Network Management Policy

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INTRODUCTION

How growing competition will affect the effectiveness and efficiency of compunications network facilities and services is a controversial matter of importance to suppliers, users and regulators. The management of interconnected networks controlled by different entities is one focus of controversy. The purpose of this paper is to examine the questions and problems which have emerged during the debate about network management and to identify the issues where opposing views or uncertainty confront the policy maker with difficult choices.

Part of the debate has involved the meaning of the term "network management." Hence, in February 1980, the Harvard University Program on Information Resources Policy published a report entitled Compunications Network Management by Robert H. Klie. The purpose of that paper was to examine network management in terms of what must be managed and why such management is needed. Klie's discussion of the principles and processes of network management provides a good fundamental description of the network management process and of its importance.

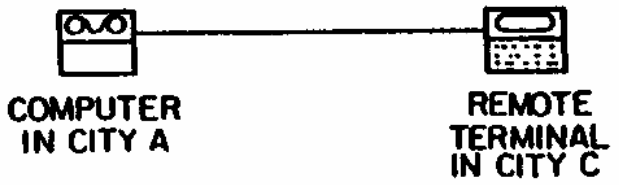
In order to further explore the questions of what, if anything, needs to be managed and why, or why not, a workshop was convened in April 1981. The workshop was made up of representatives from organizations which are suppliers and users of compunications facility and service networks. It had two objectives:

- to begin public discussion of network management policy across organizations at a senior level; and
- to assemble facts and current ideas on the subject.

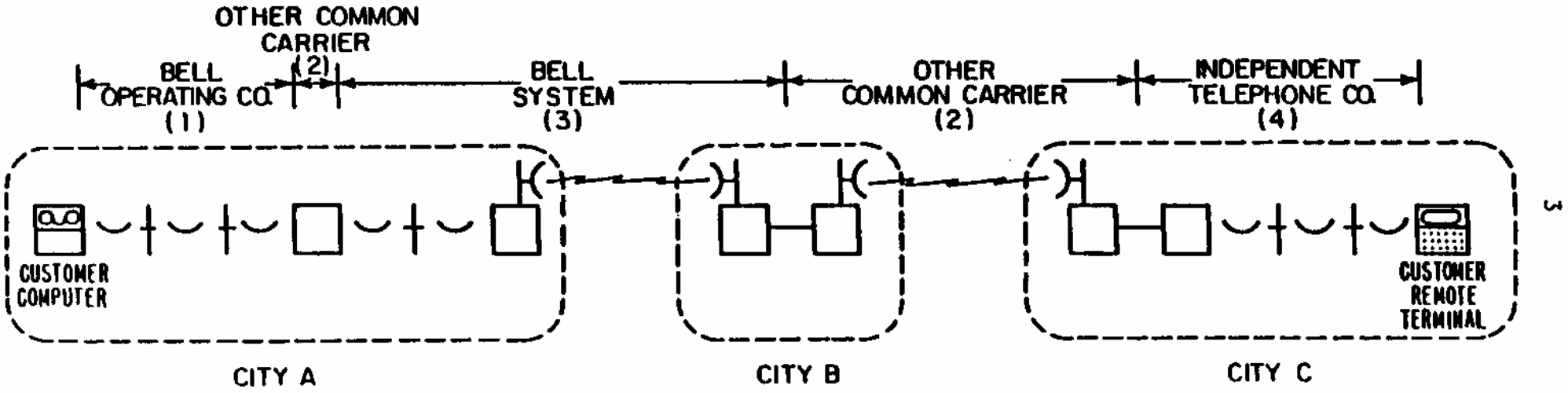
The letter which convened the workshop, together with a list of attendees, is in the Appendix.

The author served as the chairman of that workshop. This paper draws heavily on the preparatory work done for the workshop and on what was said during its course. However, the discussion which follows and the views expressed therein are the responsibility of the author. Not all will agree (including the author himself) that total objectivity has been achieved. Moreover, the viewpoints expressed at the workshop were heavily focused on supplier problems. The user communities' views did not emerge as forcefully.

As Klie points out, network management is much more than the day-to-day management of operating compunications networks. It also includes both short- and long-term planning actions. Although the concept of network management is relatively straightforward when considering a single, "unitary" network structure, it becomes more complex where a large number of relatively independent networks must co-exist. Fundamental to an appreciation of that complexity is an understanding of what has been meant by the terms "facility network" and "service network." A facility network used to consist of transmission, switching, and signaling systems providing the underlying structure for establishing service networks. A service network consisted of customer terminal devices, circuits, switches, processors, and other arrangements required to provide an end-to-end service to the users. The classical example of a service network is the nationwide DDD network provided over facilities networks of the Bell System and the independent telephone companies. But today service networks like EXECUNET and SPRINT are overlaid on the classical structure. They use facilities networks of MCI and SPCC, respectively, as well as facility networks of the Bell System and independent telephone companies, and parts of the DDD service network itself (Figure 1). Separate facility networks must therefore frequently be



ONE SERVICE NETWORK
(AS SEEN BY THE CUSTOMER)



FOUR FACILITIES NETWORKS
(AS SEEN BY THE SUPPLIERS)

Figure 1

Relationship Between Classical Concepts of Service and Facilities Networks

interconnected to provide service networks, and these in turn, can be further interconnected in various and complex ways. Moreover, the admixture of hardware, software, and firmware in both facility and service networks further compounds the problem. Users and suppliers of compunications networks are less and less certain of where to draw a line, if indeed one can be drawn, between facility and service networks.

The growing quantity and diversity of innovative service networks, particularly those providing information services, will compound the problem of network management in ways not yet clearly perceived. Those who are confronted with having to make policy decisions in legislative, regulatory, and business affairs face large areas of uncertainty. The author's purpose will be served if this paper sheds some additional light on a rather murky scene.

I. A FRAMEWORK FOR DISCUSSION

Fundamental to the discussion which follows are the values assigned certain criteria and an understanding of the major processes in network management.

A. Criteria

The following criteria provide the framework within which network management problems are usually considered. They represent the most important factors which drive and constrain the on-going change from regulated to competitive compunications in the United States. It is important to understand that these criteria have different values in the minds of the various players. Some set high store on economic criteria; others on national security; and still others on network technical qualities.

One criterion seeks consistency with the thrust of the FCC decisions resulting from the Second Computer Inquiry (Computer II). That decision, although being challenged on various grounds in the courts, provides the clearest picture of the future compunications structure in this country that is available to us. The changes taking place are sufficiently revolutionary as to render prior network management structures and assumptions suspect, and they must be re-examined in light of the most likely future.

Another criterion emphasizes economic efficiency since competition is seen as the future resource allocator. Telecommunications systems have been seen by many to possess economic benefits deriving from economy-of-scale and much regulatory effort has been expended in preventing "unnecessary duplication of facilities." Those who emphasize the economic criterion believe that the future compunications world will be

quite different as technical and economic inefficiency will be rewarded by failure. Separating the formulation of a technical problem from the formulation of the economic conditions under which that technical problem must be addressed won't advance our understanding of network management issues at all.

A third criterion requires that we consider the future adaptability of the various network management alternatives. Innovation is seen as the major benefit of increased competition in compunications. Hence, over-reliance on standards designed to make today's networks interoperate could seriously inhibit future innovation.

A fourth criterion is that national security and emergency preparedness are among the fundamental purposes of government. Compunications network management issues must take those fundamental purposes into account. National security and emergency preparedness needs are frequently complex and demanding. Their satisfaction will require investments and procedures over and above those required for satisfaction of purely commercial needs.

Finally, any decisions regarding network management must fit the final criterion; that of technical practicability.

As can be seen from this brief discussion of the various criteria applied by participants in the debate about network management, there exists some tension among those criteria. Alternatives which easily satisfy one or more of the criteria will often directly or indirectly conflict with others. Hence, the controversy.

B. The Network Management Process

Klie describes the classical network management process in some detail in Compunications Network Management. There appears to be little disagreement with his formulation. It includes the three major functions of:

- network planning;
- design, development, and facility implementation; and
- operation and use.

Network planning includes determining the types of customers to be served and their service needs, selecting service objectives, characterizing the types of signals to be transmitted, selecting the required facility types, developing and defining network topology, and specifying a number of network operating characteristics. Design, development, and facility implementation translates the broad planning effort into a detailed network design specification, then into facility design, and the actual implementation processes of engineering, furnishing, and installing the equipment. Network management continues throughout the service life of the network in the form of the operation and use functions associated with maintenance, changes, performance measurement, etc.

Certain of the network management processes described by Klie are particularly affected by the advent of multiple suppliers of both facility and service networks.

C. Selected Problems Affecting Network Management

The problems discussed in this paper are intended to illustrate some of the network management complexities brought on by the advent of multiple suppliers of facilities and service networks. They represent the most obvious ones. Even so, solutions are not readily apparent although some potential methods for dealing with them have emerged. These require additional examination, study, and application to determine their true utility. Some problems appear intractable and require some additional insights on the part of the compunications community. Still others have or will generate controversy and hence are likely to become issues requiring decision by policy makers.

D. Interaction and Interdependence of Facility and Service Networks

Klie's paper notes the strong interactions and interdependencies between service and facilities networks. He states that either may be uneconomic, unreliable, non-responsive or perform poorly if not well managed. It is easy to see the truth of that statement with respect to the facility networks which underlie the service networks. Less obvious is the effect that a poorly managed service network can have on the underlying facilities networks.

Today's networks are largely designed to accommodate the statistics of telephone calls. The statistics of the various new devices and services becoming available are not that well understood. That creates problems and, hence, there will be some upsetting situations. It is generally believed that the onset of a network problem caused by the advent of a new device will occur gradually over time. Where that is the case, most consider that economic forces will take care of the problem with some dislocations not better or worse than in other economic areas. But where the onset of the problem is sudden, the impact is much greater and actions that can be taken appear less than satisfactory. To illustrate: consider the case of customer-owned autodialers which continue to immediately redial the called number upon receiving a busy signal. The sudden introduction of a significant number of these can cause overload problems in the local exchanges of an unitary network. But postulate the effect of such dialers used extensively on service networks like EXECUNET or SPRINT which could overload the local exchange facilities of another carrier. A solution to the problem becomes more difficult because several parties are now involved. Much debate can then ensue about the adequacy of the local exchange plant vis a vis the sizing of the service network trunk groups and who should take what action, because solution to either represents an unplanned expense. Over some period

of time facilities will be added, autodialers may become less popular if calls aren't completed, pressures may be applied to the manufacturers of autodialers to insert delays before redial, etc. Thus, the problem may be self-limiting. However, in the meantime what is the effect on others who may be affected--the "innocent bystander" who cannot get dial tone in his local exchange? Other than an immediate scramble for added facilities in the affected local exchanges no quick, near-term solutions are apparent. Technology, in the form of "smarter" switching machines which recognize repetitive patterns and take some appropriate action, may provide a future solution. The FCC registration program may have to consider the use, as well as the electrical characteristics of devices to be connected to the networks. But our purpose here is to illustrate, not to solve the problem. One of the unanswered questions is whether the likelihood of an occurrence such as contained in the autodialer example is real or only theoretical. There are other examples which further illustrate the problem and some general means for coping with them.

There are voice compression devices which a user can put on the network which will approximately double the number of equivalent voice channels available to him. Under certain circumstances these can over-drive the channel and cause adjacent channel interference. The facilities network manager is obligated to protect his other customers from such interference. Thus, the offending user, who may be unaware of the problem he is causing, must be educated in such a way to ensure disciplined use of the network. "Levels discipline" is an old story to facilities network operators, but may be a new and unpleasant experience for some. Moreover, if one overdoes the discipline process, one runs the risk of losing a customer or of being accused of anticompetitive practices by making it difficult for competitors.

Another method for coping with potential network problems caused by the advent of new terminal devices is cooperation. One such example involves a service

network supplier whose network uses the X-25 standard protocol. Although X-25 is well documented, it is also complex and terminal devices containing software supposed to work with X-25 sometimes do so poorly. By working with the terminal manufacturers during the design phase, the network operator certifies the terminal device for use on his network. A voluntary action on the part of the terminal manufacturer, his payoff is in the improved marketability of certified equipment.

Another example where a service network interacts with the underlying facilities networks is where the success of the service network far exceeds expectations and overloads the underlying facilities. There are long-established network management procedures for dealing with such problems in the toll network. But the local exchanges again represent a significant problem. In such a case, cooperation between the local exchange and service network suppliers becomes mandatory. Such cooperation may or may not be easy to achieve as the self-interest factors affecting each may differ substantially; and economic motivators, like separations and settlements, may be absent. The issue that emerges is how to best forecast demand, particularly as it impacts local exchange facilities. It is discussed more fully in the section below on network planning.

Methods which can prevent problems in facility and service network interaction, which form the basis for discipline and which enforce cooperation are required. One alternative suggests that the network owner specify as accurately and precisely as he can what it is he is selling. Such a catalogue must contain electrical parameters, prices, terms and conditions, lead times, etc. Having done so, if a device or service meets the parameters of the catalogue any problems become those for the network owner to solve. There is a major question as to whether such a catalogue can be compiled in the face of a technology with the rate of change characteristic of today's compunications. Other preventive actions include use of usage sensitive pricing to

inhibit excessive and sudden demands on local exchange plant, new local exchange alternatives, customer education, and perhaps a broader FCC certification program which considers "harm to the network" in the larger sense.

None of these alternatives do much to solve the time urgent problems. It seems clear that the network owner has the obligation and responsibility to protect his network and his other customers from "harm" caused by another interacting network, particularly in the time urgent situation. It is less clear that all will accept his right to do so particularly where there may be an adverse impact on a connected network owned by another party. Nor is it clear that such problems will occur often enough to even be worrisome to network users and owners.

II. COMPUTER II AND ITS IMPACT ON NETWORK MANAGEMENT

One of the questions raised by the FCC decision following its Second Computer Inquiry (Computer II) is whether that decision will increase or decrease the number of issues involving network management. That decision is recent enough to allow considerable divergence of views as to its long-term impact on network management. Fundamental to an assessment of that impact is the perception one has about the clarity of the boundary drawn between basic and enhanced services. Some, including the FCC itself, consider that a "bright and enduring" line has been drawn in the decision. Others note that the FCC drew what it considered to be "bright" line then weakened that definition by providing for waivers for crossing the line where the users would otherwise be denied a valuable service. Others believe that the "bright" line will remain but that it may migrate back and forth over time. Thus, to some the "bright line" equates to a "grey area." Whether one considers the boundary to be bright or grey, there are network management problems that are at best only dimly perceived at this time.

Compunications networks are large and growing more complex. Some parts of those networks can be enhanced and thus unregulated, while other parts can be basic and hence regulated. What are the problems involved in managing a network which is made up of partly enhanced and partly basic services? To whom does the user go when he has a problem with the service being provided? The standard answer is that he should go to the network owner that he pays for the service and that, if satisfaction is not forthcoming, he can change suppliers. But that answer ignores the possibility that he may have invested substantial amounts in equipment and procedures which may

have to be changed. If the problem is in the basic service network, time is required to resolve the problem and the user decides to terminate rather than wait, what recourse does the enhanced service supplier have other than a petition to the regulatory body? And what will the regulatory body be able to do about it? The opportunities for litigation seem endless.

There are other unanswered questions that can be reasonably expected to result in problems. Two examples follow.

A user may need services provided in such a way that requires two separate enhanced service networks to be interconnected. If one or more of the suppliers refuses to do so the issue emerges of a need to force interconnection and how to do so given the deregulated status of enhanced services.

Technology itself may intrude in less than obvious ways. One example is the advances being made in coding where code and protocol conversion, error correction, etc., can be done on a single chip which could be embedded in the basic transmission facilities. If such is illegal in the United States and not in Canada, will there result a price advantage such that U.S. traffic would be diverted through Canada?

Clearly, the user now has a much wider choice of services to meet his compunications needs. For some that will be a mixed blessing because his management overhead costs will increase as he adds staff or employs consultants. Nor will it be apparent to the user what kind of an operating environment he will be living in until some of the questions surrounding network management in the Computer II era are answered.

Yet, all seem to agree that the supplier who bills the customer is responsible for working with any others involved in supplying the overall service to ensure satisfactory services are provided. If it were possible to equate basic services with facility

networks, and enhanced with service networks, network management actions might become a little more clear-cut. However, to the user (and many suppliers) the line drawn between facility networks and service networks themselves is anything but "bright and enduring."

The author regretfully concludes that Computer II will add to the number of network management issues facing the community.

III. NETWORK PLANNING

Two of the network planning steps described in Klie's paper are substantially impacted by the multi-vendor world we are now entering--forecasting needs and establishing performance objectives. A third step, deciding the topology, is considered later in this paper as part of the national security and emergency preparedness problem.

Today, and at least for the near term, the nation's telecommunications infrastructure depends in great measure upon the Bell System's "core network" which ties together the many telephone companies serving both rural and metropolitan areas. The rate and the manner in which it expands and evolves to meet the needs of direct and indirect users depends upon market forecasts. These forecasts have in the past been made by a single management entity (AT&T) with some consultation with connecting carriers. Valid forecasts of user needs were often hard to obtain in the regulated monopoly world in which we once lived. The inevitable growth of competitive pressures leading to "proprietary" business plans of suppliers of both facility and service networks will tend to inhibit the free flow of information about future needs and service requirements.

Some user needs forecasting activities will not change all that much. For example, a sophisticated user who prepares a request for proposal with an adequate performance specification for competitive acquisition of a new service represents a known forecast. The international facilities planning process is a well established but relatively long term process which is now made more difficult by the increasing variety of new services and the fact that requests to potential users for their forecasts have basically brought forth extrapolations of existing service needs.

There appears to be general agreement that the results of market and new service trials will be regarded as highly proprietary, as will suppliers' business plans. There is general unwillingness on the part of competitors to identify a specific forecast with a specific customer. Some suggest aggregation of several such forecasts as a possible answer.

There is also general agreement that industry has an increasingly refined ability to forecast demand--has better data and knows how to use them better. However, it is more difficult to forecast how the emerging information industry will impact telecommunications requirements and equally difficult to forecast how patterns of data usage will change within companies. But those difficulties appear manageable.

The new problem faced by the industry is that trying to forecast market share for facilities planning purposes adds a new dimension. For this purpose we must learn how to use, or to develop for compunications usage, techniques used by other highly competitive industries in forecasting their market share. Forecasting will become a very vexing problem for the compunications industry because it is much more complex than the automotive industry whose recent performance hasn't been all that good. Telecommunications forecasts have not only a volume and service features dimension but also a major location parameter as well. Additionally, the aggregate market forecasts of several service network suppliers impact on essentially single suppliers of local exchange facilities, although that can be expected to change in the future at some undetermined rate. The flexibility inherent in satellite communications will ameliorate bad forecasts in the inter-city area, but is not useful in the local exchange area which is the bigger problem.

Thus, we face the possibility that there will either be an excess of facilities in one area or more demand than can be handled with consequent risk of overloading the network and impacting the innocent bystander.

Other than the need to develop and agree upon some new forecasting methods, the principal issue is whether the downside risks of unfettered competition in terms of oversupply or undersupply are so great that some form of market intervention is required either by the government or by an industry forecasting group.

In contrast to the difficulties foreseen in network planning caused by market share forecasting is the general reaction to the planning step whose design goal is to achieve the end-to-end performance objective in the most cost-effective manner. Doing so requires trade-offs and compromises to be made among the various elements of the network. This, in turn, can mean that the cost of one element may be driven beyond its optimum cost in the interest of achieving the lowest cost end-to-end solution. Where more than one supplier is involved, doing so conflicts with the goals of maximizing profit and minimizing investment.

There is general agreement that any uneconomic allocation of performance objectives in the networks will be more than made up for by the innovative stimulus of competition. Also agreed is the view that a service or facility network owner who puts together a cheap system can expect to see users go somewhere else when grade-of-service and reliability begin to degrade. Finally, there is agreement that the user will have a greater role, either directly or indirectly, in setting performance objectives as he makes his economic choices. As an example of indirect effect, it is very unlikely that the average household telephone user will pay a premium price for tomorrow's digital telephone simply to save the network some buried costs. Direct influence will come as the user defines his needs, selects his terminal equipment, and works with the network vendor to obtain the desired services.

IV. NETWORK OPERATION AND USE

Once networks have been planned, designed, and implemented the network management task focuses on the performance of the operating network. If only a single supplier is involved, this is a relatively straightforward management task. Multiple suppliers complicate that task and the growing complexities of modern networks add further complications.

As information systems become more deeply embedded in the users' operational processes, service interruptions and service delays become more and more serious. This will be particularly true of the digital world where high data rates will be the norm. Facility restoration and alternate routing schemes become more critical, requiring a greater degree of dynamic network control.

Multiple vendors involved in supplying an end-to-end service are all motivated to ensure that their individual portion of the service is operated and maintained so as to ensure that its contribution to the overall service and performance objectives assigned during the planning process is met. But the troubles that appear in modern, complex systems can be very subtle. The offending element is not always easy to identify.

Standards are most often cited as a solution. However, much debate occurs when trying to agree on how to achieve the appropriate standards in timely fashion and in such a way as not to hinder innovation. There does seem to be general agreement on the proposition that standards would be useful to interconnect the networks of the various carriers. Moreover, there are some <u>de facto</u> standards in place now--such as those of the Bell System. Competitors may not like all of them, but to sell widespread

service they will have to connect to that system and market economics will force a new supplier to design to those standards. There are also other, more formal standards issued by industry groups, government agencies, and quasi-governmental bodies. Some have gained general acceptance, others may apply to only a limited market-place, and still others are largely ignored. It also seems clear that innovation has, and will, to a greater extent in the future, lead to greater numbers of network incompatibilities; not fewer, unless standards are mandated.

Almost nobody (except some in government itself) wants the government to prescribe standards. Industry groups are generally seen as the preferred solution but that assumes that industry can overcome the sizeable obstacles of corporate motivation to cooperate for the general good of the users who want transparency. Quasi-governmental agencies (e.g., CCITT) are often advocated as the best way to achieve agreed standards, but such agencies appear far too slow to cope with a highly competitive marketplace. What is cited as a resounding CCITT success (the packet network standards) took 3½ years to develop. It may be that the rapidly advancing technology, particularly of microprocessors, will rescue us from this dilemma by making the notorious "black box" solution to incompatibility problems both cheap and efficient.

It is clear that the whole area of standards and technology alternatives represents an issue which will continue to generate controversy.

Technology, in the form of more sophisticated network controllers and diagnostic equipment, does offer the prospect of making the fault isolation problem (i.e., locating the defective hardware or software element causing degraded or interrupting service to the user) more manageable. However, there is an issue present in the situation where multiple vendors have diagnostic capabilities of varying degrees of sophistication. The issue is described as follows:

- One vendor possesses a very sophisticated diagnostic capability which may provide him a competitive advantage:
  - -- Is he obligated to share the information it produces with other suppliers in the interest of prompt restoration of the user's service?
  - -- Would he be willing to do so?
  - -- Would sharing of diagnostic results, either formally or informally, have anti-trust implications?
- Alternatively, the basic network provider defines the characteristics of his network in detail, to include "loop-back" commands and establishes a central diagnostic facility. Connecting carriers and services network providers then know exactly what to do. But centralized diagnosis requires the central diagnostic center to have the detailed characteristics of the competitor's circuits, giving access to that and other information the competitor may regard as sensitive.

Most consider the idea of shared or centralized diagnostic action with modern devices to be technically possible. It is the administrative and legal aspects which are contentious. Moreover, small- and large-scale networks represent two different problems--the former solvable, the latter perhaps not. There is also general agreement that a "diagnostic standoff" is the buyer's problem provided that the services being provided by the several vendors were adequately defined in the user's procurement action. What constitutes "adequate definition" is not clear. Users of complex networks may find it advisable to use a modified prime contractor approach, although here, too, there are uncertainties.

Finally, in the general category of operation and use, there emerges the issue of security and privacy. There isn't even a generally held view about the problem itself, other than that it is a problem. The community is not even sure on what basis an

informed user will demand, or ignore, security protection to guarantee privacy over what period of time. Nor is there a consensus about any implied responsibility on the part of the network owner to provide some or any level of protection. There is a modest consensus that the privacy problem gets more difficult with cost-causative pricing, greater freedom of choice by users and multi-vendor networks. Some believe the after-the-fact penalty such as contained in postal statutes might be applied. Others ask how to apply such to areas outside the legal jurisdiction, pointing to the hemispheric intercept vulnerability of communications satellites. There is general consensus on one view--if the users demand protection, they will ultimately get it in a competitive world.

Standards. There is general agreement that having a proper set of standards would greatly simplify network management processes. Having said that, the consensus rapidly falls apart. There are, of course, de facto standards that the marketplace will enforce. A supplier of equipment or services which will be interconnected to the nation's telephone network will adhere to the standards that have evolved for that network, or his product won't sell. On the other hand, the development of new standards is seen to be a slow, cumbersome process lacking an authoritative decision-making body. Quasi-governmental bodies like CCITT and ISO are often cited as role models though lacking enforcement power. If they are inadequate models, clearly something else must emerge. Most seem to prefer industry group standards bodies rather than the quasi-governmental counterpart. User participation in such groups is seen as highly desirable. There is much concern that such standards will tend to reach the lowest common denominator rather than the optimum solution, and threaten to inhibit innovation--"one man's standard is another's straightjacket."

Service network management. Computer II and the availability of multiple sources of supply will severely limit the number of times that a user can or will want to go to a single supplier to provide an end-to-end service network. One of the benefits of the single supplier world was that the user could demand and expect that the supplier would provide network management functions and the user would only have to monitor the network performance in meeting his needs. The user community now has the opportunity to "piece out" a network by acquiring parts from several facility or service network suppliers. It can do so to achieve dollar savings or more innovative services, but when doing so must accept some network management responsibility. The added network management task can be done by adding staff people, using consultant services, or perhaps by separately contracting with a facility

- There must be a capability to manage the restoration and reconstitution of the national telecommunications system following an emergency.
- The National Communications System will consult with the Federal Communications Commission on implementing these principles and will place substantial reliance upon the private sector for advice and assistance in achieving national security and preparedness goals.

A. Topology

For many years the national security community has been able to influence network planning choices by the established carriers so as to enhance the robustness and survivability of their networks. Target avoidance routing and facility protective features are but two examples. These choices add cost to the construction of facilities. The added costs have been indirectly borne by all ratepayers. The question now is whether the several competing suppliers of networks will be willing to unilaterally incur the added cost, thus weakening their competitive posture. Increasingly, the theme is heard that if the national security community wants these added protective features provided, it should pay for them. But the issue is how to do so, do it in a way that treats all suppliers equitably and at a reasonable cost to the taxpayer. There appear to be at least five choices available:

- Use only those networks most nearly meeting the government's survivability goals, relying on the government's market power (DoD alone spends about one-half billion dollars annually on leased communications equipment and services) to cause potential suppliers to make the added investment;
- Direct subsidies to all carriers;

- Reliance upon a "chosen instrument" at the expense of competition and the increased diversity that it brings;
- Government subsidies to provide increased protection for selected critical facilities; or
- Require that protection features be provided by all carriers in the national interest and hence indirectly subsidized by all users.

It is not clear which one, or combination of more than one of those alternatives, will be the best solution.

B. Facility and Network Restoral

War or major natural disasters can cause major disruption of compunications on which the nation increasingly depends. Competition will bring much greater diversity of telecommunications routes, facilities, and equipment--all of which would enhance the survivability of the national telecommunications structure if these separate networks could be organized and interconnected in such a way as to respond to a national emergency. The issue is how to do so. In a competitive environment, and given the structural requirements being levied on AT&T, the centralized network planning and direction once largely performed by AT&T will also erode. It is not clear what will take its place. Some remain convinced that only the Bell System can tie it all together. Others believe that joint industry groups with active government participation can cope with the many problems. A few (including the author with his well known bias) believe that a special case can be made for national security; that it is different from all the other national needs of business, industry, and the administrative functions of government; and that there should be a different set of rules which the carriers must follow, like it or not.

Cooperative industry planning to meet the requirements of PD53 is seen as doomed to failure without significantly greater government participation than at present. There are essentially no criteria or guidelines other than those contained in the National Communication System (NCS) restoration priority system which the government has provided to the industry but which is inadequate to the task of meeting massive restoral needs. There is considerable difference of opinion as to the details of the government's role but agreement that it should establish the requirements, lay down the rules as to what the carriers' obligations are and work with them in trying to develop appropriate reconstitution and restoral plans and procedures.

If the number of interconnects required is small and technically simple (i.e., ordinary voice frequency or teletype circuits), or if a minimum number of circuits could be identified and industry required to pre-plan restoral of those circuits, the restoral problem is manageable. That might be the case in a natural disaster but it is not in nuclear war. No easy answer exists.

VI. SOME COMMONLY HELD VIEWS ABOUT THE ISSUES

Despite the controversy surrounding network management, there appear to be some commonly-shared views held by the participants in the on-going debate. The following discussion lists some of these views arranged in a rough approximation of decreasing degree of consensus which each can muster. It should be expected that the list will change, as will the degree of consensus, as further facts are gathered, analysis accomplished, and experience gained.

The role of government. The role of government in network management activity is seen to be absolutely minimal, but crucial for certain aspects. The free market philosophy, which uses competition to substitute for governmental regulation, is regarded as the antithesis of any governmental intervention in the functioning of that market. There are, however, at least five, perhaps six areas (some of which overlap others) where the government must play a crucial role. These are:

- Allocation of the frequency spectrum;
- International facilities planning;
- Policing anti-competitive practices;
- Defense and emergency preparedness;
- A surrogate for the otherwise unrepresented small business, professional, and household subscriber; and
- Perhaps, as the "honest broker of last resort" in inter-carrier negotiations.

Despite the general agreement that these are roles the government should play, there is much difference of opinion as to how direct that role should be, by whom exercised and under what circumstances.

Standards. There is general agreement that having a proper set of standards would greatly simplify network management processes. Having said that, the consensus rapidly falls apart. There are, of course, de facto standards that the marketplace will enforce. A supplier of equipment or services which will be interconnected to the nation's telephone network will adhere to the standards that have evolved for that network, or his product won't sell. On the other hand, the development of new standards is seen to be a slow, cumbersome process lacking an authoritative decision-making body. Quasi-governmental bodies like CCITT and ISO are often cited as role models though lacking enforcement power. If they are inadequate models, clearly something else must emerge. Most seem to prefer industry group standards bodies rather than the quasi-governmental counterpart. User participation in such groups is seen as highly desirable. There is much concern that such standards will tend to reach the lowest common denominator rather than the optimum solution, and threaten to inhibit innovation--"one man's standard is another's straightjacket."

Service network management. Computer II and the availability of multiple sources of supply will severely limit the number of times that a user can or will want to go to a single supplier to provide an end-to-end service network. One of the benefits of the single supplier world was that the user could demand and expect that the supplier would provide network management functions and the user would only have to monitor the network performance in meeting his needs. The user community now has the opportunity to "piece out" a network by acquiring parts from several facility or service network suppliers. It can do so to achieve dollar savings or more innovative services, but when doing so must accept some network management responsibility. The added network management task can be done by adding staff people, using consultant services, or perhaps by separately contracting with a facility

or service network supplier as a prime contractor. It is not clear that the less sophisticated part of the user community understands this fact. Moreover, neither suppliers, nor even the most sophisticated users fully understand how to jointly discharge the functions of network management that Klie describes.

Participatory management. There is a body of opinion (mostly from the Independent telephone industry) that points to the successful planning and operation of the present telephone system in this country and asks why such cannot continue into the future. Bell's dominant leadership role is assumed. Adherents to this view also generally support the idea that an industry group could develop and implement the full spectrum of network management functions, from planning to emergency restoral. Those who challenge the idea of participatory management as the solution, point to the fact that Bell/Independent cooperation was founded on the idea of joint provision of a "through service" and that separations and settlements processes provide economic motivation for agreement on the part of the Independent telephone companies. The question is asked, how participatory management could apply in the competitive case. Supporters of the idea generally answer by citing examples of technical problems solved and tend to avoid the economic issues; whereas the challengers of the idea focus on the economic and marketing issues. Participatory management may have a place in the future scheme of things if technical issues can be separated from the economic. The author does not believe that can be done, but others do.

Competition as a forcing factor. There is a generally held view that competition will force the network owner to manage his network properly. Otherwise he will lose his customers. Those who have trouble with this viewpoint stress the complex interdependence of multiple service and facility networks and the possibility of indirect effects on "the innocent bystander" who does not know who to blame for his problem. Thus, although the independent networks may be well-managed by their

individual owners, the overall performance of the nationwide compunications structure is not thereby assured.

National security and emergency preparedness. There is almost universal agreement that this is an important problem that must be addressed in terms of the competitive environment. However, there is very little agreement about proposed solutions or even the boundaries of the problem itself. One thing is clear however, the government must take the lead.

VI. CONCLUSION

The demands being placed on the nation's compunications caused by the impact of technology and the information revolution combine to make network management a much more complex task. The growing proliferation of facility and service networks, together with the structural changes taking place in the industry as a result of competition make the network management task even more difficult.

It is yet very early in this new world of increasing competition in compunications. It is important to begin to understand the network management problems, many of which have yet to emerge, of the multi-vendor world.

Unless many of the network management processes which have proven themselves over time can be adapted to the new competitive environment, the quality of service available to the nation's users is in danger of deteriorating even as the variety of services increases.

APPENDIX

Exploratory Workshop

on

Compunications Network Management Policy

Cambridge, Massachusetts - April 8-9, 1981

TOPIC

How growing competition will influence the effectiveness and efficiency of compunications network facilities and services is a controversial matter of importance to suppliers, users and regulators.

The management of interconnected networks controlled by different entities is one focus of controversy. One kind of extreme position holds that only AT&T's leadership and dominance are up to doing it right. At another kind of extreme, proponents say that the invisible hand in an unfettered competitive market can do it better; namely, no formal management processes are needed at all. Other extreme as well as milder and less certain positions have been advanced.

Two questions therefore seem ripe for reflective rather than reflexive consideration: manage what, if anything, and why, or why not. In the attached paper, Robert H. Klie begins to address these questions.

Some reviews of Klie's paper suggested that it might be one point of departure for discussing the pros and cons of the need, if any, for various management functions across interconnected networks. Others said it may focus too heavily on facilities management functions and not enough on services management functions. Perhaps, according to some, it reflects too uncritical a belief in the need for a centralized approach to resource management. From this standpoint, it pays too little attention to more decentralized or less formal approaches such as might result from promulgation and adherence to specifications, standards or protocols. Still others held that it does justice neither to the rich variety of potential types of connectivity among facility and/or service networks established by different entities for themselves or for sale to others nor to what specifications of facilities networks make these networks more or less readily usable for a multiplicity of service networks.

The workshop will have two objectives:

- to begin public discussion of network management policy across organizations at a senior level;
- to assemble facts and current ideas on the subject which might, if warranted, provide a base for further work by the Program and workshop participants.

Participants are invited to contribute to exploratory and informal discussion of the following points:

- What additions, deletions, or alternatives to Klie's description of what, if anything, to manage and why or why not, are required for an adequate description?
- What interests not represented at the workshop might need to be taken into account?
- What further steps, if any, should be taken after this workshop? Through what process? By whom?

FORMAT AND PROCEDURES

To facilitate discussion, active participation will be limited to 20 of the invited organizations on a first-come, first served basis. Other organizations on the invitation list that respond by the February 15, 1981 deadline are welcome to participate as observers. Any representatives of an active organization may take part in discussion, but only one at a time.

By March 9, 1981, all participants (active and observers) are requested to submit a brief statement, including a one-page summary, addressing the questions of what, if anything, needs to be managed and why or why not, with or without reference to the Klie paper. The Program will circulate these statements to all participants. It will also use them to prepare a synopsis to prime the discussion at the opening session.

The Program will make a stenographic record of the sessions for use in its own work.

The sessions will be chaired by Lee M. Paschall, Lt. General USAF (Ret.), formerly Director, Defense Communications Agency with collateral responsibilities as Manager, National Communications System, Chairman, Military Communications-Electronics Board, and direction of the activities of the WWMCCS Systems Engineer. General Paschall is now an independent consultant with a long association with our Program. John LeGates, John McLaughlin and Tony Oettinger of the Program staff will work with Lee in conducting the sessions.

SCHEDULE

Wednesday, April 8, 1981

11:00 - 12:00 noon	Registration
12:00 - 2:00 pm	Lunch; Chairman's Introductory Remarks
2:00 - 5:30 pm	Discussion*
5:30 - 6:30 pm	Social Hour
6:30 - 8:00 pm	Dinner
8:00 - 9:30 pm	Discussion*

Thursday, April 9, 1981

8:30 - 12:00 noon	Discussion*
12:00 - 1:30 pm	Lunch
2:00 - 4:30 pm	Discussion*

*Coffee, etc. available

Exploratory Workshop

on

Compunications Network Management Policy

Cambridge, Massachusetts - April 8-9, 1981

Attendees

James Fischer
Senior Vice President &
Technical Director
Warner Amex Cable Communications

Joel R. Alper
Vice President - Communications Services
COMSAT World Systems Division

Donald R. Bacon
Telecommunications Consultant
IBM Corporation

Jugtar Basi
Digital Equipment Corporation

Joseph P. Conklin
Technical Coordinator
Pitney Bowes, Inc.

Patrick Courtin, Manager
Telecommunications Industry Group
Digital Equipment Corporation

Jack W. Crawford
Vice President, Operations
Telesat Canada

Ralph DeMent
Digital Equipment Corporation

Irwin Dorros
Assistant Vice President
Network Planning
American Telephone & Telegraph

E.V. (Ned) Farinholt
Director
Ground Segment Engineering
Satellite Business Systems

Jeffrey R. Forbes
Commissioner
Massachusetts Cable Television Commission

Hal Frock
Telecommunications Development Manager
Dow Jones & Company, Inc.

John B. Funderburk
Director
Office of International Electronic
Message Systems
Research & Technology Group
United States Postal Service

A. Gavras, Director
Systems Planning
Transamerica Corporation - Information Systems

Robert E. Gradle, Vice President
Government Communications
AT&T Long Lines

C. Gus Grant, President
Southern Pacific Communications

Muriel W. Hall
Senior Staff Editor
General Book Division of Reader's Digest

George F. Hamner, Jr.
Vice President
Business and Technical Planning
GTE Telenet, Inc.

Stephen W. Harris
Group Leader
The MITRE Corp.

John A. Hollansworth
Vice President & General Manager
Western Union - Government
Systems Division

Robert S. Jackson
Special Assistant to the President
MCI Telecommunications Corp.

Joseph Kasputys
Executive Vice Preisdent
Data Resources, Inc.

Makoto Kohno
Director
Research and Consulting Group
NEC Systems Laboratory, Inc.

Dan Lacy
Senior Vice President
McGraw-Hill, Inc.

Stephen A. Lofgren
Group Manager
Research Group
NEC Systems Laboratory, Inc.

Elliot E. Maxwell
Deputy Chief Scientist for Policy
FCC

Earle B. Mullen
Manager - Advanced Programs
Corporate Telecommunications Operations
General Electric Company

B. O'Neill
Director
Market Research & Development
Telesat Canada

Joseph J. Potts
Director
Network Standards & Industry
Relations
GTE Telephone Operating Group

David H. Rowley
Director
Network Design
Continental Telephone Corporation

Robert Schmitt
Marketing Manager
Telecommunications Industry Group
Digital Equipment Corp.

Jean D. Sifleet
Manager
Telecommunications and
Networking Regulations
Honeywell Information Systems

Ted Simis
Consultant for Warner Amex
Cable Communications, Inc.

Roger L. Sutliff
Chief System Planner
Communications Division
State of New York, Dept of
Public Services

Douglas H. Taylor
Systems Engineer
NCR Comten

Troy W. Todd
Senior Vice President for
Engineering and Operations
United Telephone Systems, Inc.

F. Thomas Tuttle
Assistant General Counsel
Satellite Business Systems

Phil Walker
Associate General Counsel
Regulatory Affairs
GTE Telenet, Inc.

Anthony G. Oettinger
Chairman
Program on Information Resources Policy
Harvard University

John F. McLaughlin
Executive Director
Postal and Allied Arenas
Program on Information Resources Policy
Harvard University

Charles H. Elmendorf
Technical Management Consultant
Madison, New Jersey

Robert H. Klie
Andover, Massachusetts

Lee Paschall
Springfield, Virginia