled reconfiguration was an early example.

  - Vendors are beginning to explore the business opportunity of providing network management capabilities to their customers, in addition to basic services. This latter situation has yet to be fully explored due to the existing regulatory environment, but regulations are not expected to be a limiting factor over time.

  - NetPartner, the NMS provided to by AT&T, is aimed at allowing users controlled access to the network management capabilities of the telcos.

- *Consultants* - Although consultants are useful in the front-end design of networks and in the establishment of network management systems and procedures, users believe that the nature of network management requires a continuing, hands-on presence not usually associated with consultants.

2. Analog versus Digital Network Management

Until recently, analog and digital could be closely correlated with voice and data respectively. This correlation is dissolving rapidly as both voice and data networks are converted to digital transmission and switching.

a. People

Network management people are typically oriented toward either voice or data networks. Although the network technologies are coming together, the basic configurations, operations, and performance requirements of these networks are still different in some very important respects.

A basic requirement of the typical switched voice network is grade of service or the probability of establishing a connection. The comparable requirement for the private-line data network is response time or the delay between the entry of an inquiry and its response.

Data networks are typically designed to serve a limited number of well-defined applications. Voice networks are designed to provide universal connectivity.

The resulting impact of these orientations has been to create specialization in the network management personnel working on these networks. The trend toward service integration will result in a need to integrate the expertise of voice and data analysts into a single planning function to be able to successfully plan for future services.

b. Transmission (T-1)

One technology that is tending to bring these network management orientations closer together is the rapidly growing use of wideband transmission channels, for example, T-1, which carry both voice and data.

In the early stages of private T-1 networks the multiplexers used were simply that—devices to enable the transmission facility to handle multiple channels. More-recent T-1 multiplexers are able to perform a number of network management tasks, most notably network reconfiguration in the event of a line or device failure.

c. Modem Vendor Products

A common misconception, even among network management personnel, is that there is a huge difference between a modem and a digital line interface unit or DSU/CSU. With the exception of the function that places the actual electrical signal on the circuit, these units are essentially the same. Most of the modem vendors have product lines of DSU/CSUs that complement their long-standing modem line.

From a network management point of view the modems and DSUs have been somewhat different, primarily because of the lack of a secondary-channel capability on DDS lines. This capability has recently been added to DDS, and digital lines are managed in the same basic way as are analog lines.

With the generally ready availability of interfaces, the transition from analog to digital is not expected to be as difficult as originally believed by many users.

d. DDS Limitations

As mentioned above, one of the early limitations with DDS was the lack of a secondary channel for network monitoring messages. This was changed two years ago; there is no longer a limitation.

A limitation that does remain on DDS is its lower level of geographic availability as compared with analog lines. However, availability is expected to continue to change until digital technology is the norm rather than the exception.

3. Multinetwork Interface

a. Network Interface Problems

Almost all users, even small users, operate in some form of multinetwork environment. The most common are hybrid technology networks switched/private line networks. Others include analog/digital, terrestrial/satellite, packet/circuit switched, and others. Few users experience problems as a result of the interconnection of such varied technology networks.

In most cases interconnection problems occur because of vendor interfaces and are at the level of people-to-people communication between vendors. Some examples of these problems can be seen in users' comments in Exhibit III-23.

Although basic connections between different types of circuit services do not represent major problems to most users, the ability to interconnect value-added services remains a problem. Most users indicate that network connectivity between value-added networks remains a problem.

b. CPE versus Carrier Services

Larger users have been converting many of their service capabilities to CPE over the last few years of uncertainty. More recently the carriers have been offering expanded service capabilities and winning back many of these users. A good example is the BOCs success with Centrex and

EXHIBIT III-23

NETWORK INTERCONNECTION PROBLEMS

- We leave connecting problems up to our vendors to solve
- Vendor coordination. Biggest problem today is at the local Bell Operating Company (BOC) level. Lack of communication
- Most of the time the problems are a lack of understanding of the systems that are being connected
- Greatest problems are the local operating companies. We find this is also a problem between BOCs, which then makes anything we do a problem in these areas—mainly a people problem
- Usually don't have problems in this area except if standards are lacking or nonexistent
- We generally do not have problems except when there are no clear cut standards; then there are problems in all areas
- Interfacing between vendors
- Security
- Physical connectivity no problem. Protocols are problem
- Problems in overall loss—especially in analog systems. This is a system design problem
- There are always problems and how you solve them depends on the situation. With the proper planning and detail work a great many problems are avoided
- The problems we find occur mostly on the vendor side
- We've encountered most of our problems with phones
- Security
- IBM software

AT&T's success with its tailored tariffs. Similar examples occur with other carriers such as MCI and US Sprint.

The impact of enhanced carrier services has been especially obvious in the small-user markets where users without the network management capabilities of the large companies have been dramatically increasing their use of carrier services.

4. Remote Maintenance

Maintenance of a telecommunications network inherently involves significant amounts of remote functions. Historically this has meant either significant training for personnel at remote locations or significant expense to send people there. With the growth of the size of networks and in the demand for such personnel, this size could have been a major barrier to network expansions.

The major change enabling these remote operations to remain manageable is the growth of intelligence in network equipment.

There are three key results from the increased intelligence that together, enable equipment to be successfully maintained remotely:

- An ability to communicate. Networks have always communicated through remote equipment. What has changed as a result of equipment intelligence is that networks can now communicate directly with the remote equipment.

- An ability to be controlled. The ability to change transmission speeds, port types, connection paths, etc. remotely has opened new opportunities for flexibility in the management of networks.

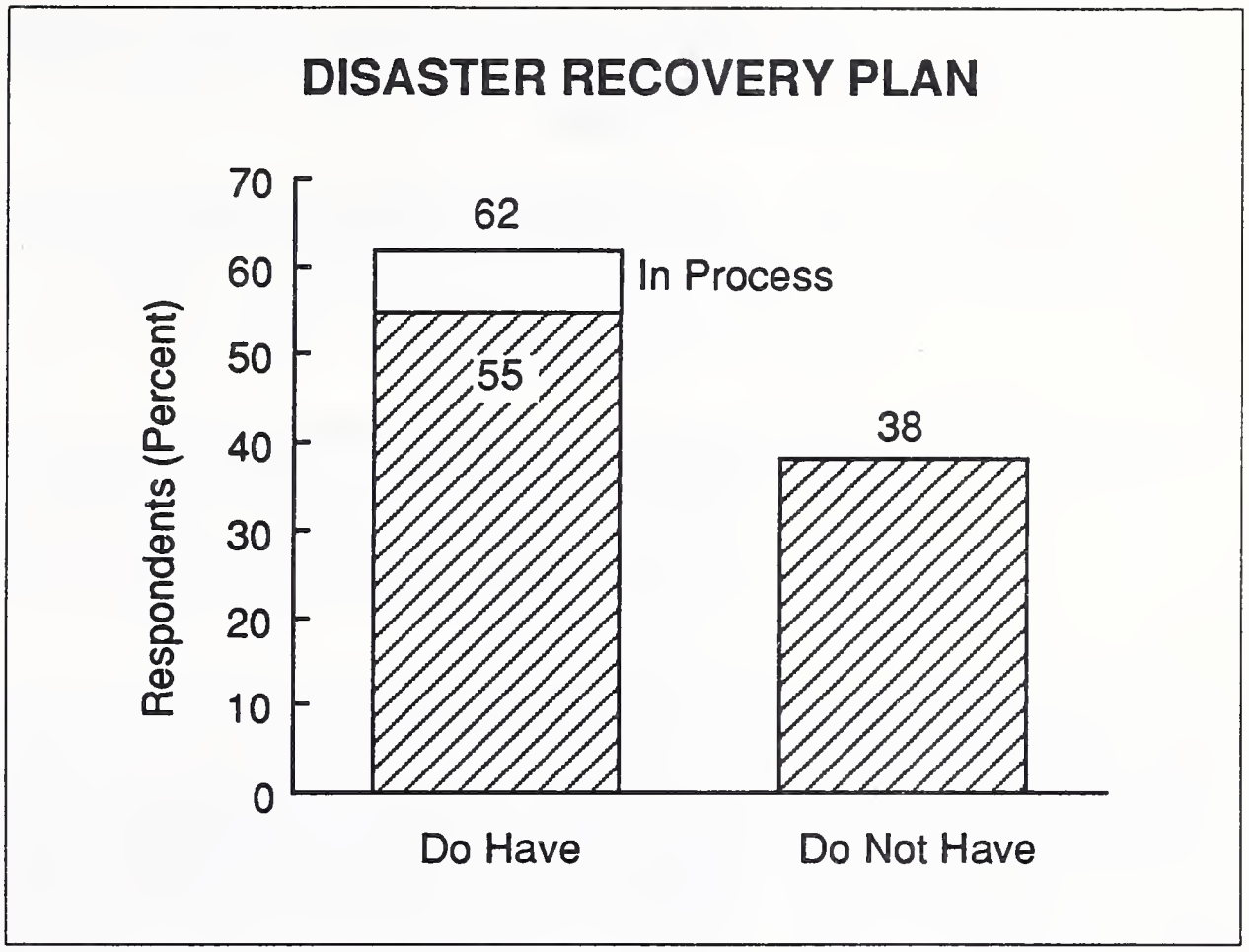
- Self-diagnosis. The ability to examine internal components and external interfaces and to collect the results or analysis makes remote devices not simply an operating component of the network but a management tool as well.

Although many of these capabilities are not new, the rapid advances of chip-based intelligence have expanded these capabilities dramatically.

5. Disaster Recovery

Although many users claim to have a disaster recovery plan, in most cases it is in fact a failure compensation plan consisting of an inventory of spare equipment or a set of dial backup modems (Exhibit III-24 provides details). Only a limited number of customers indicate that they have actual plans for a major disaster, particularly one involving their communications center.

EXHIBIT III-24



The recent Illinois Bell fire in the Hinsdale CO has sent many customers to the disaster service companies looking for solutions. So far, however, there have been few actual purchasers.

a. Customer Premises Equipment

Disaster plans for CPE, except for computer centers, usually involve a small amount of spare equipment for quantity installed devices, such as modems, and commitments from vendors for quick replacement of major items, such as PBXs.

b. Carrier Networks

The replacement of carrier networks is usually assumed by users to be the responsibility of the carrier itself. The use of switching T-1 multiplexers has become a major tool for large users to address this problem themselves.

c. Local Loops

One of the most vulnerable segments of a network is the loop between the user premises and the local central office. Some users have been able to negotiate agreements with the telco to get separate entrance facilities into their building. In fewer cases some have also been able to get the telco to provide diverse routing of loops. This usually takes the negotiating power available only to large organizations.

Many users have resorted to microwave links as an alternative.

d. Trunks

The recovery of major trunk routes is usually addressed by the use of T-1 multiplexers, either on the carrier premises or on the users premises.

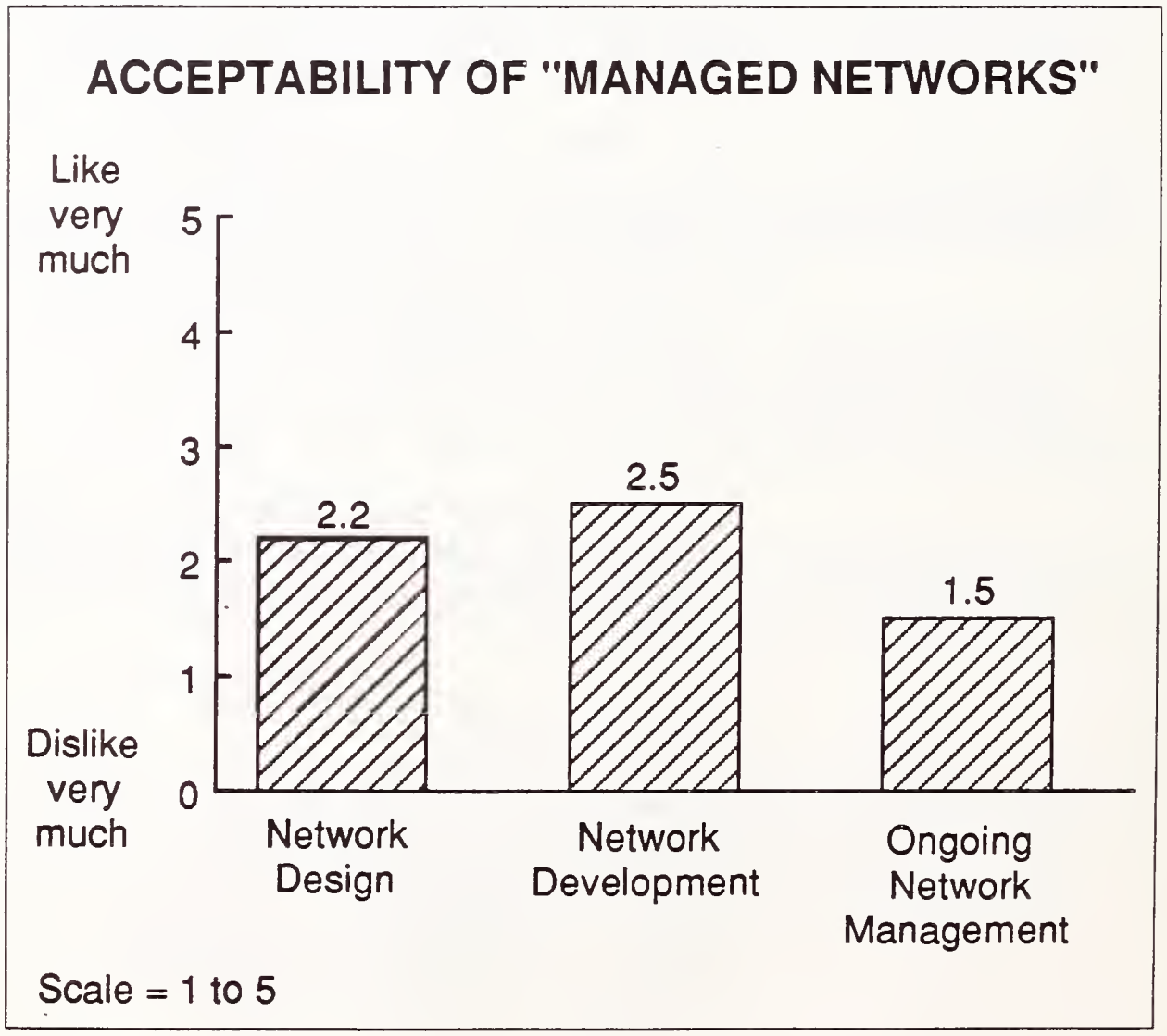
e. Central Offices

Historically, the failure of a telco central office was the least feared disaster. The Hinsdale fire has changed that view dramatically. The affected users that fared best in that situation were those that had alternative transmission capabilities, such as satellite systems, either in place or readily available.

6. Managed Networks

In the discussion of managed networks (networks that are facility managed by a third party), there is a distinct split in the views of users. The actual network managers are very much against such an alternative, as reflected in Exhibit III-25. However, senior MIS management, to whom network managers report, are increasingly looking to vendors such as AT&T, Paradyne, and others to provide such services.

EXHIBIT III-25



Although reluctance on the part of network managers will remain, INPUT believes that an increasing number of users will look to third parties to provide management services. There are two basic reasons:

- As networks become increasingly integrated and complex, many medium-size users will not have the ability to maintain sufficient expertise to successfully manage their networks. They will have to look to full-service providers to manage their services.

- The growth of value-added services will continue. As their use increases, the vendor will become the primary provider of management services.

7. Network and IS Management

In the vast majority of user organizations, the telecommunications operation reports to the MIS manager (or equivalent). Increasingly, many network management functions are being handled by applications on the information system computers. The most common of these are the data base functions of network inventory and station directories. T-1 network management systems are being connected to host software, such as Netview.

As network services become increasingly integrated with systems processing activities, responsibilities for network design and management will become integrated with systems operations.

8. Integrating LANs

Currently, few telecommunications organizations have responsibility for LANs or for their interconnection to the rest of the network. In most cases this function is handled by the functional department responsible for the LAN.

Within the next several years, as the interconnection of LAN networks grows and users want increased access to corporate systems, responsibility for LANs will increasingly be with the information services department.

E

Products and Requirements

1. User Requirements of Products and Vendors

Generally the users do not have a firm understanding of their specific needs for network management products and/or services. This is due to two basic reasons:

- The first is that users do not have a firm understanding of the products and services available or planned to be available.

  - Though vendors frequently indicate that they do not understand the needs of users, network management is sufficiently well established that vendors should be able to identify and convey strategic directions keyed to the needs of users.

  - In addition, in the case of network management products, vendors are in a better position to understand many of the changes in technology than are users.

- The second is that many users do not take the time to fully address their current and future needs. Occupied with the immediate needs of day-to-day management, most users rely on vendors to decide what products and services they need.

As a result, a common situation in many user organizations is that the decision to purchase network management equipment is made by senior people with less than adequate input from network managers. Though this produces a continuing large market for such equipment, the resulting lack of effective use of this equipment creates both internal friction and business problems for users and bad publicity for vendors of this equipment.

In fact users have a wide range of requirements for network management aids. A broad look at some of the needs defined by users is shown in Exhibit III-26. Many of these needs are the kind that can be addressed by increased intelligence in network management equipment and by increased interoperability of this equipment. More of these needs are of the kind that can only be addressed by more and better-trained network management personnel.

a. Usability

The largest problem facing network managers is the broad issue of usability. Users already have a wide variety of tools available with which to manage their networks, but in a high percentage of cases they are not able to use the tools effectively. There are three basic reasons for this lack of usability:

- The tools are frequently complex and difficult to understand.

- Users have not been adequately trained in the use of the available tools.

- The majority of the tools available address only a limited set of network problems.

A good example of all of these reasons is IBM's Netview product line and its predecessors—NCCF, NPDA, and others. There are over 3,000 installations of Netview at present. Users indicate that their level of

EXHIBIT III-26

GENERAL REQUIREMENTS

- Would like access to carrier test board. Have had lots of trouble with AT&T with wrong information
- ISDN-Technical capabilities are here, but applications are still not available to make the facility user friendly
- Like to see a package to manage local- and wide-area nets, as well as to simplify troubleshooting and to reduce the down time
- Very few new products (truly) since divestiture (the loss of Bell Labs). New products are really a rehash of what is already there
- Do not have enough tools that are universal for more than one or maybe two products.
- Network integration in data area is biggest problem
- People
- Better software for better simulation and modeling
- Better controls; better equipment for routing configuration instead of using AT&T
- Better reports (customized)
- Probably our weakness is in call monitoring—that is for our PBX system
- More people
- Artificial Intelligence
- On-line to our network

understanding of how Netview operates and the benefits it provides is very low.

The point is that network managers need, and need badly, significantly more training and experience to be able to use tools like Netview effectively.

- *Training Time* - Training time is an extremely scarce commodity in all user organizations. The average time spent on training is less than 2% of the total time of network management staffs.

  Most of the training time that is spent is on-the-job training.

  The formal training that is available to users is either very generic—intended for neophytes—or very specific training on one vendor's product. The lack of available training courses is a chicken and egg problem. There are not enough appropriate courses available because there are not enough potential customers to make such courses profitable. There are not enough customers because there are not enough companies that are prepared to release their network management people for the necessary time.

- *Understandability* - One of the key impacts of the lack of training is that many network management tools are installed but not used. This is particularly true of network management tools installed on mainframe computers, as mentioned above.

  A partial alternative to training is simplification. Though generally considered crude, "idiot lights" are used very effectively by many users. A typical implementation is the placement of all of the modems in a communication room in such a way that the network manager can see the front panels of all of them from his desk. Users report that the lights are frequently the most effective means of monitoring the status of a network.

  Though this technique is only practical for small- to medium-sized users, that is precisely where the problem is.

- *Experience* - Although training and understandability continue to be a major problem, the network managers do develop a very strong capability in "doing what has to be done." This involves a wide range of experience-developed procedures, such as who to call, who to trust, what to try, what usually works, and so on. Most of these procedures are kept in a loose-leaf notebook or in a network manager's head.

  This is a potential area for artificial intelligence techniques, and some vendors and users (large users) are considering such a path.

- *Scope* - Network management tools available today are extremely limited in the scope of network problems each is capable of addressing. Therefore, many different tools are required.

  This is true in spite of the recent and highly publicized efforts on the part of network management vendors to provide integrated network management systems. IBM's Netview/PC and AT&T's UNMA are examples of these efforts.

  The problem this creates for users is the large number of tools required greatly expands the magnitude of the training and understandability problems already discussed. It also expands the practical problem of physical space and, more important, the need to use multiple separate devices for the resolution of single problems.

  An example of a critical user need for an integrated tool is that of rerouting. In the event of a line failure, the network manager has tools available to reroute the line to another circuit. He also has tools to examine the performance impact of additional traffic on that circuit. What he would like to be able to do is perform a real-time, or at least quick, "what if" analysis of a proposed reroute, ideally from the same device.

b. Multivendor

Most network users are faced with a requirement to deal with multiple vendors. At a minimum, a user will generally need to deal with an equipment vendor and a carrier. The average user is dealing with about a dozen vendors and some large users are obtaining network products and services from over 100 vendors.

This creates two different network management problems. One is the simple, but massive, logistic task of knowing which vendor is responsible for each component of the network. The other is the more complex problem of knowing how each of these vendors' products works with the network.

Many network management system vendors are addressing the logistic problem with good quality data base systems. Few are addressing the interworking problem.

c. Programmability

Programmability is very much a large user issue. Only the large users are equipped or even interested in doing their own programming of network management operations. Most, if not all, of these are large data network users with sophisticated network software.

Smaller users do not need or want the responsibility of programming their own network equipment. Smaller users will generally obtain services from vendors that have the capability of dealing with software problems as part of their service.

2. Vendor Response to Meeting User Needs

Although network management equipment, software, and services are being sold at an increasing rate, the value of most of these installations in meeting the ultimate users' needs is somewhat questionable.

Key among the reasons is an unwillingness of management to provide sufficient resources for the proper training of network management personnel. A common management flaw is a willingness to spend money on equipment and a comparable unwillingness to spend money on people.

The end result is that the capability of network management tools will continue to outstrip the ability of their users and much of their capability will go unused.

Regardless of the cause of the problem, it will eventually impact the business of those vendors who do not provide a way around the problem. These ways may take many forms but are not likely to be simple.

a. Successful or Unsuccessful as Seen by User

As previously noted, there are, in fact two types of users that are important in the network management market. One of these is the actual network manager—he one directly responsible for use of the system or device. The second user is his manager, commonly the head of MIS department or equivalent.

These two users have distinctly different views of the task of network management. The network manager believes that he and his staff are doing an adequate job. He also believes that, by and large, the tools that they now have are adequate and that additional tools would be more trouble than they are worth.

The MIS manager views the performance of network management as barely adequate and not likely to be able to cope with the anticipated future environment. He also sees existing network management procedures as antiquated and labor-intensive, and therefore, in dire need of automation.

It is to the MIS manager that most of the more advanced network management systems are being sold.

From the point of view of the network manager, the ultimate definition of a successful offering comes in two flavors.

- The first is an offering that doesn't create any new problems.
- The second is an offering that allows him to demonstrate progress with his existing problems.

The network managers' comments on the proper use of vendor services, shown in Exhibit III-27, is a good illustration of his views.

b. Range of Capabilities

As noted earlier, most network management products address only a narrow range of network problems. Almost every vendor of network equipment has some form of network management system for his product line.

These systems, now being termed "element management systems", have been available for many years from modem vendors. They have recently become available from PBX and MUX vendors, and they are now becoming available from the carriers.

Element management systems allow the user to obtain monitoring and other status information from all of the elements within that system. They also allow some, frequently significant, measure of control of these elements.

However these element management systems do not talk to each other. They only talk to the elements of that particular vendor's product line. This is entirely understandable in that these systems were designed by vendors in order to enhance the salability of their own products.

The problem that this presents to users is well-understood by vendors. Now that vendors must concede that multivendor systems are here to stay, most vendors are working to make their systems compatible with as broad a range of other element management systems as possible.

- *Penetration Level* - The offerings showing the greatest level of penetration of user installations are those which are associated with the mainframe computer, most notably IBM's Netview and its predecessors. This is primarily attributable to the "purchased solution" mind-set of senior MIS management who are responsible for network management.
- *What Products Are Needed* - There are two general areas of product need identified in this study.

EXHIBIT III-27

USE OF VENDORS

- Mostly use them for line problems
- Provide recommendations
- Assist with technical and pricing aspects
- Usually on their own products with the exception of AT&T, which usually helps across the board
- We tend not to deal with vendors unless we have to
- After we design the network—vendors are asked if their communications services can handle the load without any trouble
- Rely heavily on them. We use four major vendors on data and on the telephone side
- We depend on their input in some ways
- Only when we have to pending our own competency
- The least amount possible
- To provide a conceptual design
- Currently use vendors to reaffirm what we have designed—an operation system, etc.
- We need them
- Set-up, assistance, training

- The first is an increasing level of vendor support, including, but not limited to, on-site personnel.

- The second is simpler products to manage—possibly self-diagnosing, but not necessarily self-correcting.

3. Vendor Support

Vendor support has always been needed on all types of products, but in telecommunications, with products inherently distributed over a wide geography, vendor support is absolutely essential.

This need becomes dramatically apparent with carrier services, where users are looking not only for good-quality services but also for the carriers to tell them how well these services are operating.

Many users are looking for on-site personnel to be able to handle some of the more technical tasks of managing their networks.

4. Simpler Products

Simpler products are needed because it is not likely that users will spend much more time on training. The products that will be used will be those products that require little training.

This conclusion conflicts with the current high rate of purchase of sophisticated network management systems. However, users are reaching a point where the resulting lack of use of equipment will backlash on vendors.

a. Services for Smaller Users

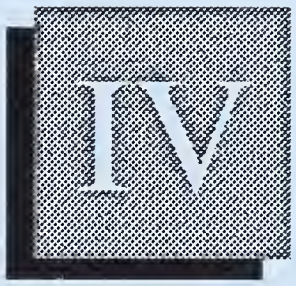
Smaller users in particular are looking for assistance in a world that has greatly outgrown their ability to manage. In the small user market, the expansion of telecommunications applications is being held back by the users' concern about potential network management problems. Larger users are readily absorbing the new capabilities and the rapid growth of their own networks.

b. Multivendor Systems

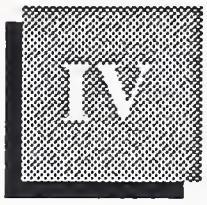
In the area of multivendor systems, there has been little real progress—especially among the users who are unable to do much programming of their own. There appears to be an attitude of resignation on the part of users.

This situation may be changing. To date, the change has been less in the nature of the products, but mostly in the attitude of vendors that have

recognized the multivendor environment is the norm and not the exception. This change in focus has begun to result in greater functionality in network management products. The trend will continue for some time.



User Projections



User Projections

A Product Needs and Requirements

Product needs and requirements are summarized in Exhibit IV-1. They revolve about the key areas of:

- *Ease of Use* - Training is scant, and the products are complex. It is incumbent upon vendors to help solve user problems in their use of network management tools.
- *Multivendor Situations* - No product stands by itself. At the very least, a communications line is connected to hardware. A large user might have a hundred or more vendors. Vendors should make it easy for their equipment and their communications services to fit into this multivendor environment (manuals, training, assistance, etc.).

Training is a problem in network management. The telecom network management staff is too busy to take the time for training. As a result, they do not know how to use many of their tools.

- The lack of training hurts users because the problems that the tools were meant to solve are not being solved.
- It also hurts vendors because non-use does not result in recommendations to other users or in repeat or add-on sales.

Potential solutions to the training problem include:

- Self-training materials, such as Computer Based Training (CBT) or interactive video disk, will allow the telecom staff to train at their own sites during intervals of free time.
- Built-in training guides, such as "help screens" or even embedded CBT, allow the users to obtain specific help when they need it.

EXHIBIT IV-1

PRODUCT NEEDS AND REQUIREMENTS

- Training
  - Self-Training Materials
  - Built-In Training Guides/Help
- Network Management Tools
  - Integrated Solutions over a Full Range of Problems
  - Multivendor
  - Easy to Use/Learn
- Disaster Recovery
  - Network Services
  - Bypass Central Office
- Services from Carriers
  - Supply Network Usage & Status Information
  - Multivendor Connect to Others
  - Backup for Failed Private Lines and Local Loops
- Support from Vendors of Equipment and Communications Services
  - Multivendor
  - Areas Where the Users Are Weak
  - Smaller Users Full Range of Services
  - Large Users as Needed
- Equipment
  - Simple to Learn and Use
  - Capable of Self-Test and Remote Test and Reconfiguration

However, training for a single problem does not give the student an overview of the entire process. To be effective, vendors must offer full-length and introductory courses about network management with both self-learning materials and conventional instructor-lead training.

Network management tools must be designed to fit the complex, real environment. Included are:

- Integrated solutions for a full range of problems. (For example, recommending reconfiguration actions to take when a fault is found. Perhaps the recommendations can be implemented automatically.)

- Tools that recognize the multivendor environment by allowing for a range of communications service and hardware vendors.

- Easy to use and learn tools. It is far better to have a tool that is used and perhaps has fewer functions than to have a tool with great functionality but which is not used because of complexity or lack of support.

Disaster recovery is mentioned by many, but good solid plans and implementation of these plans is far less prevalent.

- Network services that support disaster recovery are required. (For example, the ability to bypass failed private lines or a major network node.)

- Central Office failure is possible (witness Hindale, IL). It is also very possible for all the local loops to a major node to be cut at once. The local loop bypass solution probably involves satellite or microwave transmission.

Carriers can supply network management services. They should include:

- Network usage and status information used both for short-range corrective actions and for long-range changes in the design of the network.

- Recognition of the reality of multivendor environments by supplying information for the full network. It will be necessary to interface to other vendors to do this.

- Backup for failed private lines and local loops. Most likely (especially for local loop
backup) the backup will be for different communications vendors services.

Support is key for any product, especially a complex one, and for users in complex situations. At times the support is more important than the

product features. Support should consist of aid in the solution of problems and of training users to solve the problems themselves. Requirements include:

- Support multivendor environments. It is certainly difficult to support some other vendors products. But this is what is needed, and anyway third party maintenance vendors do it all of the time so it is possible.
- Support in areas where the users are weak. For example a user might not be familiar with VSATs or with data by radio.
- A full range of support services for the smaller user who does not have the depth of knowledge of a large user.
- Services only as needed for a large user. For example, the need might not be at headquarters but in a remote geographical region.

Equipment must be designed for the realities of a multivendor environment, for geographical separation, and for relatively untrained users. It must be:

- Simple to learn and use. This might be an extreme example, but few people have to take a course to learn how to use their refrigerator or stove.
- Capable of self-test and remote test to handle the geographical separation problem. Then it should be capable of remote reconfiguration to do something about a problem.

B

Projected Expenditures

Projected expenditures for network management staff time and for the related hardware and software products were forecasted for companies of over 500 employees, because in the great majority of cases, only these companies actually have major networks. These (large companies) are the ones that vendors target for sales of network management products and services.

The smaller companies obtain network management functions (if they are multilocation) by purchasing communications services directly from carriers and relying upon the carriers for network management functions and usage data.

The basic forecast information was obtained from the 35 user interviews performed for this report. Users were asked to relate the expenditures for network management staff time to the total telecommunications expenditures of their companies (including line charges, equipment charges, staff and maintenance). They were also asked to divide these expenditures into the following categories:

- Network design
- Problem management (not including repair charges or contracts)
- Configuration management
- Management reporting (expenses, bill back, usage, etc.)

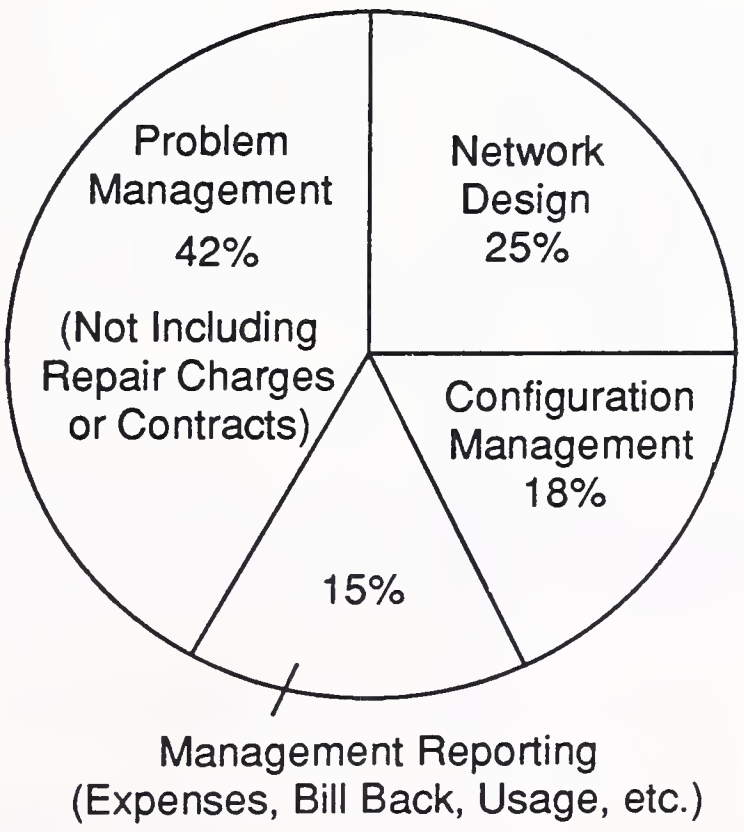
The answers respondents provided showed how much money the firms were spending on network management and for what applications they were spending.

The total staff expenditures for network management varied from 8% to 43% of all telecommunications expenditure. The average was reported to be 22.4%. This average relates well to the "rule of thumb" that 15% of all telecommunications expenditures are for staff.

Exhibit IV-2 shows how these expenditures are divided. The largest percentage (42%) is for problem management. Network design is 25%, (which the users think is a rapidly increasing expenditure).

EXHIBIT IV-2

STAFF TIME USED FOR NETWORK MANAGEMENT FUNCTIONS



Configuration management is 18% and management reporting is 15%.

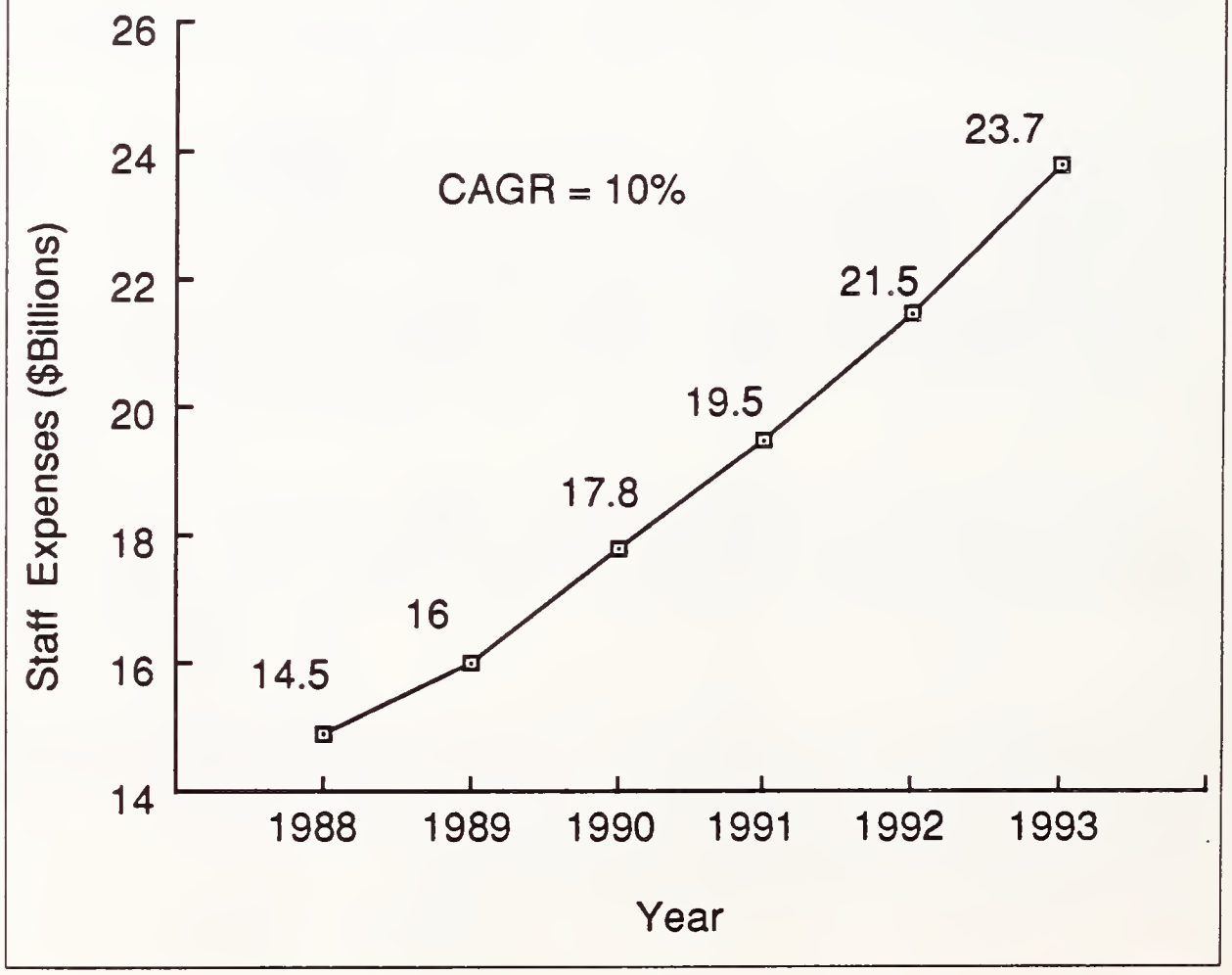
To convert from the percentage of telecommunications expenditures for staff time spent on network management to absolute dollar expenditures for staff, INPUT's forecasts of expenditures for line charges were used as a base and converted to absolute staff expenditures by using accepted ratios of staff expenditures to line charges.

This conversion provided a forecast for staff expenditures on network management for all companies in the U.S. However, the forecast needed was for large companies only. Previous INPUT research showed that 30% of all U.S. employees work in large companies (over 500 employees). Thus, the forecast for staff expenditures on network management in large companies was taken as 30% of the staff expenditures on network management for all companies in the U.S.

Exhibit IV-3 shows the expenditures for staff in large companies (U.S.) as $14.5 billion in 1988 rising to $23.7 billion in 1993 for a compound annual growth rate of 10%.

EXHIBIT IV-3

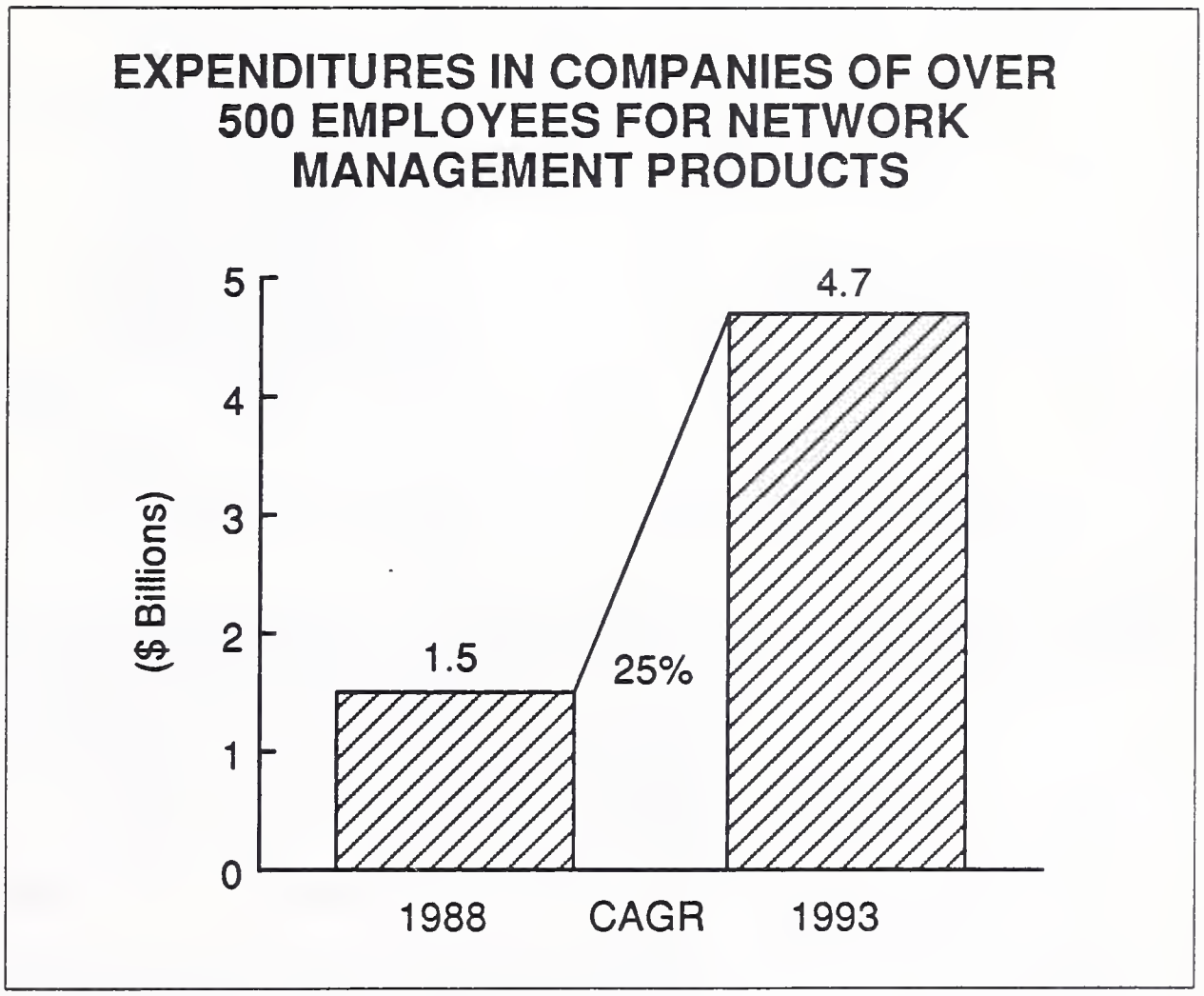
EXPENDITURES IN COMPANIES OF OVER 500 EMPLOYEES FOR NETWORK MANAGEMENT STAFF



To forecast expenditures for network management products sold into large U.S. companies, it was assumed that the amount of network management products obtained to "back up" a member of the telecommunications staff was 10% of staff expenditures in 1988 increasing at 2% per year to 20% of staff expenditures in 1993. This increase matches the general increase in products to assist professional telecommunications staff.

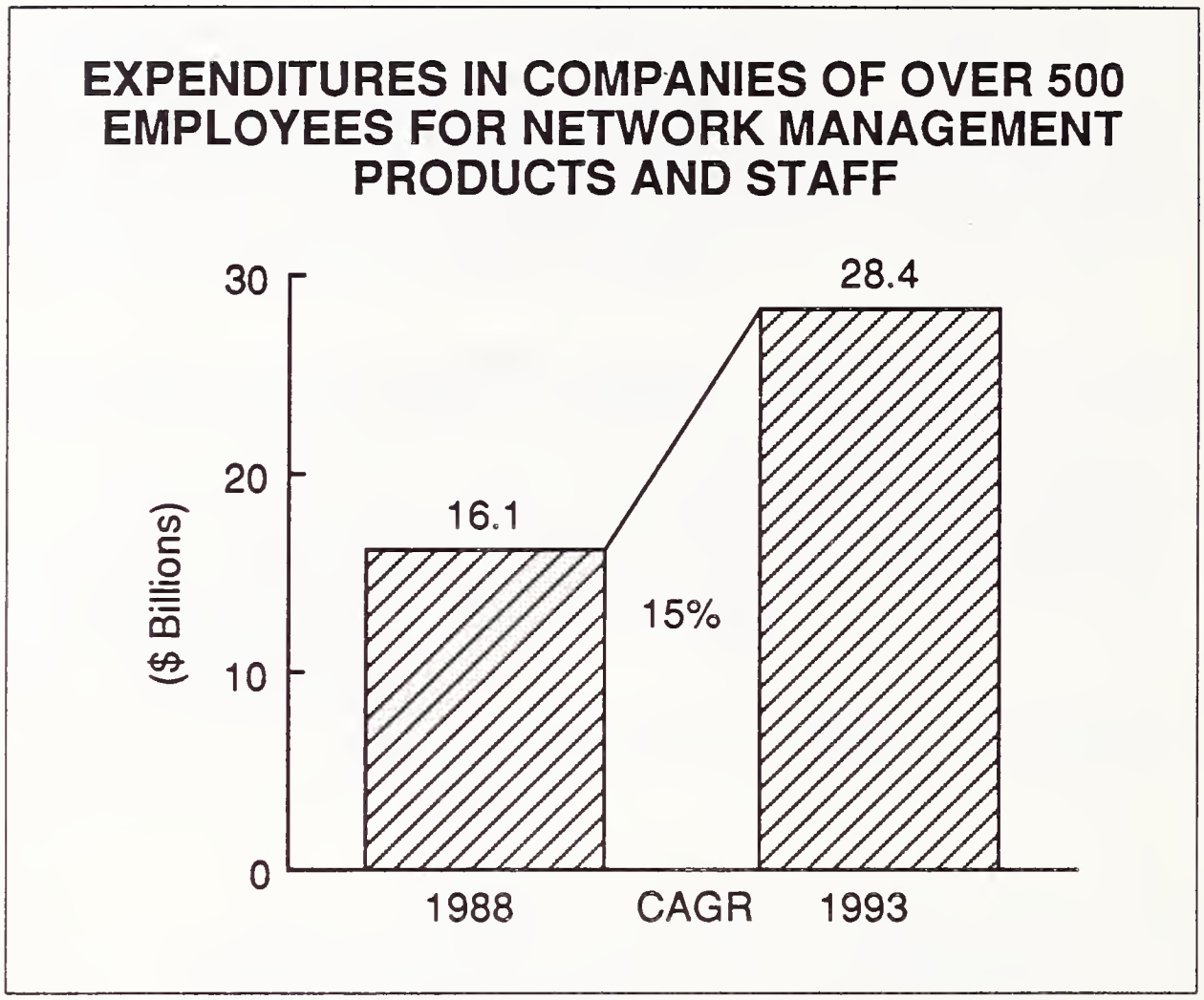
Exhibit IV-4 shows these expenditures as $1.5 billion in 1988 rising to $4.7 billion in 1993 for a compound annual growth rate of 25%

EXHIBIT IV-4



Total U.S. expenditures in large companies for network management staff and equipment are shown in Exhibit IV-5 as $16.1 billion in 1988, growing to $28.4 billion in 1993 for a compound annual growth rate of 15%.

EXHIBIT IV-5



C

Driving Forces

Driving forces in the area of network management (illustrated in Exhibit IV-6) are complex. They basically consist of "more": more offerings, more vendors, more new technology, and more applications for the networks. The exhibit shows the driving forces affecting users and vendors, by internal and external forces.

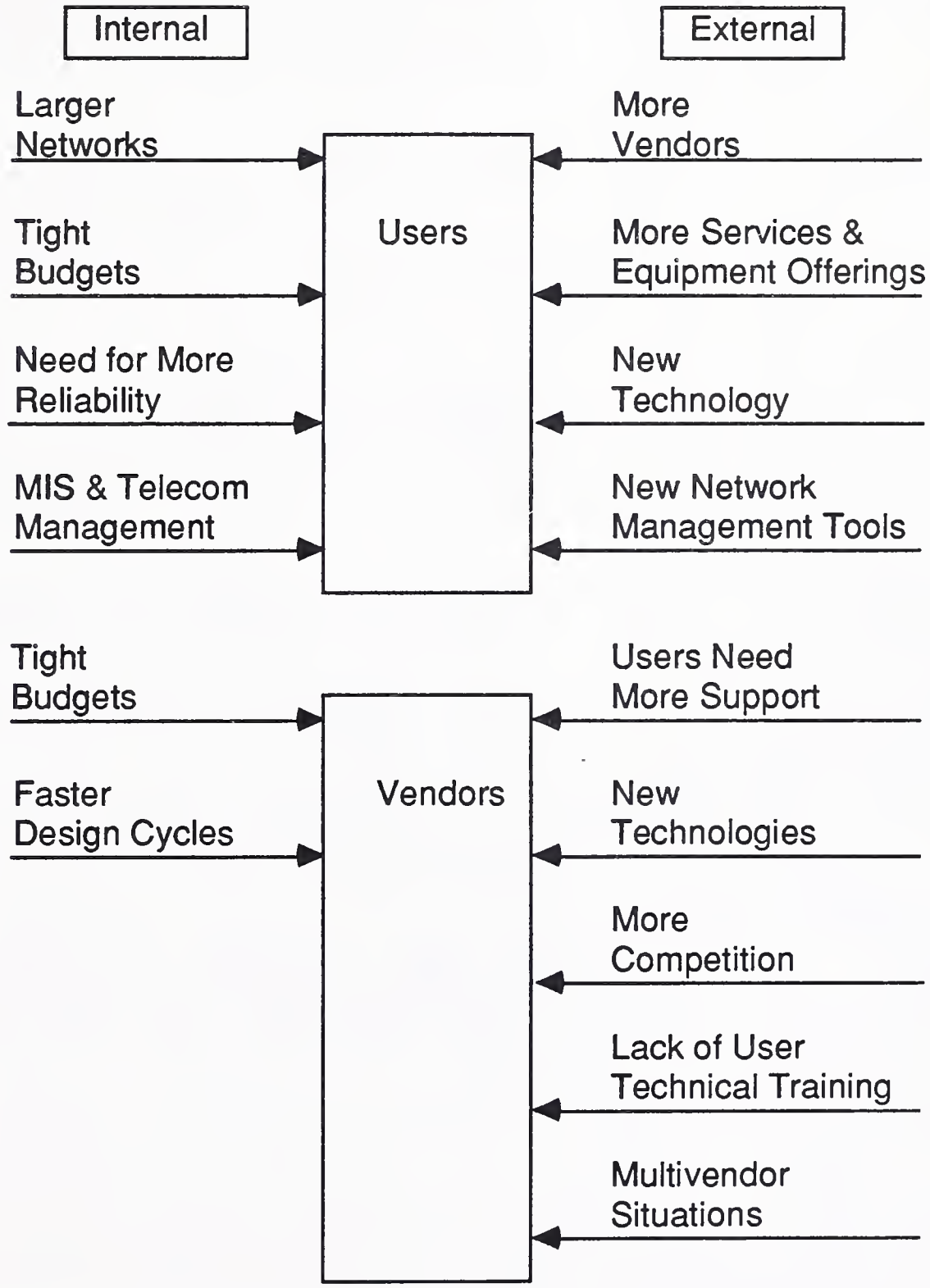
First driving forces for the users. The internal forces include:

- Larger and more complex networks, which are harder to design and manage because complexity increases faster than size.
- Tight budgets, which require more planning to optimize expenditures for the network and provide less staff and training for the job.
- The need for more reliability, which means that bypass and other redundancy type of network features are needed, while tight budgets (above) means they can not be afforded.
- MIS and telecom management relationships result in a complex management structure which requires more time and effort for decisions.

External forces upon the users add to the increased complexity.

EXHIBIT IV-6

DRIVING FORCES AFFECTING NETWORK MANAGEMENT PARTICIPANTS



- More vendors increase the complexity of multivendor situations and increase the need to understand (and to have) standards. They also increase the amount of intervendor discussions that have to be managed.

- More service and equipment offerings require more time to be spent in choosing a product.

- New technology increases the capability of products and seems to increase the complexity, not the simplicity, of the products.

- The new network management tools provide even more things to learn for the user staff.

Internal driving forces on vendors also add to the market complexity. Tight budgets make it harder to design products and support customers, while faster design cycles increase the need for design and support.

External driving forces on the vendors are:

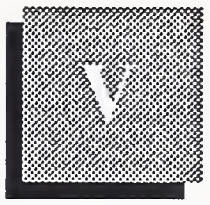
- The greater support needs of the users (because of their own budget problems which reduce staff and training)

- New technologies, which their competitors can use to make better and cheaper products

- Multivendor situations, where each vendor must understand and design for the products of many other vendors since the users require compatibility.

For both the users and the vendors, the result is a difficult situation as they try to manage far more complex problems with many more participants and less staff (budgets).

Conclusions and Recommendations



Conclusions and Recommendations

This chapter provides recommendations about how providers and users should take advantage of the developments in network management discussed in this report.

A Recommendations to Users of Telecommunications Services

There are great opportunities for managers of the telecommunications and MIS departments to make a contribution to their company by proper design and management of the network. However, the situation is not simple, and it will take excellent political and technical planning and execution to make it happen.

Exhibit V-1 summarizes INPUT's recommendations as to actions which users of telecommunications services should take.

First, get the relationships in order. MIS top management, the MIS staff, and the telecommunications department all have important roles to play. In addition, they all need each other to succeed in the corporate environment. It is important that the goals and plans are agreed to and that there be a continued cooperative relationship.

Training is key. If the telecommunications staff cannot use the network management tools, both their jobs and the corporation will suffer.

- It is worth the extra effort to train people to do things right.
- Provide people with the time and the courses for training.
- Take advantage of the training provided by equipment and service vendors.

Consultants and vendors have unique skills and knowledge. By employing consultants for highly directed projects, you can take advantage of these capabilities without giving up control.

EXHIBIT V-1

RECOMMENDATIONS TO USERS OF TELECOMMUNICATIONS SERVICES

- Ensure that MIS management, the MIS department staff, and the telecommunications staff all have common goals and a common plan
- Train the telecommunications staff in network management tools and network management
- Learn how to take advantage of the unique skills of consultants and vendors without giving up control
- Develop a disaster recovery plan, and practice for problems
- Invest in sufficient network management tools, training, and consultants to "get the job done properly"

Disaster recovery needs a plan and it should be practiced often. The plan should relate to MIS users and all of the key voice communications users.

- There can be a disaster. It has happened before, and ignoring its possibility is negligent.

Invest in the best network management tools and make sure that they are used.

- Tools (network management tools or any other tools) are always worth the effort and provide a return far greater than their cost.

B

Recommendations to Companies that Provide Network Tools

Network tools are important. But they are not well-accepted by the telecommunications department and are not well-used. This lack of use will certainly harm the vendors of these tools. INPUT recommends the following (Exhibit V-2).

- Keep them simple to use. It is worth the effort to have the tools used—more important than to develop even more functional capabilities that are not used.

EXHIBIT V-2

RECOMMENDATIONS TO COMPANIES THAT PROVIDE NETWORK MANAGEMENT TOOLS

- Make them simple to use and/or provide "help screens" and other user aids
- Provide training of all types, including instructor-led and self-paced training
- Extend solutions to total user needs, even if it is necessary to include consulting assistance
- Sell to MIS management as well as telecommunications management

- Help screens and other user aids are very useful especially in an environment where training is not adequate.

- Provide training of all types—especially self-paced training which can be used by those who refuse to, or can't, go to formal classes. Investigate the possibility of:

  - Computer-Based Training (CBT)
  - Interactive video

- Solve user problems. If the tools don't cover some situations or some equipment, consider backing them up with applications engineering support.

  - No one wants a "three-quarters working network".

- Sell to all levels of MIS management as well as to telecommunications management. Of course this is hard, but that where the purchasing is done. On the other hand, if telecommunications management does not participate, the tools will be ignored.

C

Recommendations to Vendors of Telecommunications Services and Equipment

There are great opportunities here to build the type of ongoing relationships that make major accounts want to continue doing business. Exhibit V-3 highlights a number of recommendations to accomplish this.

- Develop relationships throughout the entire MIS/Telecommunications organization. Decisions are made at all levels, and it is important that they all know what a vendor has to offer.

EXHIBIT V-3

RECOMMENDATIONS TO VENDORS OF TELECOMMUNICATIONS SERVICES AND EQUIPMENT

- Develop relationships with MIS management as well as telecommunications management
- Ensure that service and equipment are handled by network management tools
- Provide as much network management assistance as possible to users and consultants
- Make products easy to use by providing training, help systems, and interfaces
- Adhere to standards—don't try to "go it alone"

- If the network management tools don't handle your products, it is harder for your products to be used. Work with the vendors of network management tools and help them with any interfaces necessary.
- Help users and consultants. Ease-of-use and installation are as important as functionality and cost.
- Do everything possible to help people use your products. Some approaches are:
  - Help screens
  - Providing training of all types

  - Assisting any independent organizations that wish to develop and provide training courses about your products. The more help you get, the better.

  - Assisting consultants. The users may believe them ahead of the vendors.

- Adhere to standards. Perhaps IBM and AT&T can go their own way, but most companies can't. Unique standards will not keep out competition in an increasingly multivendor world. They will most likely keep out the unique vendor.

D

Recommendations to Firms that Provide Managed Network Services

Exhibit V-4 summarizes these points.

Sell to the highest level of management that can be reached. The top of the MIS department is a good place to start.Telecommunications management is against this type of service so it becomes a hard sell. However, it can be done.

EXHIBIT V-4

RECOMMENDATIONS TO FIRMS THAT PROVIDE MANAGED NETWORK SERVICES

- Sell to the highest level of MIS management and even higher
- Offer network reliability and control of the network
- Show how you can save money for the client company
- Become expert in all network equipment, services, and management tools
- Bridge the gap between telecom and MIS management

The major advantages to stress to management are:

- Network control
- Network reliability
- Cost savings

In order to be able to implement management of the network better than the internal company staff, it is necessary to become an expert in all phases of network management. This includes:

- Equipment
- Services
- Network management tools
- Training

There is often a gap between telecommunications management and MIS management. Learn how to bridge it.

E

Recommendations to Firms that Provide Consulting Services

Telecommunications management generally believes that it has the entire task well under control. MIS management frequently does not think so. This is the situation into which consultants and system integrators must sell (Exhibit V-5).

Relate to all levels of management and the MIS and telecommunications departments.

EXHIBIT V-5

RECOMMENDATIONS TO FIRMS THAT PROVIDE CONSULTING SERVICES

- Relate to all levels of management in the company, and the MIS and telecommunication departments
- Provide help wherever it is needed, especially for remote regions and new technologies
- Become expert in network management tools
- Be creative in pricing, be willing to accept shared savings for a portion of fee

To get a "foot into the door," provide whatever help is needed. Often it will be:

- Areas in technology where there is not internal expertise, such as VSATs or ISDN

- Geographical areas where the central telecommunications staff is not represented

Become an expert in network management tools:

- To demonstrate skills that are often not user-resident
- Because they increase efficiency

Consider creative pricing with shared benefits. It certainly aids a sales proposal if the consultant is willing to share risk.

F

Recommendations to Companies that Provide Training

Training in network management is sorely lacking. However, people in the telecommunications department frequently do not think that they need it and also do not think it is worth the time.

Thus, vendors of training should be able to relate to all management areas, especially the human resources and MIS departments where they have been selling training before (Exhibit V-6).

EXHIBIT V-6

RECOMMENDATIONS TO COMPANIES THAT PROVIDE TRAINING

- Relate to MIS management, telecommunications management, and the human resources department
- Approach the medium and small vendors of network management equipment to develop basic courses for them
- Have a very strong self-paced learning element in courses
- The largest markets for standard courses are
  - Network management principles
  - Netview

Self-paced training, such as CBT and interactive video, is much needed in the network management area. However, it is beyond the internal capability of small- and medium-sized market participants to develop.

These companies are candidates for contracts to prepare these courses.

For vendors that prepare their own courses for sale to end users, the largest market needs are:

- Network management principles
- Netview

G
Concluding Remarks

The network has become a major resource to many companies. It also has become:

- Very large
- Complex to design and operate
- Expensive to operate
- Absolutely critical for the company (a major network failure would be a disaster)

In response to the driving forces, network management has become extremely important.

This critical and complex task provides opportunities to all participants—provided that they understand network management and implement it properly.