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## PROGRAM MANAGEMENT COURSE INDIVIDUAL STUDY PROGRAM

JOINT SERVICE, UNSECURE TELEPHONE NETWORK  
FOR THE EUROPEAN THEATER  
(JOSUTNET)

STUDY PROJECT REPORT  
PMC 77-2

David Richard Gust  
Captain USA

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DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE:

JOINT SERVICE, UNSECURE TELEPHONE NETWORK FOR THE EUROPEAN THEATER (JOSUTNET)

STUDY PROJECT GOALS:

1. Analyze the need for new military telephone networks in Europe.
2. Examine the feasibility of installing a Joint Service Telephone Network.
3. Study management problems involved with Joint Service acquisition.
4. Review DOD policies on Joint Service procurements.

STUDY REPORT ABSTRACT:

The purpose of this study is to discuss the acquisition of a new administrative telephone network for the American military forces in Europe. The study reviews the history of the existing military telephone systems in Europe operated by the Army and the Air Force. An in-depth review of joint-Service procurement history and policies is included to show the previous trends and present policy guidance, with emphasis on the use of commercial, off-the-shelf equipment.

Several management problems which are discussed in the study project are:

1. a discussion of the Defense Communications Agency's (DCA) role in DoD communications management.
2. the unique aspects of the negotiated agreement between the German and American governments pertaining to operation of communications equipment within the host country.
3. the use of the JOSUTNET by NATO allies.
4. involvement by all Services concerned at the beginning of the Concept Phase of a program.

The study is mainly substantiated by research in DoD Directives, publications and GAO reports. The author has expressed his thoughts and opinions based on a recent tour in Europe in a job with staff responsibility for managing the Army's existing system.

The study concludes with an acknowledgement that a joint-Service program for implementing a JOSUTNET is viable and is needed. The study recommends that DCA manage the program and each Service participate in the development of the JOSUTNET plan.

Program/Project Management (10.02) Joint-Service

NAME, RANK, SERVICE	CLASS	DATE
David Richard Gust, Captain, USA	PMC 77-2	November 1977

JOINT SERVICE, UNSECURE TELEPHONE NETWORK  
FOR THE EUROPEAN THEATER  
(JOSUTNET)

Individual Study Program  
Study Project Report  
Prepared as a Formal Report

Defense Systems Management College  
Program Management Course  
Class 77-2

by

David Richard Gust  
Captain USA

November 1977

Study Project Advisor  
LTC Larry A. Deem, USAF

This study project report represents the views, conclusions and recommendations of the author and does not necessarily reflect the official opinion of the Defense Systems Management College or the Department of Defense.

## EXECUTIVE SUMMARY

This study project discusses the acquisition of a new administrative telephone network for American forces in Europe. An important aspect of this network is that it must serve more than one Service. The Air Force and the Army each operate separate administrative networks which have evolved since World War II. Presently these networks are using a type of electromechanical equipment with technology dating back to 1920. The quality of telephone service being provided to military users is poor and has a detrimental effect on productivity. Maintenance costs are increasing as this equipment's use is extended beyond an expected lifetime.

There have been several plans developed by the United States European Command and by the Army to replace the present networks with new electronic equipment using the latest technology. However, none of these plans have been successful in obtaining Congressional funding.

Current policy guidance from the Congress, the Office of Management and Budget and the Department of Defense recognizes and recommends joint-Service procurement actions whenever possible. Procurement of commercial hardware, when appropriate is also recommended.

The Joint-Service, Unsecure Telephone Network for the European Theater (JOSUTNET) can become a reality with firm guidance developed by DoD, tasking and managerial responsibility given to the Defense Communications Agency and complete support rendered by each Service.

### ACKNOWLEDGEMENTS

My last tour of duty was with the Army's 5th Signal Command in Europe. During this three year tour, my job encompassed staff responsibility for the Army's Direct Distance Dial and Dial Service Assistance telephone networks in Europe as well as the interface of these networks into the AUTOVON. My thoughts and opinions in this study represent a compilation of information which I received during this tour of duty. Although there were many individuals who provided input to my "personal data base", I must express special appreciation for the substantial advice and technical information received from the following coworkers:

MAJ Charles Gray, USA

Mr. Walter Lovingood, GS-12, USA

Mr. Charles Clark, GS-13, USA

Mr. Celso DiBernardo, C-9  
(a local national employee of the Army)

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## SECTION I

### INTRODUCTION

#### Purpose of the Study Project

The purpose of this study is to discuss the acquisition of a major system for use by more than one Service. Specifically, this major system is a new administrative telephone network for American military forces in Europe called the Joint Service, Unsecure Telephone Network for the European Theater (JOSUTNET).

#### Specific Goals of the Project

In this study, the author will undertake three specific goals. First, this study will analyze the need for replacing the existing military telephone networks in Europe. A study of their history and evolution into the present configurations is included in Section II. Second, this study will examine the feasibility of installing a single joint-Service telephone network to replace several separate networks. Section III contains a discussion of several attributes of joint-Service procurements, including present policy guidance. Finally, this study will consider several of the management problems involved with acquiring and installing a major joint-Service system in overseas locations.

#### Definitions

Several administrative military telephone networks exist in Europe at the present time. Some of them require operator assistance to complete a call and these are defined as manual networks. The Army operates the largest of these manual networks which is called the Dial Service Assistance (DSA) telephone network.

The bulk of all administrative telephone calls by the American military forces in Europe are dialed directly by the users without any operator

assistance. There are two of these administrative automatic dial networks. The Air Force operates a Voice Frequency Dial (V F Dial) network and the Army operates a Direct Distance Dial (DDD) network. A user of the V F Dial or DDD networks obtains operator assistance and access to manual networks by dialling zero. Presently there are in excess of 40,000 users of these two networks.

There is another type of telephone network in use which should be discussed. The Defense Communications Agency (DCA) is responsible for the management of command and control communications through the Automatic Voice Network (AUTOVON) and the Automatic Secure Voice Network (AUTOSEVOCOM).

#### Scope of the Study Project

By definition, the JOSUTNET is planned to be a replacement for the existing manual and automatic dial networks used for administrative telephone service. The JOSUTNET would interface with the AUTOVON but would not be considered as a replacement for it or for any other command and control telephone network.

There are four alternatives which will be examined in this study. They are listed as follows:

- #1 Maintain the Present Systems of Mechanical Switching Equipment
- #2 Purchase US-manufactured Electronic Equipment for Operation and Maintenance by US Military Forces
- #3 Lease Equipment and Maintenance from the Local Commercial Telephone Company
- #4 Purchase Equipment But Contract for Maintenance from the Local Commercial Telephone Company

A detailed cost analysis of these alternatives is included in Appendix A.

### Study Approach

The study will review the history and evolution of the present military telephone networks with a view toward establishing a single network to replace them. Next, a survey of joint-Service procurement history and policy will examine the guidance available to a program manager who may be assigned the implementation task of a JOSUTNET program. Finally, after some discussion, this study will draw some conclusions and make a recommendation for a JOSUTNET.

## SECTION II

### HISTORY OF EXISTING MILITARY TELEPHONE SYSTEMS IN EUROPE

After the Second World War, American forces occupied many locations in Europe, mainly in Germany. The telephone communications system that was available was primarily interconnected switchboards with operator assistance. In some locations, operable, captured German dial telephone equipment was used for local dial service with operator assistance being used for long distance connections. A prime example of this "early dial" capability is presently in service at the Abrams Building in Frankfurt, the headquarters of the Army's V Corps. Some of this dial telephone equipment was installed in the attic of the then-named I. G. Farben building in the early 1930s. The building was not destroyed during the war and became General Eisenhower's headquarters. This dial telephone equipment is of the step-by-step type of technology which uses electromechanical switches. However, most of the other locations in Europe received telephone service by manually ringing the switchboard and obtaining operator assistance.

With the continuing presence of American military forces in Europe and an increased deployment in the logistical base to support these forces, it soon became obvious that additional dial telephone equipment was needed to support the ever increasing needs for telephone service for administrative and logistics purposes. In the early 1950s, a procurement of European-manufactured dial telephone equipment was made. Step-by-step equipment, manufactured by Siemens in Germany, was purchased and installed wherever the Army (and also by this time, the Air Force) had a mission and needed telephone service. These installations, predominantly in Germany but also in France, made use of a favorable currency exchange rate and inexpensive

German labor. This procurement was in consonance with current American foreign policy which was interested in stimulating the German economy. The step-by-step dial telephone equipment provided local intra-area dial capability to telephone users, but long distance calls from one area to another still had to be placed via operator assistance.

By the late 1950s the demands for long distance service became quite large and operator assistance needed to be augmented by automation. Again, the Army entered the German market and purchased dial telephone equipment for use in signalling over long distance circuits. A numbering plan was developed and a dial network began to evolve as most operator-controlled circuits were converted to automatic dial by the telephone user.

By 1964, the Army's DDD network had evolved into a dial network which operated in several countries. The Air Force's V F Dial network was smaller in size but provided similar administrative telephone service to Air Force units which were also operating in several countries.

The decade of the 1960s provided considerable turmoil for military telephone service in Europe. The exodus of American military forces from France presented new requirements for telephone service in previously unoccupied locations in Germany. The Army provided telephone service to these new locations fairly quickly by removing the dial telephone equipment formerly operating in France and reinstalling it in Germany. In addition, the telephone industry in Europe had achieved technological advances and was marketing a new long distance dial equipment which was superior to the step-by-step equipment technology. Again, the Army entered the German marketplace and purchased a considerable amount of the new long distance dial equipment. It was compatible with existing step-by-step equipment and it improved long distance service within the DDD network.

For many years the Army and the Air Force each operated separate networks which had interface only through operator assistance. However, it was this same detrimental situation in the continental United States during the Cuban missile crisis in the early 1960s that resulted in the formation of the Defense Communications Agency (DCA). DCA was to assume certain management responsibility over telephone service being funded and operated by each Service. The fact that DCA was a joint-Service organization, staffed with communications personnel from each Service, did help establish credibility for the difficult task ahead. Commanders in each Service relinquished control of major voice communications networks which were merged to form the AUTOVON. The Commander-in-Chief needed this command and control network with access to each Service. In addition, each Service had some communications requirements with the other Services. A natural extension of the AUTOVON was soon established at overseas locations with priority in the Pacific because of the Vietnam war. Ten AUTOVON switches were installed in Europe and were interconnected with some existing telephone offices in the DDD and V F Dial telephone networks. The overseas AUTOVON is a computer-controlled switch and represented another technological advance. These advances in technology were summarized in a recent FORTUNE magazine article:

For half a century, or more, telephone exchanges operated on what the industry calls the "step-by-step" principle, meaning the opening and closing of mechanical switches in accord with dialed instructions. In the mid-Fifties the crossbar exchange, which did some routing electronically, began to replace step-by-step. But the displacement was nowhere near completed when, in the early Seventies, all-electronic exchanges came piling in. (9: 144-145) \*

\* This notation will be used to refer to the numbered references in the Bibliography. The page numbers of the reference where the quoted passage was found will be shown after the colon.

The European manufacturers did not really develop the interim technological step of crossbar exchanges to any great extent because of the interruption of the war. However, there are now several manufacturers in Europe who have developed all-electronic telephone exchanges which are of equal quality and state-of-the-art as those of American manufacture. By 1970, electronic telephone exchanges were being installed by these European manufacturers throughout the world while the Army and the Air Force continued to operate step-by-step equipment for the vast amount of their administrative telephone service in Europe.

There are essentially two measures of quality in telephone service. These measures are loss in volume and "grade of service". Loss in volume involves electrical principles where a signal is attenuated or loses some of its strength as it travels from origin to destination. In simple terms, many circuits in Europe have excessive loss. The signal is reduced in strength many times and is often barely audible at the receiving end after traveling a short distance of, say under two hundred miles. This loss is directly attributable, for the most part, to antiquated dial switches and old cables. The measure of sound power used in the telephone industry is the decibel. Every three decibels lost in sound power represents a loss of one-half of the strength of the signal. The maximum loss that is permitted for good telephone service by industry standards is 36 decibels. In many instances in the European military telephone networks, losses of 55 to 60 decibels are common.

The second measure of quality of telephone service is the "grade of service" calculation. The grade of service simply refers to the probability that a given number of users will seek telephone service at the same time.

Telephone engineers in industry discovered in the 1930s that the habits of telephone users were closely approximated by the Poisson probability distribution equations. Using mathematical techniques and actual measurement of the amount of dial telephone equipment in use during a certain time period, it is possible to establish an acceptable grade of service objective and then actually measure the grade of service being experienced by users. A grade of service of P 01 would indicate that during some specified time period, called the "busy hour", one out of one hundred calls was blocked from completion. In order to attain this high probability of success, an excessive and prohibitive investment in equipment would be required. Most telephone industry standards are established at less demanding probabilities, such as P 03. The AUTOVON has an objective of P 05 established for certain parts of its network. The Army's DDD network experiences poor grade of service figures on some of its circuit groups. In some instances, a P 30 (and worse) grade of service is actually calculated from collected data. If you were a user of the DDD and needed to call across several of these grades of service in tandem, you could expect less than one completion in three or four attempts.

If the quality of service is so poor and the dial telephone equipment is, in fact, antiquated, a logical question apparently is what have the Services done recently to replace these telephone networks?

There have been three separate programs initiated which have proposed replacements for military dial telephone equipment in Europe. In 1971 the United States European Command (USEUCOM) developed the "Policy for the European Telephone System" (ETS). The Defense Communications Agency subsequently developed three possible configurations for implementing the

ETS plan. However, due to the expensive nature of the plan at that time, none of the configurations were adopted and no procurements resulted from the first ETS plan.

It is important to note that this plan had some joint-Service involvement in its formulation and was envisioned to provide a single replacement network for both Services. An ensuing action in 1973 was the interconnection of the DDD and V F Dial networks. Although both networks had previous interconnect capability using operator assistance, both Services installed long distance dial equipment and interconnecting circuitry to permit Army and Air Force users of these networks to directly dial each other.

The second effort to develop an equipment replacement program was initiated unilaterally by the Army for its DDD network. In 1974, the Army's non-Defense Communications System System Improvement Plan (non-DCS SIP) was developed. This plan proposed the incremental replacement of the Army's approximately 120 telephone offices in Europe with state-of-the-art, US-manufactured electronic equipment over a five year period. The Army did extensive work in developing this plan and directed the effort toward demonstrating the benefits of the technological advances in telephone equipment by showing anticipated manpower savings. Once the electronic telephone equipment is installed, it needs very little maintenance. The savings in life cycle costs in the years after installation prove the plan to be cost effective. "Bottoms-up" cost estimates employing FY 75 dollars were developed by the Army for several alternatives, including "lease versus buy" options. These cost figures are shown in Appendix A. As the Army prepared to pursue this program, decisions were rendered within the DoD to return the program to its proper perspective as a joint-Service venture

under the auspices of DCA. Accordingly, in 1975 and 1976, a second ETS plan was developed which incorporated replacements for both Army and Air Force networks. In this plan, the Air Force network requirements were superimposed on the non-DCS SIP and the evolution of the second ETS resulted. Again, replacement of the existing equipment was to be time-phased over a five-year period. As of the time of this study, Congress had deleted funds for the initial procurement from the FY 1978 budget.

One final aspect to be considered about the ETS plan has been the involvement of the host nation's government. The Telecommunications Ordinance which is a part of the Status of Forces Agreement between the German and the United States governments prescribes what communications activities the military Services may conduct in the host country. The net result of the host country's involvement has been an understandable insistence to insure that a German firm is successful in obtaining any contract for new telephone equipment, or at least to be considerably involved in providing some of the new equipment. The legal ramifications have been escalated to government-level negotiations. The future of the ETS plan may very well be decided in negotiations between the two governments. In any event, the Army and the Air Force still need immediate replacement of their existing, archaic administrative telephone networks.

### SECTION III

#### JOINT-SERVICE PROCUREMENT HISTORY AND POLICIES

The problems of Department of Defense procurement policies seemed to become more visible in the early 1960's. Perhaps the emphasis placed on procurement at this time was a result of the "cold war" scare of the previous decade. It is also possible that the interesting personality of Secretary of Defense Robert S. McNamera contributed significantly to the intense scrutiny that has befallen DOD procurement policy. Mr. McNamera summarized his views of operating the Department of Defense in the book which he wrote after his cabinet duty. He stated:

The challenge of the Department of Defense is compelling. It is the greatest single management complex in history; it supervises the greatest aggregation of raw power ever assembled by man. Yet my instructions from both President Kennedy and President Johnson were simple: to determine and provide what we needed to safeguard our security without arbitrary budget limits, but to do so as economically as possible...Two points seem to me axiomatic. The first is that the United States is well able to spend whatever it needs to spend on national security. The second point is that this ability does not excuse us from applying strict standards of effectiveness and efficiency to the way we spend our Defense dollars. (19: 87-88)

Mr. McNamera is often given credit (or condemnation) for innovations in management techniques. Certain actions occurred during his tenure which added to the strength and power of the Office of the Secretary of Defense.

One of Mr. McNamera's innovations was the program to develop a fighter aircraft for use by both the Air Force and the Navy. Although the F-111 aircraft program did not result in the subsequent fielding of an aircraft acceptable to both Services, it did reinforce the developing concept of joint-Service procurement of military hardware.

The Services must cooperate and work together in joint procurement

ventures to avoid intolerable proliferation and incompatibility. My singular unfortunate experience in this area relates to the assassination of Dr. Martin Luther King in 1968. The resulting riots in many cities caused the development of Federal troops in support of police and the National Guard. My brigade from Fort Knox deployed by air to the Washington-Baltimore area to assist in riot control with a show of force. This all-Army brigade was equipped with the older tube-type, frequency modulated radio equipment (AN/GRC-3 through 8). The brigade was composed of armor, artillery and infantry battalions and each had a different radio which did not have a frequency compatibility. It was not possible for the brigade operations center to communicate with each battalion on a single command net.

There have been several investigations and reports by the General Accounting Office (GAO) which confirm that a lack of standardization and joint-Service interoperability exists. There were severe communications difficulties between individual Services during the Cuban missile crisis in the early 1960's as discussed earlier. As a result of lessons learned during this crisis, DOD established the Defense Communications Agency (DCA) to provide DOD guidance over communications matters. DCA has a management responsibility for transmitting all written or data communications via the Automatic Digital Network (AUTODIN). In addition, DCA has management responsibility over voice communications via the Automatic Voice Network (AUTOVON) or the Automatic Secure Voice Communications Network (AUTOSEVOCOM). Although these communications management responsibilities have been centralized at the DOD level, there has not been a complete removal of problems among the Services regarding communications compatibility.

The GAO report on "Reduction of Communications Costs through Centralized Management of Multiplex Systems" reported economies could be achieved

involving leased circuit costs. This report proposed the use of multiplex equipment (some spare on-site and some in storage) which permits combining data and teletype circuits on one circuit path. The resultant savings as compared with leasing a separate circuit path for each circuit from a commercial carrier would be significant. A DCA study, as referenced in this report, identified 579 circuits which could be eligible for multiplexing. The element that is lacking in this present, expensive operation is the lack of firm guidance and direction from DCA to implement use of available multiplexers. The GAO stated:

The facilities and personnel of the DCS, for the most part, are funded by the military departments. DCA has no authority to specify the manner in which a military department communications requirement is to be fulfilled: it can only recommend. (15: 27)

It seems that DOD has given "chartered responsibility but not chartered authority" to DCA to enact its management decisions. Another GAO report recommended a consolidation of message centers feeding messages or data into the AUTODIN that are located within a ten-mile radius. This consolidation was recommended without regard to the Service operating the message center. The JCS had initiated a study of similar recommendations. The GAO observed:

We noted a lack of cooperation and a recurring parochial emphasis by the military departments...This example illustrates, in our opinion, the lack of cooperation among military departments and the desire of each service to control its own communications...If the matter were approved from a DOD-wide standpoint by some central authority, consolidated communications centers on an interservice area-wide basis would be even more economical. (14: 17-18,20)

A further condemnation of DOD's management consolidation is found in another GAO report outside the communications area.

Nearly 3 years ago, the U.S. military services agreed to participate in a joint, or inter-service, program to predict--through spectrometric analysis--imminent failures on oil-lubricated mechanical equipment...objectives have not been met because the joint agreement did not provide for a central program manager with requisite authority to insure the success of the oil analysis program...The Secretary of Defense should provide direction to the military services to develop one cohesive oil analysis program. Specifically there should be a single manager having authority and sufficient responsibility to carry out the objectives that the military services themselves specified in the joint agreement. (11: i-ii)

A subsequent GAO report again criticizes the DOD and other government agencies for a failure to consolidate high frequency (HF) radio communications facilities without regard to the Service operating the facility or being served as a customer of the facility.

The GAO Report of "Consolidating High Frequency Communications" provides several reasons for consolidation / collocation.

There is a continuing need to pursue consolidating or collocating Government HF facilities, at least where geographical concentrations exist, because of the potential savings to the Government, similarity of services provided through HF facilities, need for communications compatibility in wartime or emergency conditions, and the future role of HF communications. The primary recommendation is for guidance and an implementing plan to be prepared by the Director, Office of Telecommunications Policy. (13: 16)

A final example of the GAO's desire for consolidation of capabilities involves the calibration of a multitude of test equipment by each Service.

Each military service has established its own system and facilities to satisfy common calibration needs. DOD has recognized that many facilities are housed together or in close proximity to each other and has had some success in reducing existing duplication. However, the services continue to maintain independent, substantial, and duplicative calibration staffs, equipment, and facilities...we found no serious attempts by the services to maximize calibration cross-servicing. As a result, our study showed DOD continues to underutilize its resources and incurs unnecessary costs for transportation, equipment, staff and facilities. (10: 10)

It is not the purpose of this paper to propose that DOD implement without exception every recommendation by the GAO. In some instances, the manager within the DOD who has a responsibility for a particular area has to decide whether consolidation is desirable from all aspects. The manager must take the "systems" view and consider not only cost, but also performance, deployability and other parameters.

However, it is noted that the GAO has raised certain criticism which is irrefutable and even the DOD has observed parochial Services' viewpoints. This fact of life is quite evident in the area of weapons procurement. In order for different Services to communicate with each other, they must have compatible equipment. In order for the equipment to be compatible, there must be some commonality in the equipment. This commonality must be considered from the beginning of the equipment life cycle in the conceptual phase of the procurement process. The task of procurement of weapons systems within DOD has been the responsibility in recent years of the Director of Defense for Research and Engineering. Dr. Malcolm R. Currie, who recently left that position in DOD, had these comments:

"The time is long past when we can have the luxury (and waste) of individual Service developments for every 'requirement'. In addition to fiscal realities, the complexities of modern systems and requirements for intimately integrated and interdependent tactics between Services dictate that we increasingly approach requirements and systems developments on a truly joint-Service basis.

I have stressed programs with a designated lead Service as a preferred alternative to total centralization of management in DOD...

Joint programs will be increasingly important in the future. They save money. They provide common and well-integrated military capability among Services. (2: 1-16)

Whittman (26) saw factors in the early 1960's which "encouraged" the Services to form joint project management teams. The commanders of the major Acquisition Commands began to hold meetings to discuss weapons development

and acquisition. In June, 1966 a Memorandum of Agreement on a Joint AMC/NMC/AFLC/AFSC Commander's Meeting was published. (25) It established two broad objectives:

1. Prevent duplication
2. Conform to uniform policies and standardization.

There have been several attempts at joint-Service procurement programs. Haney (16) examined three joint-Service programs. These programs were the DoD Mobile Electric Power Project, the DoD Aircraft Ground Fire Suppression and Rescue Project and the DoD Surface Container-Supported Distribution Systems Development Project. Of the three programs, only the Mobile Electric Power Project achieved a significant level of success. Haney concluded that unique management problems inherent in the program management approach made this method less desirable than individual service project or commodity management methods.

Desmond criticizes the DoD for a degree of similarity of procured equipment:

There is no outright "duplication" of military systems at issue but rather "degree of similarity". It ranges from tolerable to excessive depending on individual perceptions of tactical needs, desired balance of military capabilities and budget affordability...Duplicative military systems in the inventory imply that defense strengths are out of balance and that scarce resources have been imprudently allocated... There had been no formal process in Defense to harmonize mission needs of the separate services. The Joint Chiefs of Staff have not been authoritative in these matters. The Director, Defense Research and Engineering is charged with reconciling service requirements and curbing duplication, but results have been, at best, mixed. (4: 10,15)

However, there are indications that the DoD is getting serious about joint-Service procurement. The report of Secretary of Defense Donald Rumsfeld to the Congress in January, 1977 highlighted programs in communications which are oriented toward joint-Service use:

Ground communication equipment within the theater is rapidly approaching obsolescence. Some near term replacement is required and several programs are under way. One of these is the Joint Tactical Communications (TRI-TAC) Program. This major effort in tactical communications will provide the Department with common securable communications equipment for all four Services, will meet the need for inter-theater communications mobility as well as within the theater, and will provide the interface both between theater and tactical systems and between U.S. and allied systems. (21: 259)

Behind these efforts to implement joint-Service programs are several reference documents which encourage such ventures. This study must, of necessity, review this guidance in order to present a viewpoint in perspective. That viewpoint is quite simple: joint-Service procurements must become a way of life in the future. Inter-Service rivalry and a desire to be the lead Service in all procurement activities must be tempered with DoD-stated objectives. This guidance begins outside the DoD with Circular A-109 from the Office of Management and Budget (OMB):

Agencies are encouraged to work with each other to foster technology transfer, prevent unwarranted duplication of technological efforts, reduce system costs, promote standardization, and help create and maintain a competitive environment for an acquisition...Where an agency has more than one component involved, the agency will assign roles and responsibilities of each component at the time of the first key decision. The agency may permit two or more agency components to sponsor competitive system design concepts in order to foster innovation and competition. (20: 6-7)

The implementing directives within the DoD are Directives 5000.1 and 5000.2. The following excerpts from these directives advise the Services to work together and to use commercial hardware whenever possible:

Mission needs shall be satisfied through the use of existing or commercial hardware and software whenever feasible. When a new development or modification is essential, the mission needs of other DOD Components and NATO shall be considered including the requirement for NATO standardization and interoperability...When system acquisition programs involve more than one DOD Component, the component designated by the Secretary of Defense as the lead Component shall

assign the program manager and request the other participating Component to assign the deputy program manager. (5: 4)

The Secretary of Defense decision states the conditions for program initiation and may be directed to more than one DOD Component. In such a case the decision will include the conditions for each Component to proceed and the basis for subsequent action to select options for demonstration and validation. When feasible, mission needs shall be satisfied with the use of existing military or commercial items. (6: 6)

With this policy guidance firmly in mind, it will now be possible to review the JOSUTNET and consider an acquisition plan for a successful procurement.

## SECTION IV

### DISCUSSION

The JOSUTNET can become a reality. The success that DCA has demonstrated in uniting the Services' communications requirements through the AUTOVON and the AUTODIN could be replicated in Europe with the Air Force's and Army's administrative telephone networks.

It is important to understand the difference between military telephone systems in Europe and in CONUS. The AUTOVON in CONUS is vast and provides the bulk of the interconnections among the posts and bases of the various Services. It is a switched network which is essentially leased from the commercial telephone companies and is dedicated to DoD users. In CONUS other commercial means are used to augment the AUTOVON. An example would be the Wide Area Telephone Service (WATS) which is obtained from a commercial company. A military user can access a WATS line with operator assistance in order to contact locations in CONUS that do not have access to the AUTOVON. The main contention here is that the AUTOVON serves virtually all command and control, administrative, logistics and other telephone needs for the military Services in CONUS.

The military telephone networks in Europe do not have similar, equal relationships. In Europe, the AUTOVON provides the bulk of all command and control telephone service for the three Services. In addition, most of the Navy's administrative telephone requirement is satisfied by the AUTOVON. However, most of the Army's and Air Force's administrative and logistics telephone traffic is handled by the military-owned-and-operated V F Dial and DDD telephone networks. The commercial telephone company in Germany leases individual circuits to the military Services but does not provide a separate

switched network. The Deutsches Bundespost (DBP) in Germany is engaged in two separate endeavors. It is the branch of the German government which operates the post office and the telephone system. Even some local business organizations have been dissatisfied with some of the telephone service that is provided by the DBP. For example, the use of facsimile is very limited. Facsimile is a method of sending pages of printed material over ordinary telephone circuitry. It is a rapid method of transmitting page copy between two locations, but the inherent problem with facsimile use is that it keeps equipment in the telephone office in use for long periods of time. The quantity of equipment installed in telephone offices is engineered using probability methods. Use of telephones for other than voice communications requires that additional quantities of equipment be installed in telephone offices in order to accommodate the longer "holding times" or time each piece of equipment is in use. The DBP is the most progressive commercial telephone company in Europe. However, there are still locations and there are still customers, including the NATO military services, that cannot be provided with requested telephone service due to limited physical plant and equipment. We must remember that the commercial telephone companies in CONUS have considerable investments in plant and equipment which were not destroyed by World War II. The DBP still suffers from the effects of capital asset shortages at some locations.

There is a need to declare some assumptions in this section in order to definitize and confine the discussion to manageable proportions. The following assumptions are considered relevant and acceptable:

1. The JOSUTNET can be implemented with commercial-type telephone equipment requiring few or no modifications.

2. The Services will accept the DODD 5000.1 and 5000.2 guidance literally and will cooperate from the beginning towards a common goal - a single administrative telephone network.
3. The installation of US-manufactured telephone equipment or European-manufactured telephone equipment is acceptable to both the Services and the host country.

The policy guidance cited earlier indicates the need to install commercially-available equipment in Europe for the JOSUTNET. A recent article in a DoD publication emphasizes the use of commercial equipment:

Reliance on the commercial market place has much going for it, including just plain common sense. When defense requirements can be satisfied in the commercial market place, DOD not only benefits but also lends support to the business base of the country...Engineering considerations play a major role in determining the extent to which commercial commodities can be used to fulfill defense needs. The design engineer and the military user have a shared responsibility to carefully scrutinize those requirements which exceed commercially available items from the standpoint of cost impact. These decision makers must constantly assess the trade-off between extra capability and added equipment costs. (24: 48)

One problem with this approach occurs when the military Services fail to update their equipment as new technology updates the rest of the world. An example of the government's delay problem is apparent in electronic vacuum tubes. The DoD finds itself in possession of a vast amount of communications equipment employing vacuum tubes while most of the commercial communications world has converted to solid-state technology. The result is that some manufacturers of vacuum tubes are ceasing their production operations and DoD will soon be without a source of supply for spare parts.

A historic example of the failure of the Services to work together involved the invention of radar (22) in the 1920s and 1930s. The Navy

Research Laboratories and the Army Signal Corps laboratories were working on the development of radar in a parallel manner. Each Service had tightened security of the project over the years and had worked without an interchange of ideas. The British were also working on the concept of radar in secrecy from the Americans. It was not until 1935 that these two countries exchanged information about their separate research efforts. The prohibitive cost of weapons systems today should eliminate the possibility of a similar parallel development of equipment by two Services.

The emphasis being noted during the first few months of the Carter administration regarding DoD procurement activity is directed at NATO standardization and interoperability. These terms "standardization" and "interoperability" must become more than just hollow pledges among the NATO allies. There are weapons systems available which can be found acceptable to other nations besides the producing country. There are weapons systems which can be tailored to a co-production effort where parts of a system are manufactured in different countries and assembled into a final system. One of the errors of the previous telephone network replacement plans, specifically the non-DCS SIP, was the insistence in its text to procure US-manufactured hardware for installation in Europe. It seems ironic that the present networks have evolved over the years largely from the procurement of German-manufactured equipment and now one Service was insisting on US-manufactured equipment in its replacement plan. It is noted that the American's tactical telephone equipment, the AN/TTC-38, was developed and fielded in Europe at about the same time that the Germans developed and fielded the AKN-100 tactical telephone equipment. This type of duplication among the NATO allies must be eliminated in the future. In

addition, the limitations mentioned earlier about the host nation approval requirements will preclude the introduction of any equipment into Germany which has not received the technical acceptance of the DBP. It would be futile to suggest that the military Services would be naive enough to believe that a JOSUTNET could be established without the use of leased circuits from the host nation's commercial telephone company. Whatever procurement of telephone equipment that occurs for Europe will require the formal approval of the host nation.

There must be a substantive discussion between the user and the host nation regarding the "Quid Pro Quo" or the exchange during the project acceptance by both parties. An aura of conciliation and mediation must exist before the JOSUTNET has a chance of success. Several years ago, then-Major General Kissinger wrote of the need for such discussions and agreements:

In the NATO forums concerned with interoperability it has long been recognized that to get common systems, the agreements have to be reached before nations commit to hardware, even in the development phase. (18: 27)

Reflecting on this guidance, the two Services should perhaps consider a JOSUTNET that satisfies their individual needs and also consider the addition or integration of other NATO countries into a common administrative telephone network. An interesting example of the unfortunate separation of capabilities involves the refusal of access to the AUTOVON for the Canadian forces in Europe. Both nations now lease circuits across the Atlantic Ocean in order to permit military forces in Europe to communicate with higher headquarters in North America. There is an unnecessary duplication which could be eliminated by permitting Canadian forces in Europe to have access

to the AUTOVON on a fair-share-of-cost basis. The only prohibition to this action is a policy memorandum by the Joint Chiefs of Staff. There is probably no other country in the Free World with which America has closer ties. These ties are a natural consequence of our geographical proximity. However, there seems to be a future continuation of parallel efforts and duplicative communications capability across the Atlantic because of an unwillingness to mediate differences. This type of failure to cooperate with an important neighboring country permeates from the DoD down the hierarchical chain to become the strong interservice rivalry that defeats standardization and interoperability.

Another area needing discussion is the natural fact of the physical world that mechanical items do wear out. The existing telephone equipment employed in Europe by the Army and the Air Force has served a useful and an extended lifetime. Despite continuous and ever-increasing maintenance, the present equipment will not last forever. Daily, there are laudatory efforts on the part of local national employees of the Services who maintain and repair this equipment. Repair parts are scarce and difficult to obtain. One manufacturer has ceased production of parts that are needed at approximately twenty of these telephone offices. Expensive start-up costs and per-unit costs will be required to support this equipment, provided that this manufacturer will again contractually agree to the manufacture of required parts. A corollary to this problem was discussed earlier regarding the cessation of vacuum tube production in the United States by some of the manufacturers. In some locations, a nearby salvage yard becomes the source of supply for local national technicians who sometimes even use personal funds to buy needed parts. The labor-intensive maintenance requirements of these mechanical telephone offices will increase in the future and result in

untenable increases in life cycle costs. The age of the equipment is a prime factor in the steadily mounting maintenance costs. The cost figures in the Appendix for continuing the present system only consider present staffing levels. Should increasing maintenance requirements result in additional staffing, then the cost figure for the "present system" alternative can be expected to also increase.

A final discussion topic has to be the productivity of the average American and local national employee of the Services in Europe who is required to use these archaic administrative telephone networks in the performance of assigned duties. The lost calls which inevitably result from poor quality telephone service have a detrimental effect on employee productivity. The staff member who must make several attempts before completing a telephone call over these networks is being subjected to inefficient use of his/her time. The employee must count this cost of a loss in productivity against the job. However, this cost is, in effect, an indirect cost for which the telephone networks are liable.

## SECTION V

### CONCLUSION AND RECOMMENDATIONS

Joint-Service programs in the past have achieved some degree of success. A successful joint-Service program requires essential elements. First, the Services which will be cooperating in the program need specific, firm guidance from the DoD. Second, each participating Service must be included in the early conceptual stages with equal representation of its specific Service-peculiar requirements. Finally, a joint-Service program is not an acceptable approach for every situation. That approach must be tailored to the specific mission need. Special emphasis toward joint-Service programs should be directed at those programs which have hardware requirements that can be satisfied by commercial, off-the-shelf products.

Perhaps my support for a joint-Service telephone network has been influenced by my experience in I Corps in Vietnam. My Army artillery battalion, in support of a Marine division, often had to compete for fire missions with Army helicopters, the Navy's battleship New Jersey, Marine Corps artillery units, the Air Force's tactical fighter aircraft and the Army of the Republic of Vietnam (ARVN) air and artillery units. Our means of communications was frequency modulation (FM) radio. It was possible to tune to the frequency of a fire direction radio net and monitor the fire mission being conducted by one of the above listed units. I consider this experience as the ultimate implementation of "interoperability".

There must be a point in time when the military Services agree to a single JOSUTNET and negotiate the host nation's objections to new equipment procurement. I am not suggesting the total capitulation of the Services' efforts to obtain US-manufactured equipment. However, it is apparent that

continued parochial efforts by each Service can only have a detrimental effect on the military users of telephone service in Europe. The interests of the customer, the military user in Europe, should become paramount in importance. We professional communicators have a responsibility to provide the best, most responsive telephone communications to support the combat forces. The implementation of a JOSUTNET is long overdue.

I recommend policy reformulation by the DoD through the DCA and total support for a JOSUTNET plan by the Services. Each Service must participate in the initial or conceptual formulation and preparation of the plan. The emphasis in the plan must be on use of commercially available equipment and reduction of life cycle costs for maintenance.

## APPENDIX A

### COST ANALYSIS OF ALTERNATIVES

The cost of any new program is of equal importance with schedule and technical performance. Managers at all levels want to see the "bottom-line" or total cost of any proposal. The cost figures in this appendix were prepared in the summer of 1975 to support the non-DCS System Improvement Plan discussed in Section II. The figures were obtained in several ways. The cost of the "present system" alternative was prepared by a bottoms-up accumulation of the actual number of present employees by pay grade and the actual maintenance costs as experienced in the previous fiscal year. This cost figure was compiled for telephone networks having a capacity of 51,490 lines. Cost estimates for the remaining three alternatives are based on the proposed expansion in the plan to 62,600 lines. In order to show comparable data, I have made the following assumption: there is a linear relationship between the maintenance and labor costs and the number of lines. This assumption is considered valid because the present system is composed of mechanical switch technology. The increased capacity means an increase in the number of switches which have to be maintained. Based on this assumption, I have adjusted the cost of the "present system" alternative to the baseline of 62,600 lines. The cost estimates for the second alternative of purchasing US-manufactured equipment were obtained from trade journals, manufacturer's bulletins and other similar sources. The third alternative of leasing the equipment and maintenance and the fourth alternative of buying the equipment but leasing the maintenance were based on proposals received from the DBP, the German commercial telephone company. These independent cost estimates were assumed to be valid at the time they were received and were not challenged in-house. Neither estimate appears to

be an attempt to "buy-in" by the prospective contractor because neither alternative is the lowest cost estimate. In addition, both estimates are in reasonable proximity to the other two alternatives prepared by the government.

The alternatives and their FY75 cost estimates are shown below with a distinction made for one-time installation costs and annual or recurring personnel and maintenance costs:

Alternative	Description	Cost FY 76 (in \$mil)	
#1	Maintain Present Systems of Mechanical Switching Equipment		
	One-time installation	\$0	
	Recurring costs (annual)	<u>\$13.401</u>	\$13.401
#2	Purchase US-manufactured Electronic Equipment with Operation by US military forces		
	One-time installation	\$36.0	
	Recurring costs (annual)	<u>\$ 5.083</u>	\$41.083
#3	Lease Equipment and Maintenance from DBP		
	One-time installation	\$13.584	
	Recurring costs (annual)	<u>\$13.336</u>	\$26.920
#4	Purchase Equipment but Contract Maintenance from DBP		
	One-time installation	\$56.543	
	Recurring costs (annual)	<u>\$ 5.159</u>	\$61.702

It is interesting to note that all four alternatives had cost figures expressed in annual terms and in ten-year total cost terms. However, none of the alternatives was subjected to escalation in their preparation. The

Assistant Secretary of Defense (Comptroller) publishes a memorandum annually, entitled "Major Program Acquisition Cost Estimates" which contains the escalation factors for use in providing consistent treatment within DOD of extended outyear escalation projections. I have taken these approved escalation factors and have applied them to the cost estimates of the four alternatives.

The ten-year total cost estimates included in the plan were not escalated and were calculated by multiplying the annual cost by 10 and adding the installation costs. These figures are shown below:

Alternative	Ten-year cost (in \$mil)
#1	\$134.01
#2	\$ 86.83
#3	\$146.95
#4	\$108.12

Before proceeding with the escalation factors, I believe it is necessary to provide explanation about some of the cost figures.

Alternative #1 shows no installation costs. According to DODI 7041.3, Subject: Economic Analysis and Program Evaluation for Resource Management, costs which have been incurred at the time an analysis is made are considered "sunk costs" and are to be excluded. Hence, the present system's installation charge is not a relevant cost because of its nature as an expenditure made prior to the analysis.

Alternative #2 reflects costs for the latest solid state technology which has low maintenance requirements. Lower manpower costs are anticipated here.

Alternatives #3 and #4 were not based on the same technology as alternative #2. The older technology requires more maintenance and therefore, more outyear maintenance costs are forecasted. It is noted that even

under the "total lease" option (alternative #3) the government would be required to reimburse the DBP for some of the capital expenditures required for new equipment installation.

Based on the Comptroller's annual memorandum, escalation indices are shown below:

Year	Index
1976	100
1977	103.21
1978	107.18
1979	113.61
1980	119.72
1981	125.19
1982	130.12
1983	135.37
1984	140.78
1985	146.42
	152.27

It is noted that these indices estimate a 4% annual inflation rate for 1981 and all subsequent years.

I will now take alternative #4 and escalate its cost using the indices to show the actual ten-year cost with inflation. I have assumed that all one-time charges have been incurred in 1976. The 1976 figures are not changed because the index is 100 for the base year. However, the recurring charge increases annually for each year after 1976.

Year	Cost (in \$mil)
1976	\$5.159
1977	\$1.331 (which is 5.325 / 4)
1978	\$5.529
1979	\$5.861
1980	\$6.176
1981	\$6.459
	\$6.713

1982	\$6.984
1983	\$7.263
1984	\$7.554
1985	<u>\$7.856</u>
	\$66.885

By 1985, the cost of alternative #4 is \$56.543 million for installation charges plus \$66.885 million for recurring charges giving a new total of \$123.428 million. This amount is compared with \$108.12 million as estimated in the plan without escalation. By a similar process, the new ten-year total cost of each alternative was determined and is as shown.

Alternative	Ten Year Cost (without escalation)	Ten Year Cost (in \$mil) (with escalation)
#1	\$134.01	\$173.741
#2	\$ 86.83	\$101.904
#3	\$146.95	\$186.491
#4	\$108.12	\$123.428

The new ten-year total cost figures with escalation indicate that alternatives #1 and #3 will have a greater percentage of increase in the outyears and will have higher life cycle costs. Both of these alternatives are more labor intensive than alternative #2 and this personnel cost in the future becomes more visible when escalation is applied.

One final analysis needs to be made. The cost figures above show the cost of the plan as if it had been implemented and funded in 1976. Unfortunately, delays have occurred and recently, the House Appropriations Committee deleted all funds for FY 78. I want to illustrate the cost of delaying the decision. Assume that alternative #2 is chosen and is funded in 1980. By similar escalation procedures as used above, the ten-year total cost of this alternative would be \$121.447 million with 1980 funding as compared to \$101.904 million with 1976 funding. The difference of approximately \$20 million could be called the "cost of indecision". The administrative

telephone network in Europe is not a project similar in nature to a weapons system like the B-1 bomber. There is no cheaper alternative to the telephone network and eventually the equipment will have to be replaced. If the decision for replacement continues to be delayed, the inevitable result will be an even more expensive telephone network. If the commitment of American forces to Europe is firm, then the rapid implementation of a new telephone network will save money for the Government.

#### BIBLIOGRAPHY

1. AFSCR/AFLCR 800-2 / AMCR 70-59 / NAVMATINST 5000.10A dated 4 Sep 1973 containing the Memorandum of Agreement on the Management of Multi-Service Systems/Programs/Projects.
2. Currie, Malcolm R., Director of Defense Research and Engineering, Statement to the 95th Congress, First Session 1977, Program of Research, Development, Test and Evaluation, FY 1978.
3. Defense Systems Management School, Introduction to Military Program Management, March, 1971.
4. Desmond, Timothy D. "Weapon System Duplication: Problems and Reforms" The GAO Review, Summer, 1977.
5. DOD Directive 5000.1 dated 18 Jan 1977 subject: Major System Acquisitions.
6. DOD Directive 5000.2 dated 18 Jan 1977 subject: Major System Acquisition Process.
7. DOD Directive 5000.30 dated 20 Aug 1976, subject: Defense Acquisition Executive.
8. DOD Directive 5129.1 dated 20 Apr 1977 subject: Director of Defense Research and Engineering.
9. Fortune August, 1977 "The Great World Telephone War".
10. GAO Report, B160682 31 May 1977 A Central Manager Needed to Coordinate the Military Diagnostic and Calibration Program.
11. GAO Report, B162313 27 Aug 1975 Single Manager Needed to Obtain Cost and Fuel Savings in Spectrometric Oil Analysis Program.
12. GAO Report, B163058 6 Feb 1970 Status of the Acquisition of Selected Major Weapons Systems.
13. GAO Report, B169857 6 Jul 1976 Economies Available Through Consolidating or Collocating Government Land-Based, High Frequency Communications Facilities.
14. GAO Report, B169857 17 Jul 1974 Need to Consolidate Responsibility for Automatic Digital Network (AUTODIN) Terminals.
15. GAO Report, B169857 18 Jan 1973 Reduction of Communications Costs Through Centralized Management of Multiplex Systems.
16. Haney, James D. Defense Systems Management College, PMC Class 76-1 A Study and Evaluation of Selected Joint Service Program Managed Material Acquisitions May 1976.

17. Hendrickson, Steven C. Defense Systems Management College, PMC Class 77-1 Considerations in Applying Standard Electronics in Military Systems May 1977.
18. Kissinger, Harold A., MG, USA "Achieving NATO Military Communications Interoperability", Defense Management Journal, Oct 1973 Vol.9, No.4.
19. McNamera, Robert S. The Essence of Security, Reflections in Office Harper and Row, New York 1968.
20. Office of Management and Budget Circular A-109 dated 5 Apr 1976 subject: Major Systems Acquisitions.
21. Report of the Secretary of Defense Donald H. Rumsfeld to the Congress on the FY 1978 Budget, FY 1979 Authorization Request and FY 1978-1982 Defense Programs 17 Jan 1977.
22. The Signal Corps: The Emergency (To December, 1941) Office of the Chief of Military History, Department of the Army Washington, D. C. 1956.
23. Smith, Alto F. Defense Systems Management College, PMC Class 76-2 Review of Management Approaches of Selected Joint Service Acquisition Programs Nov 1976.
24. Stimson, Richard A. and Barnett, Marilyn S. "Buying Commercial: Why Not" Defense Management Journal, Oct 1976 Vol.12, No.4.
25. United States Department of the Army (AMC), Department of the Navy (NMC), Department of the Air Force (AFSC) Memorandum of Agreement on Joint AMC/NMC/AFLC/AFSC Commanders' Meetings 21 Jun 1966.
26. Wittmann, Matthew Defense Systems Management College, PMC Class 77-1 Joint Service Weapon Acquisition Program Environment May 1977.