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National security telecommunications policy and emergency mobilization preparedness policy require preparedness of telecommunications to support continuity of government and recovery of the nation during and after nuclear war or natural disaster. Technical standards and uniform emergency procedures allowing interoperability of diverse systems must be developed. Upgrading and hardening for disaster resistence must be supported. Unprecedented cooperation among competitors, and with the government, will be necessary. Issues of funding, industry representation and agreement, and legal authority must be settled. This report recommends actions to clarify the responsibilities of the parties involved, including expanding Presidential authority to compel cooperative, emergency planning by competitors; charging the Federal Communications Commission to take national security issues into account in rulemaking; and revising antitrust laws to allow communications firms to collaborate in emergency planning.

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NATIONAL JOINT PLANNING for RELIABLE EMERGENCY COMMUNICATIONS

A Report to the National Communications System

by the Committee on Review of National Communications System Initiatives
in Support of National Security Telecommunications Policy
Board on Telecommunications-Computer Applications
Commission on Engineering and Technical Systems
National Research Council

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This report has been reviewed by a group other than the authors, according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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PREFACE

This interim report is the first of two or three products of a committee convened in January 1982 by the National Research Council (NRC) at the request of the Manager of the National Communications System (NCS). The committee was asked to review initiatives the NCS has been undertaking in support of national security telecommunications policy to provide survivable, endurable communications for the national government under a variety of emergency conditions, including nuclear attack. At the time of the Manager's request a program of such initiatives had been started.

In response to that request the NRC established the Committee on Review of National Communications System Initiatives in Support of National Security Telecommunications Policy. The committee is conducting its review over the period January 15, 1982, to January 14, 1984. It anticipates production of two interim reports, on subjects of particular importance to the NCS, and a final report.

In March 1982 the NCS held a conference with chief executives of telecommunications firms throughout the United States to consider approaches to national joint planning by industry and government for provision of emergency communications. A National Security Telecommunications Advisory Committee (NSTAC), comprising industrial chief executives, was proposed to advise the President. It would be supported by an Industry Executive Subcommittee composed of high-level executives appointed from within their firms by the NSTAC members and by three working groups comprising technical, legal, and financial officers of participating firms. Since March 1982 the NCS has had conferences with the industry points of contact and with two working groups, the Resource Enhancements and Emergency Response Procedures Working Groups. It also held a second conference on NSTAC organization and leadership with the chief executives. On September 13, 1982, President Reagan signed Executive Order 12382 establishing NSTAC as an advisory committee reporting both to the President through his assistant for National Security Affairs and to the Secretary of Defense in his capacity as Executive Agent for the NCS. NSTAC will advise the President and the Executive Agent on planning, standards, guidelines for action, and implementation and operations options for national security of telecommunications. Following the Executive Order, the NCS has held working group meetings on automated information processing

and meetings with industry points of contact comprising the Industry Executive Subcommittee to discuss possible structures and functions of that subcommittee.

The NCS regards joint industry/government planning for national security telecommunications as a top-priority problem and requested that it be the topic for this first interim report.

The NRC Committee on Review of NCS Initiatives in Support of National Security Telecommunications Policy comprises members with expertise in a variety of complementary areas related to the planning, development, networking, operation, management, and survivability of telecommunications systems. Members' backgrounds embrace such fields as computer/communications systems, telecommunications systems, radio transmission and propagation, satellite systems, video cable systems, nuclear effects, equipment vulnerability, power systems, technology policy formulation, and government operations and organization.

The committee's review has involved extensive briefings in Washington, D.C., and at AT&T Long Lines headquarters, Bedminister, New Jersey. The committee met as a group six times in 1982 for briefings and discussion. Between meetings members reviewed materials, conducted individual discussions, and prepared reports and drafts. There has been no previous work by the NRC on any aspects of this study. Earlier external work has been compiled over the years in FCC rulemaking dockets and in the literature pertaining to the Justice Department's antitrust actions against AT&T, with both of which several members of the committee are acquainted. The combination of presentations, field visit, discussions, and background material gave the committee insight into the NCS initiatives program and its needs for national joint planning to support national security and emergency planning for reliable government communications. From that insight the committee developed the judgments that form the basis for this report.

We have enjoyed the cooperation and support from the Office of the Manager, NCS, during the course of this study. In particular, we appreciate the support we have received from Mr. John Grimes, Deputy Manager, NCS; Col. Jack Taylor, USAF, Assistant Deputy Manager, NCS; and Lt. Col. Burt Stueve, USAF, PD-53 Program Coordinator, NCS.

This committee, like others in the NRC whose members serve part-time and without compensation, must depend heavily on its professional staff. In this regard, we are particularly grateful to Richard B. Marsten for his sustained support of our work.

A major committee effort like this imposes a heavy burden on its administrative coordinator. It is a pleasure to acknowledge the assistance of Karen Laughlin for her support with the administrative and other essential activities.

Finally, as the committee's chairman, I want to express my sincere thanks to its members for their dedicated efforts.

LOUIS T. RADER

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I. INTRODUCTION

A. Background

One objective of the National Communications System (NCS) is to ensure that the necessary telecommunications resources and procedures are available to support essential government functions, civil activities, and military operations during and after national emergencies, whether of natural or man-made origin. The NCS estimates that 95 percent of the federal government's telecommunications requirements in the United States are satisfied by commercial organizations. The number of such organizations has increased markedly over the last decade. This increasingly competitive environment, further encouraged by such actions as the Federal Communications Commission's "Computer Two" decision, the settlement of the AT&T antitrust suit, and pending congressional legislation to revise the Communications Act of 1934, tends to establish barriers to the exchange of information among carriers about present and future telecommunications systems. For example, the public switched network environment after the antitrust suit settlement will tend to become one of separate networks individually optimized to achieve competitive advantage rather than a national system optimized for the common good of the overall public switched network. Competitive behavior by independent firms poses difficulties for the NCS as it attempts to achieve its objective.

The National Security Telecommunications Policy stated in Presidential Directive/NSC-53 (PD-53) and the Emergency Mobilization Preparedness Policy stated in National Security Decision Directive (NSDD) 47 require preparedness of telecommunications to support the continuity of government and recovery of the nation during and after nuclear war or natural disaster. The NCS cannot fulfill that requirement without help from the commercial organizations providing the preponderance of communication services in the United States. Accordingly, conferences were convened on March 16 and July 9, 1982, to address issues and problems of joint industry/government planning for such ends. Executives from industrial organizations spanning the spectrum of communications and information-processing activities attended.

Following the meeting of March 16, a National Security Telecommunications Advisory Committee (NSTAC), comprising industrial chief executives, was proposed to advise the President. It would be supported by an Industry

Executive Subcommittee (IES) composed of high-level executives appointed from within their firms by the NSTAC members and by three working groups comprising technical, legal, and financial officers of the participating firms.

The July 9 conference was held with other industry chief executives to explore further the potential membership of NSTAC. A conference with the chief executives' appointees, their industry points of contact, was held on July 13 to discuss approaches to the organization and operation of the proposed IES. And on August 3 and 24, respectively, conferences were held with working groups on satellite survivability and on joint network planning, discussing the problems associated with these two top-priority issues that the March 16 conference had identified. On September 13, 1982, President Reagan signed Executive Order 12382 establishing NSTAC as an advisory committee reporting both to the President through his assistant for National Security Affairs and to the Executive Agent of the NCS (the Secretary of Defense). NSTAC will advise the President and the Executive Agent on planning, standards, guidelines for action, and implementation and operations options for national security telecommunications.

The NCS regards joint industry/government planning for national security telecommunications as a top-priority problem and requested that it be the topic for this first, interim report.

The committee believes its role in reviewing NCS initiatives and in developing its reports to include aiding the NCS in its dealings with NSTAC. Such aid could include, among other things, advice on workings of the commercial networks and an agenda of ideas for presentations to and consideration by NSTAC. The committee hopes that the NCS will find this report, in particular, a useful guide to the development of information for the IES and the working groups.

The committee did not consider such topics as the effects of electromagnetic pulse (EMP) on communications devices, equipment facilities, and systems; the vulnerability of these things; or means for improving their survivability and reliability appropriate for extended discussion in a report on joint planning. Such topics will be treated in the second interim report, to follow later in 1983.

After Executive Order 12382 was issued, the NCS held a meeting (November 9, 1982) formally convening members of the IES to discuss possible structures and operations of the Subcommittee. The NCS suggested that the working groups be designated Resource Enhancements, Emergency Response Procedures, and Funding and Regulatory. Resource Enhancements would deal with engineering issues; Emergency Response Procedures with interconnection and operations; and Financial and Regulatory with administrative and implementation issues. These groups would report to the Industry Executive Subcommitte, whose members, in turn, would report to their NSTAC principals.

The next meeting of the IES took place November 30, 1982, to review IES recommendations to NSTAC members on the form, organization, and operation of NSTAC as the coordinating body for industry joint planning. A formal NSTAC

meeting to confirm such arrangements and to begin work on important issues was held on December 14, 1982. At that meeting the President, in welcoming the members, discussed national security telecommunications as a top-priority planning issue for his attention. The NSTAC identified the establishment of a central coordinating mechanism to coordinate industry activities in national security emergency preparedness telecommunications as the first issue the IES should address for NSTAC review. It then selected survivability of commercial satellite communications and of total, national telecommunications as priority issues for IES planning activities and for NSTAC's attention at its next meeting. Complementary to these, it asked the IES to bring focus to issues of automated information processing for review at the next NSTAC meeting.

The important telecommunications issue for which strategies are needed for joint industry/government planning is how to plan for, develop, and exercise a commercial telecommunications architecture, terrestrial and satellite, that is adequate to meet national security and emergency preparedness requirements. It is the view of the Committee on NCS Initiatives in Support of National Security Telecommunications Policy that such planning would be incomplete without paying some attention to cable video and mobile and fixed radio communication systems. This report addresses the problem of strategic joint planning in this broader context.

B. Statement of the Problem

The telecommunications industry in the United States, once monolithic, is rapidly becoming partitioned in ways that complicate the planning required for national security and emergency preparedness. The NCS depends on commercial facilities and networks for most of its domestic capability, and the Manager of NCS is responsible for the continuity of the system under adverse conditions. Responsibility for the design, construction, and operations of the underlying facilities, however, rests with commercial system managers, some of whom are adversaries in the marketplace.

The degree of cooperation required to plan for reliable communications appears to be inconsistent with the expected relationships among the commercial carriers and other competing services, such as cable video; the number of participants seems potentially to be inconsistent with an effective planning process; and incentives to implement security plans, once they are made, are of uncertain effect. An approach to effective joint planning within industry, and between industry and government, is needed to satisfy both industrial and government needs for reliable emergency communications. Because of the increasingly competitive environment in telecommunications services, special precautions will have to be taken to be sure that carriers who cooperate in joint planning for national security/emergency preparedness (NS/EP) purposes do not thereby expose themselves to liability under the antitrust laws without there being other cause for such action.

The accelerated introduction of competition by all three branches of the government has been based on the fundamental belief that not only will better economies for the user result but also that the pace of technological innovation will be quickened in the process. The effects of increased

competition on the performance of U.S. telecommunications with respect to emergency preparedness will probably come in two stages. Short-term, the effect will be to create a number of tactical problems having to do with a loss of centralized management and accountability. Strategically, more rapid improvements in the technological base can have a lasting positive effect on recoverability by providing richer connectivity, a wider variety of transmission media, and more powerful terminal equipment and services based on them.

In light of this rapidly changing situation, the NCS must face new options for carrying out its mission. Clearly, the growth of competition, among many other changes, calls for regular review of NCS policies. Technology and regulatory changes bring problems too, but none has been so serious as those posed by the Consent Decree entered in August 1982 in settlement of the government's antitrust case against AT&T.

C. Definition of "Industry"

"Industry," as used in this report, includes all carriers whose facilities and services are used by or are available to the government. Each carrier owning facilities is responsible for managing those facilities as a self-sufficient system or as a subsystem of some larger configuration. Each resale carrier dependent on the facilities of others is responsible for managing its own system through working agreements with its suppliers.

Each such system or subsystem requires internal specifications that govern its performance and interface specifications that define interconnection requirements. Internal specifications are the exclusive responsibility of the system provider. Interface specifications are defined in negotiated contracts between system providers or by consensus among system providers, users of services, and suppliers of equipment.

II. THE NEED FOR NATIONAL JOINT PLANNING UNDER PD-53

Presidential Directive 53 is a statement of National Security Telecommunications Policy issued on November 15, 1979. It states that a survivable communications system is a necessary component of our national security. It further requires very heavy reliance to be placed on the national telecommunications infrastructure supplied by the common carriers. PD-53 established the following principles as policy:

- National security and continuity of government telecommunications requirements have priority in restoration of services and facilities in national emergencies.

- To the maximum extent feasible, interstate common carrier networks, including specialized common carriers and domestic satellite carriers, should be interconnected and capable of interoperation in emergencies at breakout points outside of likely target areas.

- The NCS will make available the information necessary to allow interstate common carriers to locate backbone facilities, where possible, outside of likely target areas.

- Functionally similar government telecommunications networks shall be capable of interchange of traffic in emergencies.

- The Federal Emergency Management Agency, in coordination with the National Communications System, shall plan for emergency use of industry private line communications that have significant capabilities (e.g., pipeline, railroad, and airline).

- There must be a capability to manage the restoration and reconstitution of the national telecommunications system following an emergency.

- The NCS will consult with the Federal Communications Commission (FCC) on implementing these principles and will place substantial reliance on the private sector for advice and assistance in achieving national security and preparedness goals.

The planning requirement that must be satisfied covers the entire spectrum of telecommunications activities, from standards to implementation and testing of the actual interconnects required. The committee observes that:

o All communications systems are vulnerable in varying degrees to different threats. Planning should identify the strengths and weaknesses of each of the various communications media and the systems using those media and seek to match the strengths of one with the weaknesses of the others. It is not reasonable to expect to be able to make them all invulnerable, but careful planning and selective improvements can be made in such a way that the totality becomes much more robust and enduring.

o The role of the government is crucial, but if it attempts to proceed unilaterally the likelihood of success is vanishingly small. There appear to be no criteria or guidelines available to industry today other than those contained in the NCS's restoration priority system. That restoration priority system still requires value judgments to be made in each individual case by affected government agencies and is 10 years out of date. It and its civil counterpart administered by the FCC are probably adequate to handle a national emergency situation but are clearly inadequate to the task of meeting massive restoration and reconstitution needs following a nuclear attack on the United States. With proper planning by joint industry and government bodies, national capability to provide essential communications immediately after an attack can be developed.

o NCS requirements for emergency planning for government communications overlie procedures for coping with disasters that are already in place in an industry noted for continuity of service. The extant service restoration practices will undoubtedly satisfy some part of the NCS needs. Issues relating to priorities among users of circuits in need of restoration and to the handling of major disasters may be the first ones addressed by the NCS in joint planning activities.

o PD-53 calls for interconnects outside of nuclear attack target areas and facility planning so as to locate backbone facilities outside those target areas but provides no criteria by which the industry can decide even what are considered to be target areas. Government criteria and guidelines for planning of the communications facilities (and hardening of the telecommunications structure against physical effects, and radiation) are not generally available to industry. Additionally, since the government is likely to have to subsidize other than normal construction required to satisfy target avoidance and facility protection requirements, it must determine the degree to which such protection is required weighed against the cost impact of doing so. These are just a few of the reasons why government leadership in this planning effort must be aggressively pursued.

o On the other hand, the industry itself, which will be called on to accomplish the actual interconnects or to implement proposed standards, as either additions to existing plant or features to be incorporated into future plant, must be a major player in the planning effort. To illustrate: A protection feature seen as desirable by the government could be very expensive

seen through industry's eyes. Moreover, the costs are not simply direct costs. Hardening a satellite against EMP imposes a weight penalty that translates into either the number of transponders on orbit or the on-orbit life of the satellite itself. Both of these have long-term economic costs far exceeding the additional hardware costs associated with providing the added shielding and higher-quality components. Only by industry/government joint planning on an interactive and continuing basis can the objectives of PD-53 be fulfilled.

Joint planning by competing industrial concerns always raises the question about antitrust implications. However, PD-53 clearly contemplates joint planning, and the ongoing debate surrounding proposals to rewrite the 1934 Act (most recently S.898 and H.R. 5188) and the Modification of Final Judgment (MFJ) seems to contemplate some joint planning for defense and emergency preparedness with appropriate notification to the appropriate regulatory body, probably the FCC.

o Much of the centralized network planning has in the past been accomplished by the Bell system with participation by the independent telephone industry. The growth of intercity competition and the structural requirements being levied on AT&T by the FCC Computer Inquiry 2 decision, proposed telecomunications legislation, and the MFJ clearly will significantly erode AT&T's ability to provide the centralized planning leadership and direction characteristic of the past. There are provisions in both of the legislative drafts and in the MFJ that allow common planning by the divested Bell operating companies as a group to meet defense and emergency preparedness needs. There is a long tradition of telephone industry cooperation in the form of such organizations as the U.S. Independent Telephone Association (USITA). There is, however, no equivalent organization for the growing number of other common carriers or, for that matter, any formal joint planning activity within industry that could immediately replace the traditional Bell/Independent Telephone Companies relationship.

o Some organization dedicated to joint planning by the carriers and devoted specifically to defense and emergency preparedness planning is clearly needed. It will be important that the participants lay aside their competitive feelings to achieve the common good that should emerge from such a joint industry planning effort. The NCS took the first step by gathering the chief executives from a number of major carriers to a series of high-level briefings on March 16, 1982, giving background on threats to national security and the need for top-level, joint industry/government planning to cope with these threats and received substantial support from the industry leaders present. NCS has held subsequent briefing conferences with working groups comprised of high-level executives in the firms represented by the industry leaders and proposed a National Security Telecommunications Advisory Committee (NSTAC) comprised of the industry leaders to advise the President on this and other NS/EP problems of telecommunications. On September 13, 1982, the President signed Executive Order 12382 establishing NSTAC as an advisory committee reporting both to him through his Assistant for National Security Affairs and to the Executive Agent for the NCS. NCS continues to work with NSTAC and its working groups, as described in more detail on pp. 1 and 2.

There are a number of significant issues that the government must resolve internally before it is prepared to lead a joint planning activity.

At the head of these issues is that of financing the costs that will be incurred in providing the interconnects, protection features, or target avoidance. In the past the national security community has been able to influence planning by the established carriers, and the added costs for such construction have been indirectly borne by all rate payers. It is not evident that competing carriers will voluntarily weaken their competitive posture by adding features that raise the cost of their telecommunications plants. Hence, the issues of who pays for the added costs and in what manner are fundamental.

Second, the requirements must be provided by the government in a relatively scenario-independent method. Where the interconnects should be established and how much hardening is required are typical examples of the requirements-definition process that the government must undertake. It must do so with full awareness of the cost impact. Some interaction with industry will be required.

There will also emerge an issue as to who is to be included or excluded in the joint planning process and joint planning organizations on both industry and government sides, as well as who becomes an early candidate for emergency use in reconstitution activities. The telecommunications industry structure is in a state of great turbulence--new entrants and new services appear almost monthly. Private networks (both terrestrial and satellite based), satellites dedicated to cable television, direct broadcast satellites, radio and TV stations, digital termination systems--the list is almost endless. Moreover, a joint planning activity with representation from all parts of this very diverse group would fill a very large hall and probably achieve little.

Similar to the need for joint planning within industry, a joint planning body is needed within the federal government. Many government agencies arrange for their own communication services through their own budgets. Some of these services can be provided commercially; some are unique and require individual systems for their provision; and some of the individual systems are government operated. The committee does not see that effective planning procedures and organizations are yet in place within the government for NS/EP communications. While the NCS is working with NSTAC to achieve effective joint planning within industry directed to NS/EP needs, it should turn its attention to a comparable activity within the government for which it can speak effectivly, organized so that it and the industry joint planning body can work together (as well as separately) to achieve the NCS's NS/EP objectives.

The planning requirements, the respective roles of government and industry, and the issues sampled herein are not meant to represent an all-inclusive listing. They clearly fall short of that. However, this synopsis does show that joint planning is essential and that although it may not be easy it should be undertaken at a very early date. The March 16, 1982 conference and subsequent activities leading to the establishment of NSTAC through Executive Order 12382 are a good beginning. Much remains to be done.

III. APPROACHES TO JOINT PLANNING

The needs of the NCS for joint planning with industry can best be met by building on a sound structure for joint planning within industry. Even though industry joint planning efforts are narrowly focused, they are so organized, and they contain such skills, as will enable resources to be added to meet the broader NS/EP requirements of the NCS. This chapter will describe how such a structure within the industry might operate and how this can be used as a foundation for NCS/industry joint planning.

A. Industry Joint Planning

As explained on page 4, the term "industry" as used in this report includes all carriers whose facilities and services are normally used by or are available to the NCS. Each carrier that owns facilities is responsible for managing those facilities as a system unto itself or as a subsystem of some larger configuration. Each such system or subsystem requires internal specifications that govern performance of the system and interface specifications that define interconnection requirements.

Local exchange telephone operating companies (exchange carriers) are a special case, because, unlike other carriers, (1) they interface directly with nearly all users of nearly all systems; (2) near uniformity among all of their subsystems is essential for the proper operation of nearly all other systems, as well as their own; and, (3) they function within franchise areas assigned by government authority and therefore are not in competition with each other to any appreciable extent. Given these circumstances, the exchange carriers must associate for the purpose of developing and publishing standards and specifications that are applicable to the entire local network. In doing so, they must reach agreement among themselves, they must accommodate the needs of rapidly changing technology in terminal devices, and they must ensure successful interfacing with interexchange networks with which there is a mutual interdependence for the availability of interexchange services. Success in these challenging efforts is essential to the local exchange carriers for the employment of their own facilities, and it should be possible, therefore, to depend on this process as a foundation for other steps in joint planning.

The planning staffs of the exchange carriers (or the central staff of the

divested Bell Operating Companies, possibly in association with an industry trade association) will include many hundreds of engineers providing technical support for the planning and standards work for exchange networks. In the normal course of business, representatives of this group will meet with manufacturers of terminal and switching equipment to discuss possible changes in exchange system standards. (At the present time this is accomplished through the Equipment Compatibility Committee of the U.S. Independent Telephone Association [USITA] and the AT&T Company.) Conclusions will be reflected in proposed changes to published documents, which will be made available for comment to all interested equipment suppliers.

The same process will be followed by the local exchange carriers with representatives of the competing interexchange carriers, as mandated by the terms of the 1982 Modification of Final Judgment (MFJ) of the 1956 Consent Decree and because the interexchange carriers are, collectively, the largest users of the exchange networks. These discussions will also address standards but will concentrate on the interface specifications between local and interexchange networks. This subject, in turn, is closely related to interconnection among the interexchange networks themselves--a matter that is of great importance to NS/EP considerations.

The pattern described above for the local exchange carriers and the interexhange carriers may be repeated as often as necessary, with the local exchange carriers meeting with the operators of mobile systems, satellite systems, CATV systems, or any other communications provider requiring interconnection with the exchange portion of the telephone network.

At appropriate intervals the exchange carriers will reissue their published standards and specifications, reflecting the same in their tariffs by reference, as is the present practice. For example, Tariff FCC No. 1 of the Winter Park Telephone Company, Section 2.1.6, specifies signal levels that can be accommodated by the network.

Experience with the present method of developing standards, which depends on an integrated Bell Telephone System as the primary source, suggests that under new conditions of industry structure this expected method will not be highly controversial. The most important precaution required will be to ensure that all equipment suppliers have the opportunity to participate at the same time, either directly or through representation, so that none is able to obtain advance notice and thus secure a competitive advantage. Since the present vertical integration between the local Bell carriers and the Western Electric Company will no longer exist, the problem of such assurance would appear to be greatly reduced relative to past circumstances.

It must be assumed that some party to the process will at some time feel aggrieved; thus, an appeal route to the FCC must be available. Under present law the FCC has the authority to adjudicate technical standards, and all

proposed amendments to the Communications Act assign some sort of oversight responsibility to the FCC with respect to technical standards.*

Present law provides that the President has authority over common carriers in certain circumstances,** but under the expected restructuring of the industry some expansion of this authority should be sought. For example, the President might be authorized to establish programs for provision of communication services; facilities to provide such services; and plans and arrangements for mutual backup, restoration, and interconnection of such facilities and services for national security and emergency situations. The NCS may wish to consider further expansion of this authority to include requesting communications companies to engage in meetings for joint planning of national security communications, services, facilities, interconnection, and operations. It may also wish to consider an amendment to the Communications Act of 1934 specifically charging the FCC to consider national security and emergency preparedness (NS/EP) in the "public interest, convenience, and necessity"*** in its regulatory, rulemaking and ratemaking proceedings.

B. Industry/Government Joint Planning

The interests of the NCS in joint planning begin with design standards and extend through consideration of routing, physical protection, interface specifications, network management, points of access and interconnectibility, and administration under emergency conditions. There are also difficult cost or financial problems to be resolved that flow from the technical considerations. All of these extend beyond the scope of pure system standards, but all of them have important effects on system standards and other design specifications that are addressed by planning engineers. It is for this reason that the approach to solutions should draw on the same resources within the industry, insofar as it is practicable to do so.

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*The FCC's existing authority is derived from Section 1 of the Communications Act of 1934. Technical standards for terminal equipment appear in Part 68 of the FCC Rules and Regulations. H.R. 5158 contained a provision (Section 241 of the Committee Print dated April 8, 1982) directing the FCC to establish and enforce uniform technical standards for transmission services and facilities and interconnection of terminal equipment.

**Specifically, under Section 606 of the Communications Act the President is authorized to give priority to essential communications during wartime; to suspend or alter federal rules governing common carriers, close the facilities of common carriers, or authorize government operation of such common carrier facilities during war or threat of war; to suspend or alter federal regulations applicable to stations or devices that emit radiation during war or threat of war, state of public peril or disaster, or other national emergency (emphasis added).

***The quotation is from the Communications Act of 1934, as revised through 1978, Sections 214 and 302.

- **Design Issues**

Some of the technical needs of the NCS will be similar to the needs of commercial users, even if of a higher order--e.g., reliability. Some NCS requirements, however, are unique--e.g., avoidance of target areas. Among technical and operational requirements, the NCS is interested in the interconnectibility and flexibility of systems and access thereto, the vulnerability of systems to interception and interference, the routing of systems for target avoidance, and the hardening of facilities to resist damage. Three of these design needs of the NCS will be examined briefly.

a. Systems Interconnectibility, Flexibility, and Access. The interconnectibility of systems is a matter of commercial importance as well as being important to the NCS. The technical terms of interconnection will necessarily be uniform among most, if not all, exchange carriers and will ordinarily be reflected in their tariffs as well as in published specifications. The NCS will find that the same planning staffs that develop and maintain internal standards for the exchange carriers are appropriate initial points of contact for improving, if necessary, the arrangements for the interconnection of interexchange systems at the points where they meet the exchange environment. The engineers of the interexchange carriers who work on the design of exchange connections will, of course, be party to these discussions and will, in turn, open up channels for the negotiation of flexible circuit routing within and between systems.

Through these discussions, channels will be identified for the development of interconnection capabilities between interexchange carriers at nodal points that are outside metropolitan areas or are otherwise apart from the points of interconnection with the exchange systems. Flexibility, the placement of nodes having the physical capability to reroute circuits, or to interconnect systems, must be designed into systems at the beginning. NCS should make such relatively scenario-independent government guidelines and criteria for NS/EP planning of telecommunications facilities available to the participants throughout these discussions.

With regard to satellite communication the NCS should establish a domestic communications satellite planning activity with points of contact designated by the domsat carriers. The purpose of the activity would be to develop a catalog of domsat facilities and define network control connectivity required for reconstitution.

Selected earth stations (i.e., those located remotely from assumed target areas) should be the first set to be examined as candidates for PD-53 interconnect and some network control interconnectivity. Some or all of the stations so selected should be designated to perform network control functions on a prearranged successor basis.

b. Vulnerability. The vulnerability of systems to interception and interference is a function of system design, which is to say of internal standards and specifications. The NCS must first determine if existing systems are vulnerable to a degree that is inconsistent with NS/EP

requirements, and to do this it will be necessary for NCS representatives confer directly with the owners and managers of these systems. If there is need for improvements, proposed specifications should be presented by the NCS to the same engineers, already identified, who are responsible for the placement of physical facilities.

c. Routing and Hardening. The routing of transmission systems, the location chosen for switches, and the physical hardening of sites are all a part of system design, and proposals will be developed by the same planning staffs for later consideration by industry managers at a higher level.

2. Operational Issues

After the physical needs of the NCS have been identifed and the means for meeting them have been determined, practical arrangements for implementing the solutions will have to be employed. The ability to gain access to systems and to interconnect systems with equivalent interface standards is a particularly severe operational problem for which it will be necessary to have executive-level agreement, in principle, to an industry/government joint planning process, and a practical, efficient arrangement for administering the process.

a. Protection of Cooperating Carriers in Support of NS/EP. Because the interconnection of systems is of commercial importance, contractual relationships that define the terms of such interconnections will develop, as there now exist, among the carriers. While economic terms might be negotiated individually, this is unlikely with respect to the 1,000 or so exchange carriers, and a model agreement approved by the FCC is to be expected. This model agreement is a starting point for the NCS, which will require more flexible interconnections at the interface between interexchange and exchange facilities and also interconnection capability outside such areas of exposure. Initial discussions about such arrangements should begin at the highest possible level of carrier management to secure understanding and acceptance of the concept. Later negotiations can be conducted at the contracting level of management.

Gaining access to existing circuits at points where such access may be required in an emergency has already been recognized as a serious problem. It may be the first, and possibly even the largest, example of conflict between the needs of NS/EP and basic economic business considerations.

Only the simplest of services can be established entirely with the resources of any single carrier. Special contracts or working arrangements will be needed in order to meet the expectations of the NCS for the prompt establishment of new services or the rearrangement of existing services, for which past experience will be only partly applicable in the new industry environment. Restoration capability calls for similar working agreements among carriers, for which existing precedents may now be applicable to only the exchange carriers.

Because some of the carriers involved will be mutual competitors, it is possible that some specific legal authorization for collaboration in the interest of national security will be required in order to secure the necessary special working arrangements--recent antitrust history having created great disincentives for taking such risks.

b. Federal Authority to Compel Cooperation. It is easy to say with a high degree of confidence that all carriers will usually cooperate fully with the NS/EP requests of the NCS, after the other issues addressed in this section have been resolved. "Usually," however, is not sufficient in a matter of such critical importance to the public safety. Federal law must affirm the authority of the President and/or the FCC to compel cooperation, even under conditions that are not yet recognized publicly as an emergency. (Such authority exists now with respect to priorities, preemption of facilities, and their operation by the government;* the issue, therefore, is to affirm that it is adequate for planning and implementation of facilities, and/or their operation, by cooperating industrial firms under the expected conditions of industry structure or, if it is not, to define the need for changes. Any such legislation should be drafted to ensure that such presidential authority does not lead to abuse and is used only when absolutely required.)

c. Service Mobilization and Restoration. From a technical point of view, the ability to establish service on very short notice and to restore service after it has been interrupted is a function of the resources of the carriers, including availability of spare parts and the motivations of their managements to assist other carriers, e.g., their willingness to exchange equipment. This was not a problem under the system prior to the MFJ (see Chapter II, Section I, p. 4). Under the post-MFJ system, it may be. The challenge will be found in the attitudes and motivations of competing carriers.

3. Funding Issues

Many features have been built into the present telephone network that were not required for commercial reasons, in order to meet the needs of NS/EP. For example, several thousand miles of transcontinental transmission circuits have been hardened and are routed so as to avoid potential target areas, and the buildings that house terminal facilities that are critical to these and other important cables are hardened against natural disaster and military attack. To a large extent, this was done at the cost of the carriers building the network, with these costs being recovered in the normal ratemaking process. Increased competition and the likely post-MFJ environment make it improbable that future rates will permit recovery of such costs. When NS/EP requirements are clearly beyond commercial needs and are readily identifiable from both physical and secrecy considerations, e.g., the physical hardening of a terminal for an underseas cable, the costs should be paid out of the federal budget. When NS/EP requirements are of commercial value, even though beyond what the carriers are willing to pay for, the best arrangement for funding is probably to make the inclusion of such features mandatory for all carriers--

*Section 606 of the Communications Act of 1934.

either through FCC licensing procedures or through legislation--and thus enable each carrier to recover its costs in the ratemaking process, as in the past. There will be gray areas between these extremes, not easily classifiable, that should be made the subject of discussion with high-level management of the carriers to develop a recommended procedure.

Even though many such requirements might be met by direct funding or by mandatory construction standards that are readily acceptable to the carriers, it is highly desirable that new legislation be obtained as a part of the solution to this problem. The NCS may wish to seek a modification of the Communications Act that declares NS/EP considerations to be in the public interest and instructs the FCC to take them into account in its proceedings.

4. Implementation Issues

An effective plan for implementation of industry/government joint planning will depend on leadership, on both sides. Within the government, an effort should be made to ensure that the NCS can speak with authority on NS/EP matters for all of its member agencies. In industry, it may be necesary to hold exploratory discussions before the real leadership can emerge, but it should be assumed from the beginning that the chief executive officer of the central staff of the Bell Operating Companies will play a key role.

a. Executive Level Agreements in Principle. There is no directly applicable precedent for industry/government joint planning on a scale that is comparable to the need discussed in this report. It follows, therefore, that little can be accomplished until (1) there are adequate legal protections and (2) there is agreement at the executive level of each participating company that something of this nature must and will be done. By its very nature, it is a concept that will be endorsed in general terms more easily than it will be implemented in practice.

b. Effective Administrative Arrangements. The requirement for a practical, efficient arrangement for the administration of industry/government joint planning is easily grasped. The danger lies in moving too rapidly on detailed matters, before two prerequisites have been met. These are the restructuring of intercarrier arrangements within the industry and agreement on concepts at the executive levels of participating companies. There are other requirements, also, that can be met while waiting for these conditions to be established, so it does not follow that precious time will be lost, e.g., government's needs will have to be defined and quantified. Much work on definition and quantification is required within the federal establishment before detailed attention can go beyond that step. The sequence of actions must be carefully considered. Within both industry and government, these issues must be addressed at the executive level in the context of support/administrative arrangements before great accomplishments can be expected at the technical level.

C. Findings

1. Industry/government joint planning for NS/EP in communications rests on a foundation of system standards and specifications that are primarily the

responsibility of industry. Interface specifications are published by the carriers and are reflected in their tariffs.

2. Current practices for developing and publishing technical specifications for the telephone system are based on a highly integrated industry, which is now taking on a new structure of diverse and competitive entities. Some accommodation to these changes must be made by the industry in its approach to the publication of technical specifications and standards. The carriers that provide local exchange services will have a primary responsibility for the interface specifications upon which other carriers will depend. The organization that is used by the exchange carriers for this purpose is the appropriate working level contact for the NCS in its efforts to address NS/EP requirements.

3. It will be necessary for the current examination of national policy on telecommunications to continue beyond its present uncertain state before detailed arrangements can be completed at the working level for industry/government joint planning.

4. Even though the FCC is known to have authority over certain aspects of standards and specifications, the expected changes in industry structure make it necessary for this authority to be clarified, in the interest of NS/EP.

The Communications Act does not charge the FCC to take NS/EP considerations into account in its regulatory, rulemaking, and ratemaking proceedings.

An appeal route to the FCC has not been provided to ensure equal opportunity for all equipment suppliers to participate in the process of setting technical specifications and standards.

5. Presidental authority under the Communications Act does not cover establishment with industry of programs or facilities to provide communication services nor planning and arrangement with industry for mutual backup, restoration, or interconnection of such facilities for national security or emergency situations.

6. The NS/EP requirements for routing flexibility and for system interconnectibility exceed the expected commercial requirements for these features, both of which call for cooperation among competing carriers.

7. The need for the establishment of new or changed services on very short notice, which is now met through the cooperation of an integrated industry, must be addressed in other ways under the expected industry structure. The same can be said of the need for prompt restoration of facilities in case of physical destruction. Both will require unprecedented cooperation among competing carriers.

8. Even though the President has authority over the nation's common carriers under certain emergency conditions and has delegated certain of that authority to the NCS, the expected changes in industry structure together with

recent litigation under the antitrust laws make it necessary for the NS/EP obligations of the carriers to be clarified and for cooperation among the carriers in the interest of NS/EP to be required by federal law.

9. The NS/EP technical requirements for reliability and protection against interference, interception, and physical damage may exceed the expected commercial requirements for these same features, all of which impose additional costs in system design, construction, and operation.

10. The ability to gain access to communications channels under emergency conditions, and in unexpected locations, may impose on the carriers additional costs in system design and require additional investment.

11. The expected competitive industry structure will not permit additional costs to be assumed by any single carrier unless all competitors are equally burdened.

12. Since some of the added costs of NS/EP capabilities are beyond commercial needs, the competitive industry structure suggests that new legislation is needed as part of a solution of the issues of who pays for such added costs and in what manner.

13. Effective joint planning within industry for NS/EP communications is hampered by the lack of government and technical requirements and relatively scenario-independent criteria and guidelines. Much work is needed within the government to define and quantify its needs in NS/EP telecommunications, e.g., number and location of interconnections, how much hardening is required and where, and placement and description of nodes having circuit-rerouting capabilities.

14. Although there is experience with industry joint planning in terrestrial telecommunications, no comparable experience or mechanisms exist for satellite communications, nor is there any government planning activity for the interconnection of satellite communication facilities.

15. Within the government, effective, interagency, joint planning mechanisms and procedures do not yet seem to be in place for NS/EP communications, inhibiting the ability of the NCS to speak for its members.

16. Although it has the potential to contribute to an NS/EP communications system, the cable television industry has not yet participated in NS/EP joint planning activities.

D. Recommendations

1. High-level discussions between the NCS and industry management, perhaps starting with executives of the exchange carriers, should begin now, to address the following issues:

a. The need for NCS to have greater interconnectibility among systems than will be required for commercial reasons alone.

b. The need for a single point of contact with the NCS to deal with the setup, change, or restoration of services and the acceptance of end-to-end responsibility.

c. The need for specific legal dispensation for competing carriers to collaborate in order to meet NS/EP requirements.

d. Practical alternatives for funding the needed greater physical security and voice frequency access in systems design, or in routing or hardening of facilities, than the carriers will require for commercial reasons.

2. The NCS should lead an effort within the federal government to bring together and quantify the NS/EP needs of all agencies and to develop a priority rating for them, preparatory to negotiations with the standards-setting staffs of the carriers.

3. After the NCS has explored with industry management the kinds of upgrading needed to meet NS/EP requirements, it should explore the funding options with the industry and, if necessary, secure the assistance of the Office of Management and Budget and of the FCC to establish written policies and propose appropriate legislation relating to funding.

4. The NCS should recommend that the President propose to the Congress specific legislation to clarify the extent and type of federal authority over commercial telecommunications systems that is required for NS/EP and the obligation of commercial carriers to cooperate in the interest of NS/EP without, thereby, exposing themselves to damage under the antitrust laws.

5. The NCS should recommend legislation instructing the FCC to include NS/EP considerations in the public interest in its regulatory, rulemaking, and ratemaking proceedings.

6. The NCS should include the cable television industry in its joint planning activities.

7. Once the NCS establishes criteria for telecommunications systems relative to NS/EP requirements, specific studies should be conducted to determine if there are preferred cable television system designs for meeting those requirements.

8. The NCS should establish intragovernmental joint planning mechanisms comparable to those in industry, to enable it to speak for its members and to work with the industry joint planning bodies effectively.

9. The NCS should establish a satellite communications planning activity with points of contact designated by the domestic satellite carriers, to develop a catalog of facilities and define network control connectivity required for reconstitution, examining selected earth stations as the first set of candidates for PD-53 interconnection and network control.

IV. COMMERCIAL RESOURCES AVAILABLE TO THE NCS

A. Background

Commercially offered communications services in the United States are all-pervasive. They link substantially every home as well as every office in business, in government, in health services, academia, the professions, and more. The telephone network, the backbone system in the spectrum of communications services, has operated for many years as a group of regulated public utilities with interconnected services offered by a multitude of noncompeting companies ranging from the world's largest to some of the nation's smallest.

B. Bell, AT&T

American Telephone and Telegraph, the Bell System, is the largest carrier. Through its Long Lines Department, AT&T furnishes nearly all the long-distance connections in the country. It also owns or controls 22 Bell regional operating companies that provide local telephone service in their franchised geographical areas. Long Lines' interstate rates are under the regulation of the Federal Communications Commission (FCC). Local rates are approved by the State Regulatory Commission having jurisdiction over the franchise territory in each state. Bell Operating Companies (BOCs) serve approximately 146 million telephones in the United States. AT&T is under court order to divest itself of its ownership in the 22 regional companies by February 1984.

C. Independents

There are also more than 1,500 independent telephone operating companies that provide telephone services to the balance of the nation and own some long-distance facilities (mostly intrastate), serving 35 million telephones. The four largest independent systems are, in order of size, GTE with 16 million telephones, United Telephone System with 4.8 million, Continental Telephone System with 3 million, and Centel System with 1.7 million. The independents, too, are subject to state (and federal) regulation. However, state-approved local rates, even for the same service, can vary, depending on such factors as investment in facilities and quality of service.

D. Interconnection

The entire interconnected telecommunications network operating under this complex structure runs extremely well. Although more than 1,500 different corporations are owners and operators of various separate elements and are subject to various regulatory directives from 51 different federal and state governmental bodies, the service provided is the world's best. Much of this success is due to the provision in the Communications Act of 1934 providing for carriers to cooperate in the offering of joint through services, in which they are partners rather than competitors. Because of this relationship, the ownership of facilities has become almost irrelevant in the design and management of the network, and all partners have generally adhered to common standards. The aggregation of costs and the pooling of associated revenues (see Section H) has permitted improvements to be made when needed for the good of the whole system, without their having to be justified economically to the owner of the plant being improved. This whole working relationship is placed in some jeopardy by the developments now taking place to restructure the telephone industry.

E. Universal Service

The major goal of federal regulation since the Communications Act of 1934 has been to extend telephone service to all through a concept called "universal service" at reasonable rates. That goal has been satisfied with more than 98% of the nation's residential units and substantially all other customers now served by the network.

In order to achieve such universal service, the regulating agencies, both federal and state, which have authority to set rates for the service, have allocated the cost of commonly used facilities in such a way as to keep local rates low and long-distance rates higher than they would be under free-market conditions. Business services have customarily paid higher rates. In similar fashion, long-distance or toll rates have generally been based solely on distance rather than reflecting the economies of scale that arise from lower costs over routes that have heavy traffic volume. These rate-averaging and cost-shifting concepts have been instrumental in reaching the 1934 legislative goal of universal service at reasonable cost. Today a telephone is as much a public service necessity as food or shelter.

F. U.S. Standards

The need for common technical and operating standards in such an environment is obvious. Since the Bell System has both local and toll service and at the same time controls the greatest part of the total industry, most U.S. standards and operating practices have originated in the Bell System. Through the U.S. Independent Telephone Association's (USITA) Committees on Engineering and Equipment Compatibility, other telephone companies and equipment manufacturers have been kept informed of Bell practices and of new developments at Bell Laboratories. Bell has technical, engineering, and operating resources that are unmatched by virtue of its size, and most new developments in world telephony have, over the years, been introduced by Bell.

G. International Standards

International standards are established by the International Telecommunications Union (ITU), an organization operating under the auspices of the United Nations. Radio standards fall under an ITU committee, designated CCIR, while telephone and telegraph fall under another, designated CCITT. The quadrennial plenary meetings of the CCIR and CCITT result in the issuing of a number of books containing recommendations on all aspects of communications systems. While the CCIR and CCITT are purely advisory, the almost universal acceptance of their recommendations gives them the status of standards. From time to time, radio conferences are called by the CCIR on the allocation of frequencies. Their findings, when approved by the U.S. Senate, become, in effect, treaties.

The ITU permits more than one international standard in some cases. U.S. telecommunications practices have often led the European environment in the application of new technology, and our standards are generally approved, along with noncompatible alternatives. U.S. participation in the CCITT and adoption of their recommendations were greatly accelerated with the start of the transatlantic voice service over the first cable in 1956 and with satellite service in 1965. Active participation of the United States in international radio conferences dates back to the turn of the century, since radio transmission called for international cooperation to a much greater extent than did wire transmission until mid-century.

H. Separations

The application of formulas for dividing revenues among carriers, for services that are jointly provided, is a corporate function known by the name "division of revenues" when practiced within the Bell System and as "settlements" when it is between companies of different ownership. The quantity of revenues derived from a given service is determined by a ratemaking process that, in turn, depends on cost allocations known by the name "separations." The rules for allocating, or "separating," costs that are common to several services are developed by state and federal regulators cooperatively through "joint boards," with staff support and advice provided by the carriers, leading to final approval by the FCC.

The division of revenues (or settlements) process calls for all revenues derived from specified services to be pooled for later distribution so as to cover the costs (as defined by separations) of each carrier, with the residue, if any, being distributed so as to provide a common rate of return to each carrier on the plant that is dedicated (or allocated) to the same services. The carriers themselves administer the process, subject to regulatory review. One effect of this process is to aggregate costs over wide geographical areas, and over several different services, obscuring cost differences that may be substantial. Information provided by the carriers to state and federal regulators indicates that, with the advent of intense competition for certain services, these cost differences will be exposed and will have to be recognized in the ratemaking process, with resulting higher prices to some users of basic telephone services.

Separations rules have been changed from time to time, and those that are now in effect define the cost of long-distance services at a higher level relative to local services than did previous rules. Since these rules do not apply outside the traditional telephone carrier group, competitors do not have their long-distance costs defined in this way, enabling them to price their services below the costs of the telephone carriers. This fact is the basis for widespread concern that separations rules will have to be changed in ways that will reallocate costs from long distance back to local services, resulting in substantial increases in the prices for local services.

I. NCS Facilities

The unique operating arrangements within the telephone industry have made it possible for most of the needs of the NCS to be satisfied through a single point of contact within the Bell System. Whether the need was for long-range planning, hardening or other protection of facilities, the procurement of either long-haul or local circuits, or emergency restoration or other response to unexpected developments, responsibility was accepted at that single point of contact for the desired end result. All carriers cooperated with each other to make this possible.

J. Elements of Change

In the early 1970's, universal service having been achieved, the FCC began consideration of the role that competition might play in setting reasonable rates for telephone services and at the same time broadening participation in the telecommunications industry. The Congress, too, during the 1970's, perhaps uncomfortable both with the monopoly power of AT&T and with the regulatory results of the FCC, studied the matter and eventually opened hearings on modifying the 1934 Act. The Justice Department entered the picture in 1974 with an antitrust action against AT&T. An earlier case, filed in 1956, resulted in a consent decree that has been modified by the Federal District Court of Washington, D.C., in its Modification of Final Judgment signed August 24, 1982 (see Chapter V). During this same period, computer companies and users of data transmission services were vigorous in their demands for new and cheaper data services over the telephone network, even though the volume of such traffic was extremely small compared with that for the normal voice mode.

The 1970's witnessed the introduction of domestic satellite services to supplement the toll network through seven ground stations, four operated by Bell and three (one in Hawaii) by GTE, the largest of the independent companies.

Mobile telephone services became saturated in all large urban areas and a new concept called "cellular radio" was proposed and tested; FCC approval was requested and granted in 1982. The cellular concept replaces high-power transmitting stations that cover relatively large areas with a structure of small cells, each containing a low-power transmitter, arranged in a frequency plan that prevents mutual interference. Cellular transmitters and receivers have access to the public switched network (PSN); master stations in each

cellular complex are connected to the PSN through switches that operate in the CCIS network. In October 1982 the FCC gave AT&T conditional approval to construct such a system for the Chicago market. Applications for the top 30 markets have been filed jointly by AT&T, GTE, and 20 other independent telcos.

K. Competition

FCC efforts to introduce competition in the 1970's has had some impact on long-distance service but almost none on local service. Specialized common carriers (SCCs) initially offered long-distance, private-line service to business customers, largely over high-density routes, and were eventually authorized by the FCC to offer switched voice service to the public, causing them to be designated "other common carriers" (OCCs). Depending on the company, this traffic flows over channels leased from Bell and the independents or over facilities owned by each OCC. In general, rates of these OCCs become competitive with normal long-distance rates when the volume of calls reaches a substantial level. OCCs include Microwave Communications, Inc. (MCI); Southern Pacific Communications Company (SPCC); U.S. Transmission Systems (a subsidiary of IT&T); U.S. Telephone Communications, Inc.; Midwestern Relay, Inc.; and Western Telecommunications, Inc.

OCCs also have been authorized by the FCC to transmit voice and data by satellite. The "satellite" carriers include Western Union, American Satellite Corporation, RCA Americom, Satellite Business Systems, and GTE GSAT. (These satellite services are discussed in Chapter IV.)

Satellite Business Systems (SBS), jointly owned by IBM, Comsat General, and Aetna Life and Casualty, offers satellite links to business users. The service is aimed at large corporations with many geographically dispersed plant and office locations. Satellite ground station antennas of small size (diameter of 15 feet, or 4.7 meters) are located at each interconnected premise. This service will accommodate both voice and heavy data traffic, and it bypasses even the local element of the regulated telephone network. ISACOMM, a resale carrier, offers similar services via the SBS satellite. Starting in 1983, SBS offers a public switched line service.

Value-added carriers (VACs) cater to business users' needs for data traffic on a more intermittent basis. They employ packet switching, storage, and a transmission language, all of which combine to share more efficiently the cost of the leased lines over which the data flow. They also provide an instant "translation" service that allows computers of different makes to talk with one another and with terminals made by still other manufacturers. All data traffic, regardless of the "language" and "speed" of the end customer, is "translated" into a special language designed for high-efficiency transmission. That special language, known as X.25, has become a U.S. standard and a CCITT international standard. The VACs lease toll lines from AT&T and the OCCs, provide nodal connecting points in many large cities, and make use of local dial-up telephone connections to the nodes in order to offer a lower-cost service. They include GTE Telenet, Tymnet, Graphnet, and Uninet.

The considerable growth of community antenna TV (CATV) systems, which transmit over broadband coaxial cable to homes in many U.S. communities, has naturally given rise to suggestions that other communications services use these cables. At this time, these city-wide networks are not interconnected with one another and they are used for one-way transmission only. Provision for two-way capability is allowed for in the more recently completed systems, but return-path equipment has not been widely installed. Some experimental usage of narrow-band return signals is under way for alarm services, voting, and the like. The lack of privacy in systems that do not have switching or its equivalent is presumed to be an obstacle to the near-term use of CATV networks for telephone-like services. (Chapter IV deals more fully with this subject.)

L. Computer Inquiry Two

In Computer Inquiry Two (CI-2), the FCC ruled that, among other things, the status of customer premises equipment (CPE) change after January 1, 1983. This ruling applies to telephones, key sets, PBXs, on-premise wiring, and the like, which have traditionally been owned by the carriers and furnished and maintained under a form of lease agreement. After January 1, 1983, the market for CPE is to be detariffed, except for technical compliance with Part 68 of the FCC's rules, enabling users to buy or lease equipment from any available source. AT&T's participation in this market must be through a separate subsidiary that, under the court's divestiture order, will take over the CPE now owned by the regional Bell Operating Companies. The FCC has yet to determine how CPE owned by independent operating companies, or acquired later by BOCs, will be treated for ratemaking purposes. There are at least four options and numerous combinations for completing this task. One option, sale to customers according to some formula, appears likely to survive among the choice of options.

M. National Security and Emergency Preparedness (NS/EP) in Government Regulation

In federal and state regulatory proceedings, economic and social considerations have dominated the debate, with little mention of NS/EP considerations. Although the Communications Act of 1934, as amended through 1978, does say in Title I that one of the purposes for which the FCC is created is "for the purpose of the national defense," no section of the Act instructs the FCC to consider NS/EP specifically in its regulatory proceedings. Subsequent provisions of the Act relating to national defense and national emergency only define presidential powers to declare traffic priorities and to preempt facilities for priority traffic. Although individual court decisions on specific regulatory issues have supported the propriety of NS/EP considerations in FCC regulatory proceedings, the absence of specific authorization in the Act makes understandable the FCC's placing negligible weight on NS/EP as a serious consideration in what the Act describes as the "public interest, convenience, and necessity"*--criteria to

*Section 214 (a); Section 302(a).

be satisfied in regulatory decisions. Thus, NCS may wish to take an active role in seeking modifications to the Act to provide specific direction and authorization to the FCC to consider NS/EP in the "public interest, convenience, and necessity" in its regulatory proceedings and to seek authority in the law for state regulatory commissions to do likewise.

N. Government Communications

The telecommunications requirements of the agencies of the federal government are characterized by very high volumes of voice traffic, a significant amount of which can be classed as high-priority, coupled with a need for privacy. The locations that must be served are extensive and dispersed over the whole country. Some data connections are required, but their number, though increasing, is still small compared with voice.

These requirements have been met through leasing circuits from the traditional telephone common carriers supplemented by many switched connections under the normal tariff and rate structures. The current situation continues this practice for the most part. Departures are starting to occur from the practice of leasing subscriber premises equipment (PBXs, key sets, telephones, etc.) from the traditional common carriers as allowed under Computer Inquiry Two.

In light of the changing current situation as outlined in this chapter, NCS has faced new options in the last few years for carrying out its mission. Clearly, the growth of competition, among many other changes, calls for regular review of NCS policies. Technology and regulatory changes bring problems, too, but none has been so serious as those posed by the consent decree entered in August 1982 in settlement of the government's antitrust case against AT&T.

V. LIKELY EFFECTS OF JUDICIAL AND REGULATORY DECISIONS

All three branches of the government have initiated actions to accelerate the introduction of competition into commercial provision of communications services. Although Congress has not completed any action, the effects of its deliberations can be seen in the outcome of FCC decisions and court actions initiated by the Department of Justice. This chapter considers the latter two.

The accelerated introduction of competition by all three branches of the government has been based on the fundamental belief that not only will better economies for the user result but also that the pace of technological innovation will be quickened in the process. The effects of increased competition on the performance of U.S. telecommunications with respect to emergency preparedness will probably come in two stages. Short-term, the effect will be to create a number of tactical problems having to do with a loss of centralized management and accountability. Strategically, more rapid improvements in the technological base can have a lasting positive effect on recoverability by providing richer connectivity, a wider variety of transmission media, and more powerful terminal equipment and services based on them.

A. The AT&T/Justice Department Antitrust Consent Decree

In January 1982, AT&T and the Department of Justice jointly proposed settlement terms to the Federal District Court of Washington, D.C., for a consent decree in the government's seven-year antitrust action, terms that, if accepted, would have a far-reaching impact on the traditional regulated telephone system. The terms of the settlement suggested by the two parties called for a major restructuring of the Bell System. The court, recognizing the validity of certain points raised by interested parties, formulated 30 questions and asked for comments that would lead to additional hearings. In late June, when these hearings were opened, more than 50 respondents had filed material with the court. After the hearings the Federal District Court judge issued his decision in early August. Both parties agreed to his Modification of Final Judgment (MFJ) terms, and the MFJ was entered on August 24, 1982.

Under the terms originally proposed by the two parties, AT&T will divest the 22 local-service Bell Operating Companies (BOCs), which remain subject to federal and state regulations. Divestiture is to be completed within 18

months of the settlement date. The BOCs will be restricted from certain businesses that independent companies may pursue. AT&T will keep Long Lines, Western Electric, and Bell Laboratories and will set up a new subsidiary to offer competitive services (the latter is not permitted under the 1956 consent decree).

The court's modification of some of the terms and the court's added conditions include a provision that allows BOCs to retain "yellow pages" revenue, to market new terminal equipment, and to petition the court in the future for the lifting of restrictions imposed by the decree.

In spite of the thoroughness of the court's procedures, in a restructuring of the magnitude encompassed by the MFJ many questions remain to be resolved. Some of these detailed elements supporting the agreement will be submitted by AT&T to the court and the Department of Justice on or before February 24, 1983, as part of the proposed reorganization plan due then. (AT&T's reorganization plan was filed on December 16, 1982.) Others may be worked out only after some years of experience with the changed structure, and still others may not be resolved even after appeals procedures have been exhausted.

There have been many expressions of concern, in filings before the court and in testimony before committees of the Congress, that the existing telephone system--widely regarded as among the finest in the world--is being restructured by the court. Some regard this as a technical action for which the court is not qualified, and some regard it as a setting of national policy that should be a function of Congress. It now seems clear, however, that any technical considerations will take second place to antitrust considerations and that the efforts of Congress to amend the Communications Act of 1934, and thus restate national policy, will produce nothing before 1983 at the earliest. A few of the issues, some far reaching, that continue to require study and attention include service to the public over the long term, defense and emergency needs of government, the impact of major technological changes on the network, and the role of regulatory procedures--federal and state--in the future as increasing competition is introduced into telecommunications. The national welfare as well as the future competitiveness of the United States with other nations require careful deliberation and reasoned judgment on the part of Congress in eventually preparing legislation that will address these and other issues.

In spite of the uncertainties that remain after approval of the MFJ by the court, it is possible to speculate with some certainty on parts of the outcome. In particular, the NCS is concerned only with particular elements of the result, not the entire effect. With that in mind, the following assumptions seem reasonable. It should be pointed out that these assumptions are intended to provide a basis for a scenario for planning purposes. Other scenarios can and should be considered.

1. The ruling of the court has been appealed, but it is assumed that this action will have no significant effect on either the decision of the court or the dates on which the rulings will be effective. (The appeal by the state of Maryland is based on the premise that the courts cannot preempt state regulation and it seeks a stay.)

2. AT&T will divest itself of the 22 BOCs, which are being formed into 7 regional groups having a single central organization for engineering, administration, and standards setting. The central staff organization will also contain the single point of contact for national security and emergency preparedness in dealing with the BOCs.

3. The divestiture will occur no later than February 24, 1984, and probably on January 1, 1984, the current AT&T target date.

4. The BOCs will be permitted to offer only exchange or exchange access services and other services that are considered to be natural monopolies and are regulated under tariff. The independent (non-Bell) companies are not thus restricted.

5. Before divestiture, new "exchange" area boundaries will be adopted by AT&T within which BOCs will carry the traffic. Currently designated as local access and transport areas (LATAs), they redefine the "territories" of the BOCs. AT&T has proposed 161 such LATAs. Traffic between LATAs will be toll or long-distance traffic, to be handled by AT&T Long Lines or any other qualified competitive carrier.

6. To ensure equal exchange access, BOCs and independent local companies will eventually share with qualified, competing long-distance carriers the long-distance revenues from calls arising from or terminating in their territory. These charges, designated "access charges" (for access to the local network), may continue to help subsidize local service, which remains under regulation. Access charges that are set too high will encourage competition in local distribution, competition from CATV networks, or competition from Long Lines and OCCs that can bypass the local company and provide direct lines to large businesses and other users. FCC and state regulation will approve access charges.

7. BOCs are barred from equipment manufacturing, all inter-LATA (interexchange area) service, and the information service markets.

8. BOCs may market new, detariffed, customer premises equipment (CPE).

9. BOCs will turn over to AT&T the ownership of the currently installed customer terminal equipment (the embedded CPE base).

10. AT&T will no longer be subject to compulsory patent licensing requirements.

11. The final ownership of some shared facilities is indefinite. Where such facilities and equipment are jointly used by AT&T and one or more BOCs, the ownership will be transferred to the BOCs if AT&T makes less use of the facility than the divested BOCs.

12. The plan of reorganization (including the divestiture plan) must be filed with the Federal District Court judge by February 24, 1983. (As noted on p. 27, the reorganization plan was actually filed on December 16, 1982.)

13. The judge retains the authority to issue further orders for the interpretation of the terms of the settlement, for its implementation, and for dealing with violations of the agreement.

14. The judge has made provision for further intervention on the part of a number of interested parties up to the time of divestiture. Thereafter, the court retains jurisdiction and can open the case on its own initiative or at the request of either of the two contending parties.

The committee believes that the preceding assumptions are very likely to occur as of the writing of this report (30 November 1982). They form the basis for suggestions to the NCS on guidelines for that part of future planning to be carried out in concert with the providers of telecommunication services.

The words used in the MFJ are subject to interpretation, and the forthcoming AT&T reorganization plan will contain new definitions. It is therefore important to recognize that elements of the terminology commonly used in the industry prior to this judgment will no longer be appropriate for Bell and AT&T operations. The former independent industry (to which the MFJ does not apply) must also review terminology in the interests of uniformity and common understanding. For these reasons, special care must be exercised to avoid misunderstandings. Certain words used in the past, such as "toll," "long distance," "local service," and "interexchange," may not correctly define the new circumstances. Some words have new meanings. The decree's references to "exchange area" and "interexchange telecommunications" are defined in the decree. AT&T's attempt to carry out the terms of the decree has introduced the LATAs--a term not yet clearly understood. In dealing with the industry at this time, NCS should ask for clear definitons of terminology and make use of full explanations in internally prepared documents.

The preceding discussion of the MFJ suggests certain assumptions for future planning by the NCS:

1. NCS can no longer deal with AT&T on a semiexclusive basis for either local or long-distance planning, in contrast to any past practice.

2. Since toll and some local services will be offered by competing companies, the practice of loading common costs onto long-distance services to lessen local rates will become less common than in the past. Thus, local telephone rates will increase, and long-distance service will be available from multiple sources, probably at lower cost. NCS must increasingly be prepared to pay for its NS/EP requirements under these competitive pressures.

3. The equal exchange access provisions of the decree will undoubtedly suggest the issuance of requirements documents and requests for quotation to the competing long-distance carriers even though AT&T Long Lines may still be the dominant carrier (currently more than 95% of traffic).

4. Considering the fact that some competing long-distance carriers lease lines from AT&T and from one another, the search for alternate geographical routes to reduce vulnerability will be complex.

5. Mechanisms for joint planning and standardization by local service telephone companies must continue to exist. NCS planning may couple with the body that provides this ccordination as a procedure both for informal information exchange and for joint planning.

6. Long-distance carriers must compete with one another, and joint planning among them is therefore unlikely (possibly unlawful) under the decree. The NCS planning workload will increase if each carrier must be separately involved, yet legal requirements may dictate "equal treatment." For this reason NCS may find it advantageous to deal with local service companies as suggested under 5 above. Those companies, in turn, must work with all long-distance carriers.

7. The period prior to the divestiture date (assumed to be January 1, 1984) is likely to be one in which some companies are cautious about entering into any long-term (more than one year) contracts. Reduced dependence on separations and settlements procedures and the adoption of the new access charges will bring about temporary uncertainties in the income of many of the companies. The uncertainties are compounded by the difficulty of and the time required to redefine the equipment and assets used for local service in contrast to the assets assigned to interexchange or long-distance services. This redefinition is a function of LATA boundaries, among other factors.

8. The question of LATA boundary definitions is expected to be a controversial matter that may affect NCS planning and that will require some time to resolve. In principle, the LATAs were to avoid noncontiguous territory; crossing state boundaries; and so-called gerrymandering, among other conditions, wherever possible. The initial 161 LATAs proposed by AT&T require a substantial number of exceptions to these constraints and hence will lead to objections to the court by independent companies and probably by state commissions. The financial implications are potentially very significant. Only the court can resolve controversies under the MFJ (see assumption 13, page 29), and it is therefore anticipated that the overload on the judge may be considerable, leading to delays.

Some experts in the industry believe that there will be many more issues, such as the one just described, that will require court intervention. This leads to the conclusion that perhaps three to five years will elapse before conditions stabilize with respect to the MFJ.

9. The Class 4/5 study implementation appears to be threatened by the decree because ownership and control over Class 4/5 offices and related facilities may be confused for a brief period. The decree calls for future establishment of ownership of jointly used facilities based on some measurement of the "use" made by AT&T and by the BOC. (See MFJ Assumption 11, page 28.)

10. Since the MFJ permits the long-distance carriers to "invade" the franchised territory of BOCs in order to provide "interexchange connections" (long-distance lines) directly to customers, it is likely that this technique will be used where the long-distance traffic volume warrants. Large business customers (or possibly a group of different commercial users) can in this way expect special rates for long-distance service probably not subject to state regulation, over facilities that bypass the local service company. Government and NCS planning must recognize that this possibility may present opportunities for alternate routing, lowered costs, and less vulnerability through diversity.

11. The MFJ limits the products and services that may be offered by BOCs (under regulation). The BOCs are different from independent companies in this regard. State regulators will be faced with two different classes of local service companies under their jurisdiction, which cannot be treated equally and which cannot give statewide uniform services to the public. The two classes will possibly be called BOCs and non-BOCs since the term "independent" may need redefinition. NCS, too, must recognize that local service will no longer be essentially identical throughout the nation. For planning purposes, this disparity may introduce problems. Eventually, state regulators are likely to find ways to eliminate these differences.

B. FCC Computer Inquiry Two (CI-2) and Likely Effects

1. Background

In recent years the FCC has taken a number of actions to increase competition in the telecommunications industry. The Competitive Carrier Policy docket, under consideration since 1979, aims at reducing regulation in cases where it is found that competition is a better vehicle for defining the service. For example, the July 1982 decision on resale states that, for just these reasons, the FCC will "forbear" from regulating pure resellers of transmission services. Computer Inquiry Two (CI-2) has resulted in a determination to detariff nonbasic common carrier services ("enhanced services") and all new CPE.

The CI-2 decision of May 1980 defined what basic transmission service and enhanced service are and stated that if the provider of competitive enhanced services was the dominant carrier (the Bell System) it could not own basic transmission facilities. Basic services were defined as "the offering of transmission capacity between two or more points suitable for a user's transmission needs and subject only to the technical parameters of fidelity or distortion criteria, or other conditioning." Enhanced services were defined as "any offering over the telecommunications network which is more than a basic transmission service." This has meant for Bell an arm's-length separation between AT&T (basic services) and the "fully separated affiliate" American Bell, Inc. (enhanced services). In the case of the nondominant carriers, those providing enhanced services, such as GTE Telenet, could, if they so desired, own basic transmission facilities and their tariffs would still not be subject to FCC regulation.

Thus the FCC actions, including especially CI-2, take a different cut at deregulation and competition from that of the Department of Justice's antitrust decisions described in the preceding section. Whereas the distinctions drawn in the antitrust decisions are dominated by geography (local versus national long-haul communications), the FCC has been preoccupied with the question of what kind of service is to be provided by whom, regardless of geography.

The CI-2 decision and the other FCC actions mentioned have important NS/EP consequences for at least three reasons: (1) because the competition they engender is expected to provide a variety of connectivity alternatives going beyond what is presently available, (2) because CPE is expected to proliferate as a result of new technical capabilities, and (3) because the decisions affect how computers may be used.

2. Increased connectivity

The basic transmission service provided by such other common carriers as MCI, Satellite Business Systems, and Southern Pacific represents usable long-haul connectivity resources whose existence is directly attributable to the procompetition policies of the FCC. In the long-haul area, such resources as the microwave relay network of MCI or the satellite earth station complex of SBS come to mind. In the short-haul sector ("local exchange"), the domain separating the customer's premises and the central office of a long-haul carrier, there are many new options in the making, notably the cable facilities discussed in section IV-B. Sophisticated and ubiquitous radio-frequency circuits are about to proliferate in new frequency bands with cellular radio, and existing mobile radio (including CB) is an obviously usable resource. Local, private, fixed, microwave systems--e.g., two-foot dishes pointed across the street between office buildings--represent connectivity that, if extensive enough, can help solve recovery problems in urban areas. These local resources are essentially all analog; proposals are now being made that will define two new classes of digital termination services, one using cable (or fiber) and the other radio.

In addition to the long-haul and local connectivity resources of carriers providing only basic transmission services, one should not overlook those components of value added carriers (VACs) that provide the basic transmission upon which the value is added. For example, if one of the VACs added its own long-haul microwave backbone, this would not be tariffed by the FCC but would be just as valuable an NS/EP resource as one that was.

The problem in exploiting this capability is that a new dimension of advanced contingency planning will be required, involving the coordination of a large number of enterprises on behalf of the national good. Legal and regulatory issues such as the FCC's position on occasional breaches of the basic/enhanced split will have to be worked out in advance, as will schedules of repayment to a carrier for loss of use of the preempted resource. The NCS should start now to explore which of these augmented connectivities is apt to be most valuable and should prepare for their use as early as possible in support of NS/EP functions.

3. Customer premises equipment

Much of the evolving customer premises equipment (CPE) has built-in capability that can serve in performing recovery functions. For example, many PBXs embody special route-finding and route-optimizing software that automatically cycles through several available inter-city connection options looking for one with desirable properties, usually economic. Autodialers, even at the home consumer end of the market, often include repetitive redial and other options that have the effect of increasing the ability to communicate when some circuits have failed. Any computer network, whether public or private, has some form of alternate routing capability built into the software and the operator functions.

As these capabilities become more attractive, the same kind of contingency planning mentioned earlier will be required jointly between NCS, the FCC, and the community of end users owning the CPE.

4. Utilization of computers

Until recently, network recovery has taken place mostly by the expedient of voice conversations across analog paths. As long as these voice paths could be found across pieces of the network, little else was needed to accomplish a great deal of the recovery. However, the story is changing rapidly. The role of the computer and of such services as database inquiry or the execution of special application programs on nonswitching-related processors is already becoming a significant element of recovery processes, for the simple reason that the system is too complex to be managed otherwise. Many of these database and application functions fall exactly in the area that CI-2 addresses.

According to CI-2, such databases and such processing, when a part of the process of providing basic transmission, are to be considered part of that function and therefore part of the tariff-regulated function, as is the case today. Other database functions and applications, such as long-term message storage and banking applications, are to be executed in facilities owned by competitive enterprises, for example, American Bell.

One of the NS/EP implications of this more competitive aspect of the enhanced services is that there is certain to emerge a rich variety of data-processing facilities normally used by the fully separated subsidiary and others using the basic transmission service backbone. Although these facilities will not be intended for emergency service in recovering the backbone, careful advance planning and suitable contractual arrangements ought to allow them to be pressed into some form of service during a national emergency.

5. Other effects

The decision by the FCC that no new CPE may be added under tariff starting January 1, 1983, opens the way for new alternatives and new policies in this regard. The regulated utilities will continue to use, re-use, and re-install

the present embedded base of terminal equipment where customers will accept the equipment. For settlement purposes only, the FCC will permit the straight-line depreciation of this equipment over a five-year period.

With respect to the future cost of long-distance services to the NCS, it seems clear that, with its large usage of service, the government's costs will decline. Very substantial decreases in rates will depend on the formula used to allocate the costs arising from non-traffic-sensitive elements in the network. If the FCC should determine that these particular costs should be borne equally by all telephone users (on the basis that all users have equal access to the long-distance network), the drop in rates will be large and local service charges will increase.

To summarize the implications of the FCC actions: as increased competition produces more transmission paths, and as the machines interposed between user and the bare transmission technology become more sophisticated, less standardized, and also less a part of the regulated world of basic transmission, managing the recovery of the path will involve not only an increased number of players to coordinate but also an increasingly powerful set of tools to exploit.

VI. COMMUNICATIONS SERVICES AND STRUCTURE OTHER THAN TELCOS

Satellite, cable, broadcast, mobile, and high-frequency radio communications systems provide services that augment, and in some ways differ from, those provided by telephone carriers. In particular, satellite and cable system services represent important additions to the telephone-network resources potentially available to the National Communications System (NCS) for NS/EP communications. This chapter considers the NS/EP potential for those two types of services. Concentration on them does not imply that there is no NS/EP potential for the others; rather, it is meant to present examples of approaches to NS/EP communications planning that could be applied to other services as well.

A. Communications Satellite Services

1. Growth

Domestic communications satellite services have grown at an extraordinary rate in the last five years. That growth has been due in large measure to the unique advantages of satellite transmission. These are generally agreed to be:

- o distance insensitivity, making satellite transmission costs competitive for circuits over 500 miles in length, particularly for the growing wideband (56 kilobits and higher) data market;
- o very high quality transmission path produces the very low error rates required by high-speed data users;
- o generally much quicker response time to install satellite earth stations than to extend terrestrial facilities into remote areas; and
- o area coverage gives unique advantage (technology and cost) for broadcast application.

The explosive growth in domestic satellite capacity can be most clearly seen in the number of transponders in orbit. At the end of 1981 there were about 150 transponders in orbit. At the end of 1982 there were about 270 domestic transponders in orbit (excluding the Canadian Anik series and military communications satellites). By the end of 1985 that number will rise

to approximately 600, assuming FCC approval of requests currently before it and successful financing by some new entrants.

2. Satellite-Based Services

There are two general categories of satellite-based services: conventional common carrier services and broadcast (particularly TV, but with audio on the rise).

a. Common carrier services are provided by the following:

1. American Satellite Company owns 20% of the WESTAR I through V series and 50% of the commercial capacity on Advanced WESTAR and plans to launch its own satellites in 1985 and 1986. It has 80 earth stations, with 25 under construction in 1982. It offers private-line voice, data, and facsimile to the business community and other common carriers through five large, general-purpose earth stations. It provides dedicated business and government networks through the remaining 100 earth stations.

2. AT&T leases Comstar satellites from Comsat but will begin replacing them with its own TELSTAR satellites in 1983. AT&T has six large, general-purpose earth stations with 16 more planned, principally for use in wideband (1.5 megabit) data applications. Satellite transmission is, in general, used to complement the terrestrial network or public network services, voice and data private lines, and video service.

3. GTE shares part of the Comsat Comstar capacity with AT&T but plans to launch two of its own satellites in 1984 or soon thereafter. GTE also has three large earth stations and shares others with AT&T. It primarily offers private-line voice and data services for resale to other common carriers. Future planned use of its own satellites has not been clearly defined but will certainly include providing transmission for its own public network services, e.g., TELENET.

4. RCA Americom has four satellites in orbit, one of which is a "cable bird" (dedicated to video usage). It has 11 general-purpose earth stations and 19 used for private networks. RCA's primary emphasis, other than transponder leases for video users, is private-line voice and data circuits for other common carriers, government, and business. It also provides dedicated networks, primarily for the government. RCA recently acquired Cylix, which has 16 earth stations providing business communication services.

5. Satellite Business Systems (SBS) has three satellites in orbit, 20 general-purpose earth stations, and between 50 and 75 earth stations in being or under construction for private network applications. It offers business communications services (voice, data, facsimile, and video teleconferencing) to large users. Recently, it announced plans to provide dial-up services to the general public and international data services to the United Kingdom.

6. Southern Pacific Communications Company currently provides voice and data private lines and a public access long-distance telephone network

(SPRINT). It plans to enter the domestic satellite business with the 1984 launch of two satellites. It appears that the Southern Pacific Satellite Company will primarily lease or sell transponders to other carriers and video users. Southern Pacific Communications will apparently use some of the transponders to provide transmission for its common carrier services. The Southern Pacific Railroad recently agreed to sell to GTE all the communications activities of Southern Pacific, including their domestic satellite and terrestrial long-haul "Sprint" systems, subject to the necessary regulatory approvals.

7. Western Union has five satellites in orbit, one of which is nearing end of life. It has eight earth stations. It uses these satellites as transmission for its traditional common carrier services (as a complement to its terrestrial system), leases private line voice and data circuits to other carriers, and provides transponders by lease or sale to other users.

8. Others offering common carrier services include:

(a) ISACOMM has 17 operational earth stations with 23 more planned and resells space on the SBS satellite, providing data services to the business communications market.

(b) Vitalink has small earth stations providing data communications via leased or owned transponders.

(c) Transponder Corporation of Denver (a subsidiary of Johns Manville Corporation) provides private-line voice and data. Subject to the necessary regulatory approvals it has recently been acquired by the American Satellite Company.

(d) Western Telecommunications Company, Inc., has extensive terrestrial microwave networks and is now entering the common carrier satellite services market primarily to penetrate the Alaskan market with two earth stations.

(e) Equatorial uses a spread-spectrum technique to broadcast business information to very small (2 feet) receive-only earth stations.

(f) Private networks, e.g., MACOM (five earth stations), Harris (three earth stations), CitiCorp (eight earth stations), ARCO (five earth stations), and PSSC (two earth stations) also offer various private-line voice, data, fax, and video telecommunication services.

(g) The Public Broadcasting Service's television system (150 earth stations using 10-meter antennas), leasing several transponders from Western Union; and National Public Radio's broadcasting system (200 receive-only stations, using 7-meter antennas for reception of radio programs).

b. Broadcast carriers are many and varied. They offer a great variety of video broadcast services that range from religion to X-rated movies. There are about 25-40 large earth stations that feed thousands of TVRO stations that can receive these channels. Presently, all obtain their space segment from

transponders leased or owned from the common carriers described above. A partial listing illustrates the variety found in this category:

1. Hughes Television
2. Robert Wold
3. Cox Broadcasting
4. Bonneville Satellite
5. Double B Enterprises
6. Midwest Radio TV
7. United Video
8. Southern Baptist
9. Spanish International Network
10. Landmark Communications
11. POP Network
12. Lincoln Resource

c. New entrants in the space segment supplier role are emerging to provide broadcast and private network transponders by lease or sale. Examples are Hughes Communications (three satellites planned in the Galaxy series), USSI (two satellites planned), Rainbow Satellite (three satellites planned), and Advanced Business Communications (ABC) with three satellites planned.

3. System Characteristics and Planning Issues

The rapid growth of communications satellite systems has led to a growing set of incompatibilities among those systems. Early in the history of domestic satellites, a 36-megahertz transponder at C-band frequencies was conventional. More recently, however, 36- and 72-megahertz transponders at C-band and 43-, 54-, and 72-megahertz Ku-band transponders are appearing. TDMA systems are coming into vogue at 12-, 41-, and 60-megabit and, in one case, 64-megabit speeds. A single-sideband application for satellite transmission is under development, and various other techniques are used to enable more voice channels to be passed through a transponder. Examples are nearly instantaneous companding and 32-kilobit CVSD. Frequency reuse, cross-polarization, and other techniques are also emerging. The next result of the explosive growth and rapid technological change means that there are a growing number of incompatibilities among communications satellite systems so far as transponder bandwidth and modulation methods are concerned, but there is a common denominator in their use of 4-kHz voice channels and these can be interconnected.

There is no central network planning function nor network control system that could provide the necessary information to enable an earth station of one carrier to use a surviving satellite of another carrier unless the earth station had direct communication with the other carrier's network control station. In a reconstitution situation, some form of network control will be essential.

The growing population of transponders and satellites, together with the hundreds of earth stations in being or under construction, offers a rich resource to exploit for purposes of reconstitution. There are some fundamental actions that must be taken in planning for their use:

a. The planning activity must catalog the various satellites and earth stations by location, use, form of modulation, network control connectivity, ownership, etc. A comprehensive catalog should form the basis for pre-planning activity, particularly in providing advance knowledge of incompatibilities and the network control connectivity required.

b. Particular attention should be given to those large, C-band earth stations remotely located for frequency clearance purposes. These are most likely to survive collateral damage effects. They are, however, generally linked to central offices located within target areas; therefore, planning to obtain access from surviving terrestrial facilities to those earth stations becomes an early candidate for PD-53 implementation.

B. Cable Television-Based Communications Services and Structure in the 1980's

1. Introduction

The coaxial cable systems currently being used to deliver video entertainment programming to homes (cable television) can be used for bi-directional communications of video, data, and voice signals. There are several strong forces moving the cable television industry in the direction of providing such telecommunications services. Cable television systems, therefore, are likely to become wide-band, integrated, "local-loop" telecommunications systems within the next decade. Such systems have the potential of becoming an alternative to telephone twisted-pair or fiber-optic local loops and, from this point of view, should be considered as possibly playing a key role in meeting NS/EP objectives.

2. Background

Cable television is, today, primarily a one-way delivery mechanism for video entertainment programming to residential subscribers. Approximately 20 million of an estimated 80 million television homes are now served by cable. This number is expected to grow by 1990 to approximately 50 million cable television homes out of a total of about 90 million television homes. Cable currently passes (as opposed to serves) about 40 million homes and is projected to pass about 75 million homes by 1990.

There are approximately 5,000 cable systems in the United States today. Only 26 of these systems serve more than 50,000 subscribers.

Cable television began as a delivery mechanism for off-air television programming in small communities that were too distant from broadcast transmitters for viewing of such programming with typical roof-top television antennas. Cable television has experienced explosive growth in the latter half of the 1970's due to the availability of satellite-delivered pay-television services. This programming has become extremely popular, and, because it is not otherwise available, cable television has become an attractive business in large towns and cities.

Since the early 1970's it has been an FCC requirement that all cable systems be constructed to carry signals in two directions, i.e., both from the cable system's headend to the cable subscriber and from the cable subscriber to the cable system's headend. However, since no service had been demonstrated to be economically viable other than video entertainment programming, this requirement came to mean that cable systems were constructed so that the equipment to amplify signals in the direction from the subscriber's home to the headend was not initially installed but could be plugged in later.

3. The Changing Nature of Cable Television

The expectation that pay television services will make the owning and operating of television systems in large cities very profitable has led to intense competition for the franchises to build cable television systems in large cities in recent years. This competition has forced cable operators to promise to build their systems to be activated for carrying signals in both directions upon initial construction and to deliver telecommunication services as well as the traditional cable television entertainment programming services.

Additionally, most, if not all, franchises granted in recent years have included a commitment of the cable operator to construct a second cable system expressly set aside for two-way commercial communications services, both data and video. This second cable system, often called an institutional cable system, will typically be much more limited in coverage than the residential cable system and will tend to serve areas of a community where businesses are most prevalent as opposed to where homes are most prevalent.

Although the number of cable television homes passed by two-way active cable plant is very small today, probably less than 1 million homes, market and traffic projections indicate that by 1990 approximately half of the 75 million cable television homes will be passed by two-way active cable plant. This growth will come primarily from new construction (35 million new homes passed by 1990) that is entirely two-way active, with the remainder coming from upgrade to two-way in certain existing large cable systems. Between the residential and institutional cable networks, virtually all of the public facilities (schools, fire stations, courthouses), business facilities, and residences are passed by (if not connected to) the cable network.

4. Communications Services on CATV Networks

A typical cable television system constructed today will carry signals from the headend to homes on the residental cable in the frequency spectrum of 50 to 400 MHz. This same residential-service cable will be activated to carry signals from the home to the cable television headend in the frequency range of 5 to 30 MHz. In contrast, a typical institutional cable will have about 150 MHz of spectrum available in each direction for carriage of signals.

The spectrum on a cable telvision system is normally divided into frequency slots (frequency-division multiplexing--FDM), as is the broadcast spectrum for radio and television signals. These frequency slots can be used

in many different ways, as appropriate for the type of communications service desired. It has recently been demonstrated that packet switched networks using contention-based access protocols similar to those used in the Ethernet system are feasible on both residential and institutional cable systems for implementing home information and transaction services (videotex). Digital, switched, point-to-point voice services could be delivered over a CATV network quite efficiently also.

Since CATV networks have a "tree and branch" topology, as opposed to the "star" topology of a traditional telephone network, all signals on a particular branch of the tree enter all of the homes served by that branch. Thus, privacy and security can become concerns for certain types of services. Since these services will be digital, it is anticipated that encryption will become the major approach to mitigating these concerns, with the particular encryption approach chosen for a particular service based on the cost and security constraints of that service.

5. Interconnection of CATV Networks with Other Communications Networks

The cable television headend is the natural collection and distribution point for all signals on the cable television system. Virtually every cable television headend has at least one satellite receive antenna, and many, if not most, headends have two or three such satellite receive antennas to receive video entertainment programming signals from the various satellites in orbit. These satellite receive antennas are typically 5 meters in diameter and have an installation cost in the range of $15,000-20,000 per antenna. Certain sections of the country require larger receive antennas, 7 meters or possibly 10 meters in diameter, with somewhat higher purchase and installation costs. It should be understood that a modern, large-city cable television system will cost in the range of $30-$40 million to construct, and perhaps less than $100,000 of this will be for the satellite receive antennas. A typical 5-meter CATV satellite receive antenna can be equipped for data uplinking capabilities sufficient for a 56 kb/s data channel for approximately an additional $60,000. A more comprehensive facility with aggregate data rates in the range of several megabits per second or more would require the addition of upwards of $200,000 in antennas and other equipment.

Thus the obvious approach for interconnecting a cable television system with either other cable television systems or other communications systems for purposes of bi-directional data communications would be via satellites. It would certainly be feasible to interconnect cable system headends with telephone company switching centers or facilities of other common carriers via land-based links, either cable, microwave, or twisted pair, although it is less likely that such facilities would be constructed under presently anticipated market stimuli.

6. An NS/EP Scenario Involving Future CATV Networks

To illustrate how future cable television systems that are likely to be in place by the end of the decade might serve to help meet the objectives of the NCS with respect to PD-53, consider the following hypothetical situation. It

is based on the assumption that following a nuclear attack there will be surviving, unconnected islands of usable communications facilities that can be interconnected.

It is several days after a nuclear attack has been made on the United States. A primary target of this attack was the Strategic Air Command facility near Omaha, Nebraska. The city of Omaha has not received any direct hits, but the surrounding countryside has because of the SAC base. The primary telephone long-haul facilities connecting Omaha with the rest of the country consist of two microwave links, one of which has received near-direct hits by ICBMs directed at the SAC base and has ceased to function. Omaha's other link with the country, a Class 3 switching office in Kansas City, has been rendered inoperative because of a direct hit on Kansas City. Omaha is effectively cut off from the rest of the nation for telephone communication.

The Omaha public schools are, however, interconnected with the University of Nebraska campus in Omaha via the city's two-way interactive cable television system so that certain advanced experimental courses can be conducted. The schools are using special terminals, similar to computer terminals, for these courses. Additionally, several large corporations in Omaha are using a special private telephone network offered by the MCI Corporation to interconnect them for telephone service with their offices in other parts of the country. MCI has contracted with the cable television system to use their institutional network to interconnect these corporate offices with the MCI satellite uplink on the outskirts of the city. This institutional network utilizes the same "headend" facility as the residential network upon which the school systems are interconnected.

To assist in communicating the status of Omaha's situation for purposes of reconstitution of the government, the cable system operator switches through a data channel from the residential cable system to the MCI uplink so that the terminals in the Omaha public schools can be used to send telex-type messages to the surviving city of Colorado Springs, where the remnants of the federal government now reside.

This scenario is only slightly futuristic, in that both the education service and the MCI interconnection are currently in the testing phase in the city of Omaha by the city's cable television operator.

7. Joint Planning Interconnection Issues Involving CATV After the MFJ

Under the proposed AT&T divestiture agreement, every local communications area served by Bell will be partitioned into what are called LATAs (local access and transport areas). From the point of view of the Bell Operating Companies (BOCs), each LATA will encompass an area of local voice and data communications circuits that will interface with a long-haul network at a particular node called a "point of presence." Every long-haul common carrier who wished to do business with a LATA must establish a point of presence within each LATA. In general, one would anticipate that each LATA would contain more than one cable television system headend (possibly operated by different cable television system operators). Ultimately, one envisions a

national network of multiple, local-service providers interconnected at points of presence with multiple, long-haul service providers.

It is interesting to consider the competitive positions of providers of local services under this scenario. The BOCs and the cable system operators will be regulated on a franchise basis by local authorities based on local service. Providers such as digital termination service (DTS) operators will be regulated by federal authorities (the FCC) based on their use of radio spectrum. The dichotomy may well give one operator an advantage over the other operator for certain local services and should probably be examined from the viewpoint of the criteria for both fair competition and NS/EP. In any case, joint planning between such competing entitities will be difficult.

From the point of view of the NCS, it would seem most advantageous to have network interconnection standards defined so that multiple, local communications carriers are interconnected with multiple, long-haul carriers; with a common approach to system total end-to-end interconnection and retry in the event of failure of a single leg in the system. We can conjecture that this criterion would imply a signalling standard under which multiple, local communication paths are explored for connectivity as well as multiple, long-haul communication paths. One implication of such a strategy is that the signalling capability be distributed and implemented at the local origination point because the facilities of multiple carriers (for both local and long-haul communications) will be involved in the path retry algorithms. The definition of such a cross-carrier signalling strategy is most properly a subject for joint planning among various local and long-haul system operators as well as equipment manufacturers.

Another area in which joint planning is a necessity is that of communications protocols as functions of the type of communications system used. For example, although contention access protocols such as CSMA/CD are known to be efficient on cable television communications systems, these contention protocols are known to be very inefficient on satellite communications systems. A joint planning activity to standardize these conversion algorithms between these various protocols is a necessity.

The interconnection of numerous national communications sytems is in need of attention. We would expect that the voluntary use of agreed-upon national interconnection standards could occur via the same mechanism that achieves "enforcement" of national standards for computer systems input/output interface protocols. That is, government procurement of equipment and use of facilities would depend on the carrier and equipment manufacturer's adherence to agreed-upon standards. In return, the federal government should make use of all facilities that conform to the national standards, so as to encourage the availability of multiple sources of equipment and facilities to both government and industry as well.

There are two important points to keep in mind when considering the interconnection of cable television systems to other communications systems in the context of NCS objectives: (1) Most of the capital investment for cable television systems will be made in the 1980's. Thus it is possible through

quick action to affect greatly the facilities to be put into place. (2) There is a strong motivation for cable operators to develop and exploit data communications services because of the commitments for capital expenditures currently required to win new cable television franchises. Thus cable operators will be willing to cooperate with and, indeed, to stimulate activities leading to interconnection of their facilities with those of other communications systems operators.

8. Findings and Recommendations Involving CATV

a. Findings

1. Cable television systems have the potential of becoming alternatives or complements to telcos for local distribution services, and market forces exist that may encourage this to happen.

2. Little or no embedded plant will require replacement for this to occur because of the inherent two-way capability of cable systems constructed since about 1975 and to be constructed.

3. Since most of the investment to implement such local-loop capabilities has yet to be made, the nature of the resulting systems can be strongly influenced by planning done now. This planning may not be constrained by issues of embedded plant and existing interfaces to the extent it is for the telcos.

b. Recommendations

1. The cable television industry should be integrally involved in any joint planning activities relative to NS/EP needs.

2. Once the NCS establishes criteria for telecommunications systems relative to NS/EP requirements, specific studies should be conducted to determine if there are preferred cable television system designs for meeting the requirements.

APPENDIX

GLOSSARY OF ACRONYMS

BOCs	Bell Operating Companies
CATV	cable television
CB	citizen's band
CCIR	International Consultative Committee on Radio
CCITT	International Consultative Committee on Telephony and Telegraphy
CI-2	Computer Inquiry Two
CPE	customer premises equipment
CSMA/CD	Carrier-Sense Multiple Access with Collision Detection
CVSD	continuously variable-slope delta modulation
DTS	digital termination service
EMP	electromagnetic pulse
FCC	Federal Communications Commission
FDM	frequency-division multiplexing
GSAT	satellite communications system (to be) owned and operated by GTE
IES	Industry Executive Subcommittee
I/O	input/output
ITU	International Telecommunications Union
LATA	local access and transport area
MFJ	Modification of Final Judgment
NCS	National Communications System
NSDD	National Security Decision Directive
NS/EP	national security/emergency preparedness
NSTAC	National Security Telecommunications Advisory Committee
OCC	other common carriers
PD	presidential directive
PBX	private branch exchange
PSN	public switched network
SCC	specialized common carriers
TDMA	time division multiple access
TELSTAR	satellite communications system (to be) owned and operated by AT&T
TVRO	television receive only
USITA	U.S. Independent Telephone Association
VAC	value-added carrier
WESTAR	satellite communications system owned and operated by Western Union