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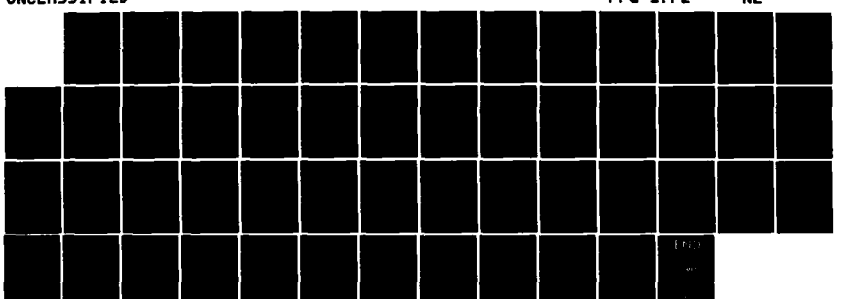

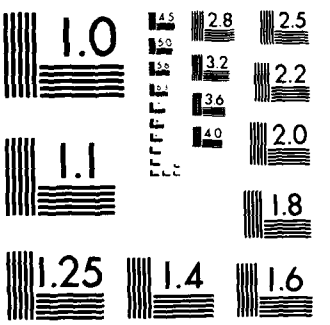

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A RAND NOTE

BASE COMMUNICATIONS ISSUES FOR THE 1980s

Willis H. Ware, Robert M. Paulson,
Martin M. Balaban

September 1984

N-2164-AF

Prepared for

The United States Air Force

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

This Note examines the role of the Air Force Communications Command (AFCC) in providing base-level communications, including transmission and reception of voice, message, and data traffic and support of automatic data processing (ADP). It identifies some of the problems faced by AFCC in planning for systems that will meet future intrabase and base/off-base communications requirements within the current structure of Command-level controls. It recommends that the AFCC do the following: (1) Create a forum for adjudicating competing user needs and generating a comprehensive statement of user requirements; (2) create a computer-based, on-line user requirements database that will be continually updated and refined; (3) examine, with support from the Electronic Systems Division (ESD), the possibility of collecting traffic characteristics and traffic-flow data for representative bases of each major command; (4) acquire the support of ESD for certain communications-related R&D tasks; (5) arrange with other commands to jointly assess the usefulness of contemporary communications equipment; (6) revise its mission statement to reflect the broader, more responsible mission it must have for the Air Force. That broader mission is summarized in a related Rand study, N-2102-AF.

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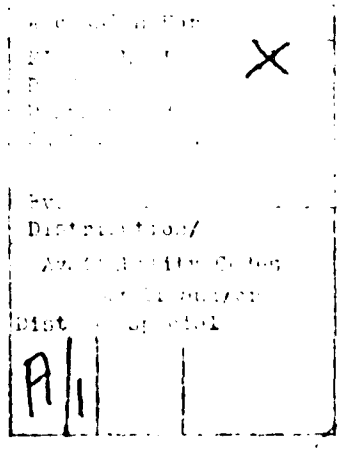

PREFACE

This Note reports on a study undertaken in response to a request from the Commander of the Air Force Communications Command (AFCC) to review current base communications systems and recommend future directions. This work should assist in developing an approach to base communications planning that will integrate 1980s technology with Air Force missions and roles to provide an efficient, secure, and responsive communications system that will meet both peacetime and wartime requirements over the next decade.

A related study has examined the technology and peacetime use of systems for transmission of voice, message, and data traffic, and for support of automatic data processing (ADP). This work will be reported in a forthcoming Rand Note.

The work reported here was completed in the spring of 1983. However, a number of changes relevant to this study were under way in the Air Force at that time, notably the creation of the Office of the Assistant Chief of Staff for Information Systems (AFSI). It therefore seemed appropriate to withhold publication of our results until the Air Force actions had been completed, rather than suggesting actions that had already been taken or were no longer applicable. Rand interacted extensively with both AFCC and AFSI during this period; thus there are parallels between the position taken in this Note and the actions taken by the Air Force, but there are also important differences.

The recommendations discussed here complement the points made in companion Rand Note N-2162-AF, *Information Systems: The Challenge of the Future for the Air Force Communications Command*, by Stephen M. Drezner and Willis H. Ware, May 1984. Those earlier points included the following:

1. AFCC can and should make a force multiplier available to decisionmakers through information systems that provide timely status and option information.

2. AFCC should be reorganized as necessary from a service organization into the focal point of the Air Force for communications systems and functional-area information system matters.
3. AFCC should become the requirements and advocacy focus for common-user communications improvements and systems and for the development of functional-area information systems.
4. AFCC must acquire the capability to perform system analyses and other technical studies that support its programmatic and advocacy proposals, and to relate them to mission effectiveness.

The present Note makes the following recommendations:

1. AFCC should create a mechanism that can, by integrating functional-area and technical people, provide a forum for adjudicating competing user needs and generating a comprehensive statement of user requirements.
2. AFCC should create a computer-based, on-line user requirements database that will be continually updated and refined and that will be available as an input to local (e.g., on-base) planning efforts, wherever necessary.
3. AFCC, with support from the Electronic Systems Division (ESD) and its assets as appropriate, should examine the possibility of collecting traffic characteristics and traffic-flow data for representative bases of each major Command (MAJCOM).
4. AFCC should make appropriate arrangements with the Air Force Systems Command (AFSC) to acquire the support of ESD (and its assets) for certain communications-related R&D tasks, and for occasional special studies as needed.
5. AFCC should make appropriate arrangements with flying or other operational commands to conduct joint experiments designed to assess the usefulness of contemporary communications equipment for activities such as flight operations.

6. The mission statement of AFCC should be revised to reflect the broader and more responsible mission that it must have for the Air Force.

That "broader and more responsible mission" is summarized in the major point of Note N-2162-AF:

- *In the long run, AFCC should become the "Air Force Information Systems Command."*

The points made in these two Notes together provide a comprehensive set of actions that could move AFCC into its proper posture.

Not all of the steps taken by the Air Force were considered in the present study. For example, the Note does not discuss the combining of the career fields of data automation (51xx) and communications (30xx) or the combining of these two areas under Information Systems throughout the Air Force. Conversely, the study produced some recommendations that the Air Force had not initiated.

Publication of this work at this time both complements and supplements the recent Air Force efforts. The decision to delay publication until the Air Force had had time to implement its changes has enabled the authors to sharpen their conclusions and recommendations. Thus the study can most effectively support important Air Force-initiated actions that the authors believe to be essential for bringing the USAF into a contemporary posture regarding information systems.

SUMMARY

This Note examines the role of the Air Force Communications Command (AFCC) in providing base-level communications, including transmission and reception of voice, message, and data traffic and support of automatic data processing (ADP). It identifies some of the problems faced by AFCC in planning for systems that will meet future intrabase and base/off-base communications requirements within the current structure of Command-level controls.

There are serious questions about the capability of existing and planned base-level communications systems to meet either peacetime or wartime mission requirements in the next five or more years. Communications at many U.S. bases are presently limited by obsolete hardware systems, most of which are inadequate to handle the extensive digitized transmission of computer data and, to a lesser degree, message traffic. Many on-base telephone systems were installed in the 1950s and 1960s, and some even date back to the 1940s. These older systems are personnel-intensive, and the manpower requirements for dealing with today's heavy communications traffic workload have led to overcrowded conditions at the communications centers.

AFCC is responsible for providing timely and secure movement of information both within and among bases. However, at neither the base nor the Headquarters level has it developed an overall base-level communications architecture, i.e., a long-range master plan for a controlled, programmed, and technically cohesive base communications capability, together with a companion plan for orderly transition to it. Improvements and upgrades are made primarily in response to specific requirements of base occupants, channeled to AFCC by the occupant units themselves or by their parent Commands. These improvements usually consist only of changes at the margin to existing capabilities and systems.

Moreover, there appear to be no structured attempts to anticipate or specify wartime communications requirements and missions for CONUS bases. Little attention has been given to the operational survivability

of their communications systems in the event of conventional warfare or sabotage by terrorist or dissident adversaries.

AFCC, however, is not currently in a position to initiate any master planning to accommodate future base communications needs for either a peacetime or a wartime environment. Projections and determinations based on studies and simulations as well as user inputs will first be needed to reduce uncertainties.

Moreover, although AFCC is responsible for developing the USAF program plan for communications, it is not authorized via its mission charter to design or develop a preferred base communications architecture. If AFCC is indeed expected to provide the leadership needed for base-level communications, its mission statement must be extended and it must be given the appropriate authority.

CONTENTS

GLOSSARY

ACD	Accounting Controller Data Services
AD	Air Division
ADP	Automatic Data Processing
AFB	Air Force Base
AFCC	Air Force Communications Command
AFIG	Air Force Inspector General
AFLANSPO	Air Force LAN System Program Office
AFLC	Air Force Logistics Command
AFR	Air Force Regulation
AFRES	Air Force Reserve
AFSC	Air Force Systems Command
AFSI	Hq USAF Assistant Chief of Staff for Information Systems
AMPE	Automated Message Processing Exchange
ANG	Air National Guard
ATC	Air Traffic Control
AUTODIN	Automatic Digital Network
AUTOVON	Automatic Voice Switching Network
BCEP	Base Communications Electronics Plan
BMO	Ballistic Missile Office
BW	Bomber Wing
C-E	Communications-Electronics
CCPC	Communications Computer Programming Center
CCSO	Command-Control System Office
CCTV	Closed Circuit Television
COB	Collocated Operating Base
CONUS	Continental United States
DCA	Defense Communications Agency
DCS	Defense Communications System
DDN	Defense Data Network
DOB	Dispersed Operating Base
DOD	Department of Defense
DSDC	Data Systems Design Center

DSDO	Data Systems Design Office
ESD	Electronics Systems Division
FOL	Forward Operating Location
FTS	Federal Telecommunications Systems
HQ	Headquarters
JCS	Joint Chiefs of Staff
JTIDS	Joint Tactical Information Distribution System
LAN	Local Area Network
LG	Logistics
MAC	Military Airlift Command
MAJCOM	Major Command
MAW	Military Airlift Wing
MEI	Management Effectiveness Inspection
MOB	Main Operating Base
NATO	North Atlantic Treaty Organization
O&M	Operations and Maintenance
OCR	Optical Character Reader
ORI	Operational Readiness Inspection
RDT&E	Research, Development, Test and Evaluation
SAC	Strategic Air Command
SMALC	Sacramento Air Logistics Center
SOA	Special Operating Agency
TAC	Tactical Air Command
TFW	Tactical Fighter Wing
USAF	United States Air Force

I. INTRODUCTION

BACKGROUND

The Air Force Communications Command (AFCC) is officially responsible for all Air Force base-level communications, including data processing and transmission. As specified in AFR 23-32, its mission is as follows:[1]

> Overall Mission: The AFCC mission is to provide communication electronics (C-E), automated data processing (ADP), and air traffic control (ATC) support and services for the Air Force, other agencies, and designated command and control systems of the specified, unified, and component commands, as directed by the Chief of Staff, USAF.

The mission includes such tasks as:

1. Planning, budgeting, engineering, programming, installing, operating, and maintaining communications facilities.
2. Providing central management of commonly used ADP activities, resources, and systems.
3. Analyzing the technology, economy, compatibility with other systems, and responsiveness to operational requirements of current and proposed systems and facilities.
4. Analysis, design, development, testing, and maintenance of communications systems.
5. Organization and training of communications personnel for worldwide deployment.

Within these general responsibilities, AFCC has many specific roles. For example, it

1. Serves as single manager for base communications.

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[1]As given in AFR 23-32, dated 6 March 1980. AFR 23-32 is reproduced in the Appendix to this Note.

2. Operates and maintains communications and ADP components of command and control systems, including on-base Command-dedicated systems, for various Commands.
3. Plans, programs, budgets, operates, and maintains portions of the Defense Communications System (DCS) for which the Air Force has operations and maintenance responsibilities (e.g., switching centers for AUTODIN I, the DOD-wide secure digital network).
4. Develops the USAF Program Plan for Command, Control, and Communications, and for Telecommunications.
5. Serves as the central acquisition agency for Air Force ADP systems and as the evaluation agency for independent assessment of ADP systems effectiveness.
6. Incorporates Hq USAF-approved integration and interface requirements for assigned ADP systems.
7. Develops and maintains assigned Air Force automated systems and assigned communications software systems.
8. Provides the communications staff for all major Commands (MAJCOMs) and most lower-level Commands, services, and agencies.
9. Provides ADP-related services to all MAJCOMs, services, and agencies.

AFCC unit commanders at the base level also serve as base C-E staff officers and as C-E representatives to the base master planning board and the Command, Control, and Communications Requirements Board. These officers, assigned to the base commander's staff, are also responsible for preparing and implementing plans for upgrades and other modifications to existing communications capabilities.

At the beginning of the study, the Commander of AFCC had indicated concern about AFCC's ability to fulfill its mission, particularly the task of technological planning to meet the peacetime and wartime communications needs of the 1990s. In addition, the Air Staff had questioned the capability of existing and planned base communications systems to support the Air Force's combat missions.

RESEARCH METHODOLOGY

We began our investigation of the status of existing base communications systems by examining the relevant documentation. We visited four airbases in California to obtain a first-hand view of the base communications environment.[2] At each base, we talked with the commander of each local AFCC unit and his staff, with planners responsible for telephone and ADP systems, with representatives of the primary mission areas (who provided information on communications planning for wartime), and with personnel at telephone switches and switchboards, at the communications centers, and at one AUTODIN switching center.

We sought data on the nature and extent of the communications workload at CONUS airbases in the course of day-to-day operations and also attempted to learn the status of communications planning for wartime at these bases. In particular, we were concerned with the changes in operational procedures and workloads that might be expected to occur in the event of hostilities.

Using the information obtained on these site visits, we attempted to assess current base-level planning to accommodate future workloads and defense emergencies. We also examined the planning operations of base communications units delineated in base master plans or base communications plans to determine (1) the technological direction in which each base is moving, (2) the capacity of each base and its responsiveness to the current and anticipated workload, and (3) current capabilities for emergency operations in the event of general war. We also tried to identify planning actions that would enable base-level functional areas to meet the communications requirements of the 1990s, and how these would affect the worldwide communications and ADP planning for which AFCC has responsibility.

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[2]During an earlier visit to Hq USAF, we also had visited the communications center at Scott AFB, Illinois.

LIMITATIONS OF THIS STUDY

This study is limited to base-communications issues. Although data collection was limited to CONUS bases, the recommendations apply to AFCC responsibilities worldwide. The study is not concerned with other AFCC responsibilities, such as ATC or military affiliate radio stations. It does not address off-base command and control systems or long-haul communications systems, except as they affect or may be affected by base-level communications planning, programming, or operations. The study deals primarily with message, data, and two-way voice communications over telephone lines and digital circuits. It does not consider radio, nonelectronic mail, courier, person-to-person, CCTV, loudspeaker and intercom systems, or detection, alarm, or intrusion systems, even though some of these may use facilities normally provided for voice or data communications.

Because we were able to visit only a small sample of airbases, all of them located within the same geographical area, our conclusions may not be applicable to Air Force bases worldwide. They pertain specifically to regular bases within the CONUS, although they may in some cases apply to OCONUS bases. Despite these limitations, the study points out important issues that should be considered in future studies of wartime deployments and wartime employment of tactical air forces in Europe.

ORGANIZATION OF THE NOTE

Section II reviews the existing and projected status of communications at selected CONUS bases and describes the communications environment at each, including capabilities, operations and management, and planning and budgeting for future needs and requirements. Section III highlights the need for a point of focus on base communications and suggests how AFCC might progress to such a responsibility. Our recommendations are summarized in Sec. IV.

II. STATUS OF EXISTING BASE COMMUNICATIONS SYSTEMS

There are 90 Air Force bases in the CONUS, three in Alaska, one in Hawaii, and one in Guam. There are also 40 USAF bases and operating locations in foreign countries.[1] In addition, there are approximately 55 Air Force stations, such as the Satellite Control Facility at Sunnyvale and the USAF Space Division at Los Angeles, which do not have aircraft or their associated support functions, but whose communications requirements are critical to Air Force missions. Finally, there are about 80 Air Force Reserve and Air National Guard bases, some of which are appendages to civilian airports or Naval Air Stations and some of which are nondominant components of biservice or triservice Reserve or National Guard complexes.

Every Air Force base in U.S. territory is formally "owned," "hosted," or "managed" by one of the MAJCOMs. There are 26 SAC bases in the CONUS, 22 TAC bases, 15 ATC bases, 13 MAC bases, 7 AFSC bases, and 6 AFLC bases. USAF bases on foreign soil fall under the command of USAFE, PACAF, or the Air Force Southern Command.

The host Command is represented by the base commander and his staff and one or more operational units, or *mission elements* (e.g., bomber wings, tanker wings, regional headquarters).

A typical base may also have "tenant" units, which report to Commands other than the host Command but which occupy real property under the jurisdictional control of the host Command and receive typical tenant services from it. Tenants may also be non-Air Force, nonmilitary, or even nongovernment.

Neither tenants nor mission elements are essential to base operations. In fact, entire mission or tenant units are often moved from one base to another.

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[1]These include Main Operating Bases (MOBs); Collocated Operating Bases (COBs), operated by a host nation and intended to be used by the USAF during wartime; Forward Operating Locations (FOLs), which are not permanently manned; and Dispersed Operating Bases (DOBs), which are not usually occupied during peacetime.

Units that are essential for base operations are called "base support." They report to the base commander, although they may belong to a different Command and thus may be regarded as tenants. The AFCC unit at each base is a base support element.

BASE COMMUNICATIONS

The communications operations of a base are determined primarily by the mission requirements of the host Command units, and secondarily by the requirements of tenant units. The host and tenant units share some common systems and channels of communications, and other systems are used only by specific tenants to communicate with their primary off-base Commands. The mix of unique and common functions determines the size of the communications system at a base.

The communications needs of an airbase are met by a conventional on-base telephone system occasionally supplemented by coaxial cables or other dedicated circuits and by AUTODIN I. The telephone system was originally capable of transmitting voice only, but acoustic couplers and other modems now enable nonvoice digital traffic to be carried as well. Off-base connections are provided to AUTOVON, Federal Telephone System, and other government and commercial lines, and most bases also have dedicated point-to-point links.

A switchboard and an adjoining facility that houses the cable terminations, switching units, and sometimes encryption equipment is the heart of the base telephone system. The base communications center is the gateway for all message and data traffic passing through AUTODIN.

Certain Air Force bases also house AUTODIN switching centers which, by DOD directive, are operated and maintained by AFCC. However, we have not examined these facilities in this study.

During 1982 we visited the four Southern California airbases listed in Table 1. Each has a different parent Command and tenant composition, with tenant units ranging from 10 to 300 persons.

Three of the bases we visited have government-owned telephone systems that are operated and maintained by the on-base AFCC organization. The fourth base, McClellan AFB, has a commercially installed and maintained telephone switch and system.

Table 1

HOST-TENANT COMPOSITION OF BASES VISITED

Base	Host Command	Major Units
George AFB	TAC	35 TFW, 37 TFW, Hq XVI AD
Norton AFB	MAC	63 MAW, BMO (AFSC), AFI&SC (AFIG), AFAA, 445 MAW (AFRES)
March AFB	SAC	22 BW Hq 15 AF 452 (AFRES), 303 ARRS (AFRES)
McClellan AFB	AFLC	SMALC, 41 R&WRW (MAC), Hq 4 AFRES (AFRES), 66 APS (AFRES)

The switches at the other bases represent technology ranging from the 1940s through the 1960s. The older systems require extensive maintenance and incur increasingly high support costs. Furthermore, because the equipment at each base is unique, personnel must be trained to maintain specific switches and specialty sets and to interface them with the commercial trunk carrier.

Table 2 indicates the volume of monthly digital traffic at the bases we visited. The workload at McClellan was by far the greatest; this is to be expected, given McClellan's central role as the Sacramento Air Logistics Center. We found no correlation at the other bases between the volume of message traffic and the number of base personnel, aircraft, land area, or other factors. No planning surrogate was apparent. Traffic seemed to depend to a greater degree on the role and mission of the base, its major tenant composition, the nature of the Commands represented, and the organizational positions of the mission

Table 2

DIGITAL TRAFFIC AT BASES VISITED

Total Traffic	George AFB	Norton AFB	March AFB	McClellan AFB
Text sent and received (messages)	1,494	10,602	1,715	66,810
Data batches sent and received	476	1,549	622	....
Data cards (80 columns each)	95,376	149,533	95,341	4,419,133

elements within the host Command and of the base tenants within their respective Commands. We likewise deduced no quantitative or statistical relationship between digital traffic and base composition.

Table 3 gives a functional breakdown of traffic through the communications centers of each base. In each case, the base logistics organization is the largest originator and recipient of data communications. However, the transmission of punched cards is not a personnel-intensive operation at the communications center, because the base supply computer prepares the requisition and status cards, which are then hand-delivered to the message center and transmitted off-base via a card reader to AUTODIN I. In contrast, message traffic requires a great deal of communications-center personnel involvement. Except at McClellan, which has an optical character reader (OCR), each message, averaging 1 or 2 pages, has to be hand-delivered to the communications center and then manually keypunched onto paper tape for off-base transmission via AUTODIN I.

The logistics-originated data traffic through the message center at McClellan is not broken down in Table 3 because traffic from the logistics components at the Sacramento ALC is routed directly into the AFLC Bulk Data Network, a Command-unique net that interconnects the ALCs with Hq AFLC. This traffic is transmitted and received over direct circuits from computer to computer and does not pass through the AFCC communications center. McClellan transmits and receives approximately 4.5 million 80-column cards per month.

Table 3

FUNCTIONAL BREAKDOWN OF TOTAL MESSAGE AND DATA TRAFFIC
(In percent)

Function	George AFB	Norton AFB	March AFB	McClellan AFB
Logistics				
Supply	81.8	70.3	68.3	...
Maintenance	4.8	...	3.0	...
Transportation	0.8	1.4	0.4	...
Data automation	9.8	12.6	13.8	70.3
Other	3.8	16.7	14.5	0.4

CONUS systems are clearly operational and therefore generally meet current requirements for communications speed and volume. Most of the communications traffic is routine, and delays are generally small. Communications delays are reported to occur less than 1 percent of the time, either in receipt or origination. However, no two bases are alike in manning, equipment, mission, or workload. All are connected to AUTODIN I, as well as to any unique networks of the host Commands. McClellan and Norton AFB also have AUTODIN I regional switching stations, which are operated by AFCC personnel. Each base appears to have sufficient capacity to meet its current peacetime voice, message, and data traffic workload.

MAJOR PLANNED BASE COMMUNICATIONS UPGRADES

The SCOPE DIAL Program

Recognizing the penalties in capacity, performance, and reliability imposed by old telephone equipment, as well as the high operations and maintenance (O&M) costs of such equipment, the Air Force has embarked on a major program, called SCOPE DIAL, to replace government-owned manual switches with a family of digital switches. However, the existing government-owned switches differ from base to base, because the hardware and technology reflect the time of installation at each base. Each upgrade must therefore be individually engineered, and the configuration of the equipment must be tailored to the unique characteristics of the base.[2]

By replacing old telephone switching centers with contemporary standardized equipment, the Air Force expects to achieve a modernized capability that will decrease manpower requirements for maintenance and improve on-line performance. The savings in manpower and maintenance costs are expected to pay for the modernization program, which is to be completed over a 5-year period ending in 1986.

AFCC's role in SCOPE DIAL is primarily that of program manager for engineering and installation activities. AFCC is not the procuring agency, but it does have ongoing operational responsibility.

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[2]Equipment for all SCOPE DIAL upgrades is procured under a master contract with Northern Telecomm.

The SCOPE EXCHANGE Initiative

SCOPE EXCHANGE is a Command-generated modernization initiative similar to SCOPE DIAL, for bases with leased, rather than government-owned telephone switches that are provided by the local telephone operating company. Although AFCC personnel have less direct involvement at these bases, the Command has management responsibilities for leased services.

The AF/AMPE System

The Air Force Automated Message Processing Exchange (AF/AMPE) system provides direct user interface with AUTODIN, handling traffic to and from AUTODIN entirely electrically. It eliminates the tedious and labor-intensive task of manual transfer from originator to AUTODIN and from AUTODIN to recipient. AMPE systems are being installed at selected Air Force bases worldwide. However, because AMPE is not a multilevel secure device, its electrical outreach is limited and its potential value can be only partially realized.[3]

Other Programs

AUTODIN II, the intended successor to AUTODIN I, was canceled in favor of the Defense Data Network (DDN) program, which generally follows the technology and concepts of ARPAnet, and will become the DOD long-haul, multilevel secure digital network.

THE ROLE OF THE AFCC UNIT

Each base is represented and supported by an AFCC squadron, group, or detachment whose primary functions are to (1) operate the base communications center, (2) provide O&M support for all on-base communications systems, including designated Command-unique systems, and (3) assist the base commander in planning for future needs.

[3]The so-called ISA/AMPE, a triservice version, will be multilevel secure and will therefore afford even more efficiency in the all-electrical handling of messages. AFCC has program responsibility.

The communications unit receives incoming voice, message, and data traffic, decrypts and reproduces encrypt-for-transmission-only traffic, delivers communications to on-base recipients, and performs the inverse functions for outgoing communications traffic.

AFCC is only minimally involved in base telephone systems served by commercial telephone companies, but it participates extensively in government-owned base telephone systems. AFCC squadrons or groups have sole responsibility for planning of additions and modifications to existing on-base lines, implementation of such additions and modifications, and maintenance of the entire switching system and plant.

AFCC and the local base Commands also have joint planning responsibility for new systems, with the base tenants providing inputs concerning their own requirements. Primary responsibility for systems with multiservice applicability and interfaces, however, rests with higher DOD authority, notably the Defense Communications Agency (DCA). Nevertheless, new systems--whether they are initiated by the local base command, Hq AFCC, or a higher Air Force or DOD level--are usually engineered and installed by one of AFCC's engineering and installation (E&I) squadrons, which have worldwide responsibility for all government-owned airbase communications facilities.

Communications Planning

The commander of each AFCC unit also acts as the C-E staff officer to the base commander. In this latter role, he is responsible for developing annexes to the base master plan and for developing the annual base communications electronic plan (BCEP).

The BCEPs for several Air Force bases we examined were generally limited to work orders and corresponding cost allocations for the next fiscal year's planned additions and modifications to existing communications systems. They consisted primarily of detailed plans for cable laying, phone installation, and two-wire links between on-base communications points. We saw no attempts to define a truly long-range communications master plan, or any programs to achieve such long-range master plans.

The base personnel we talked with were not aware of any master plan for communications developed by AFCC or by the base Command organization. McClellan AFB does have a base master plan that was generated at AFLC initiative, but the communications appendix had not been prepared at the time of our visit.

We found no base-level forecasting of major changes in communications traffic loads that might adversely affect future operations or, for that matter, of enhanced capabilities that might be expected to result from forthcoming system improvements. More important, the BCEPs contained no contingency plans for wartime operations or workloads.

Base communications planners did not appear to have access to USAF-level planning or programming documents that project changes in tenants or hosts on the base, define changes in the program of communications for new technologies, or describe new systems for the base. However, the planners did seem to be peripherally aware of forthcoming upgrades in data-processing capabilities, probably because of the planning activities that had been done by the AFCC Data Systems Design Center (DSDC) and because the Phase IV computer upgrade[4] has been very visible. Planned changes to existing systems and capabilities appeared to be developed at higher levels and not necessarily tailored to individual base needs or capabilities.

Instead of base-wide systematic efforts to exploit the enhanced technical capabilities that will result from forthcoming new systems or existing system upgrades, ad hoc meetings are held to examine and plan for necessary changes and actions. There is no long-range plan to go beyond the immediate need or to visualize new applications, such as what the base central computing unit might be able to do for other functions not currently netted to it.

The bases we visited had no organization to survey the state of the art in technologies potentially relevant to base communications, or to do independent requirements analyses of base needs for communications.

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[4]An Air Force-wide program to provide equipment upgrades for the aging UNIVAC-1011 and various Burroughs computers that support base-level administrative and support functions.

While such an endeavor might be viewed as having low priority at the base level, base-generated requirements could reflect the availability of communications technologies that are not now being exploited and would provide a "wish list" for consideration by higher authorities.

Base-Generated Plans

The base master plans for future capabilities and expansion that do exist are generally developed at the direction of the base's host Commmand, and many do not have a C-E appendix. Each base does have a BCEP, but each is an amalgam of the plans for the individual base elements (mission, tenant, and support) that have been channeled to AFCC by these elements or their respective Commands, plus an overriding allowance for excess capacity in some instances. These plans include programmed and budgeted actions to implement the internetting and linking of Command-unique systems, as well as the support needs of the base elements. Most BCEPs represent only a current assessment of the wire and cable requirements for installing telephones and for supporting ADP gear at base level--and then for only a one- or two-year horizon. They represent no attempt to generate a genuine master architecture to guide future capability or funding.

Thus, programming actions for each base's communications upgrades are fragmented. The mission Command plans base capabilities, the Communications Command plans base programs, and some of the tenant Commands have special requirements for on-base equipment. In addition, individual functional areas program such acquisitions as local area networks (LANs), word-processing equipment, and sometimes small computers. All these actions represent different funding allocations, different time horizons, and different levels of technology. There is no attempt to plan a total base capability that can integrate all such actions in a standardized way.

For effective centralized and integrated planning, the mission and tenant elements would have to define and submit their future requirements well in advance, rather than submitting individual programs for accommodating requirements as they arise. Long-range plans could be submitted to AFCC for evaluation and integration into a standardized master base-level communications plan. Such a plan would provide a

schedule for implementation as well as implementation costs for budget purposes. The plan could be updated annually to reflect changing requirements.

Wartime Planning

Each base we visited appeared to have equipment adequate for its present peacetime tasks, although operations are quite labor-intensive. We suspect that the timeliness of message traffic would increase and reserve capacity might be adjusted (e.g., by using bulk transfer of non-time-urgent data via physical delivery) in the event of a war. However, none of the bases had explicit estimates of potential wartime workloads, nor did they have formalized or fallback positions to be used if current systems became inoperable.

More specifically, none of the bases we visited appeared to have a detailed plan for the transition from peacetime to wartime communications operations. There is a contingency plan for operation under reduced capabilities at McClellan, but no other base had anything similar. While the bases would probably develop workaround modes during an emergency, no detailed checklists or plans for such operation are in place. In addition, no projections of wartime workloads or wartime priorities are discussed in any of the plans.

Telephone switches and other communications links are highly vulnerable to sabotage or external disruption. At many bases, there is only one communications entry point for cables. Entry sites are generally isolated, prominent, and unprotected. We did not learn of any base-level planning to enhance the security of off-base links to other networks.

No attempt has been made, either at AFCC Command level or at the local base level, to specify the wartime consequences for communications of CONUS base operations.[5] AFCC personnel do not seem to be familiar with mobilization and augmentation plans for their bases. Thus, AFCC

[5]Exercises at some bases have been run with airbase communications and ADP severely degraded (or turned off), simulating wartime conditions. But adjacent bases provide alternative facilities, and workarounds give the impression of adequate performance that would not be available in wartime but might suffice for isolated dissident attacks.

base planners have no way of assessing the adequacy of their communications facilities, existing or planned, to meet wartime requirements.

Furthermore, little attempt has been made to determine the effects of degraded or nonexistent base communications facilities on the mission performance of on-base military forces or on the operation of other support systems. For example, the quantitative effect of degraded base communications on sortie-generation capability has not been determined, either through analysis or through tactical exercises.

No wartime logistics studies have been performed, to our knowledge, that estimate the consequences of increased wartime communications traffic flows or of changes in traffic patterns. While a communications breakdown would not immediately affect the amount of logistics materiel in the system, it would have considerable effect on the location and movement of such materiel.

The logistics community has specified the kinds of communications services it expects, and it is generally receiving adequate support, at least in the CONUS in peacetime. However, there is concern that in the event of war, logistics might not have access to the 60 percent of existing communications capacity it currently consumes.

Until the operational consequences of degraded communications services can be articulated, there will be no pressure to upgrade such service. And until there is documented need to improve service, AFCC will not be able to demonstrate the value of upgraded services in terms of Air Force missions and roles.

SUMMARY

The AFCC squadron or group at a base is primarily a service and maintenance unit, and it is structured as such. AFCC units are responsible for providing both the management and the technology expertise for on-base communications, as well as base-level data-automation and its interface with future communications equipment. However, there is uneven response to this role. The local units are not always aware of activities taken by other on-base organizations to enhance their data processing and internetting with various on-base functions. Sometimes the only information that the local communications

units have concerning such activities is obtained via the annual requests for wire and phone services to complete the expansions.

Most existing CONUS base communications systems represent outdated technology and are labor-intensive. The Air Force is making them work in peacetime, but they may not be adequate in a general war or a major conflict. The capability of bases to plan for the future in terms of workload, technological exploitation, and transition from peace to war appears to be quite limited. And even within the framework of this limited capability, we found no evidence of systematic planning to meet future base-level requirements either in peacetime or in wartime.

Admittedly, this assessment is based on observations at only a few CONUS bases and on perusal of available documents. However, we feel that our limited sample is indicative of the larger scene and that careful planning could result in reduced costs, increased capacity, and the alleviation of many manning problems associated with current communications capabilities.

III. ALTERNATIVE FUTURES FOR AFCC

AFCC is presently organized and staffed in the image of its mission statement, notably "to provide ... support and services for the Air Force [and a variety of other agencies] ... [in various areas related to communications and data processing]." Its access to only O&M funds further amplifies its support-and-service appearance. The mismatch between the historical and present AFCC posture and the future communication needs of the Air Force can be illustrated by the following analogy to the components of the national telephone network.

THE NATIONAL TELEPHONE SYSTEM

Since the divestiture of AT&T, the local telephone companies that once formed the basic unit of the national telephone system have become regional companies. However, they have retained essentially the same responsibilities for services and functional capability. Connectivity among local companies and with international systems was formerly provided by the long-lines department of AT&T, but in recent years competitive services have appeared, e.g., MCI, GTE/Sprint.

An essential component of the national system has been and will continue to be the Bell Telephone Laboratories. The Bell Laboratories played a pivotal role in the evolution of the telephone system from a collection of independent local companies that could not interoperate with one another to a technically knit and operationally integrated national system. Among other things, it provided a steady flow of research and development, new products, new technology and operational concepts, new techniques, new transmission methodologies, interface standards, system-level standards, and system design studies. Other telephone companies (e.g., General Telephone) likewise generally have, or have access to, a corresponding laboratory or source of technical expertise.

Presiding over the operating companies, the long-lines division, and the laboratories has been the umbrella of AT&T's corporate authority. AT&T has provided overall policy guidance for the

development of the national telephone system, has served as the focal point for national and international standards and agreements, and has been the contact point for agreements with other (so-called "independent") telephone companies in the United States. It has provided the leadership that has enabled the many components of the national system to function and develop smoothly together.[1]

THE AIR FORCE COMMUNICATIONS SITUATION

The Defense Communication Agency (DCA) is analogous to the long-lines department of AT&T or other long-distance carriers. It provides point-to-point switched services, and it interfaces users--in this case, airbases rather than telephone companies--at multiple points. As local telephone companies must interface with long-haul carriers, Air Force bases must meet the interface and other operational characteristics of the DCA networks.

AFCC, as a Command, has many of the characteristics of a local telephone company. In addition to Hq AFCC at Scott AFB, there are communication squadrons or communication groups at each airbase which have a dual responsibility: to AFCC, for which they serve as field representatives to operate and maintain AFCC systems and as a channel to Headquarters for planning data; and to the local base commander, for whom they comprise the communications technical staff. In the latter capacity, a local contingent may provide advice on equipment selection or on local source-selection actions, may assist in on-base communications planning, does provide responsive day-by-day support for changes in communications arrangements, and may provide inputs for long-term base- or Command-oriented communications planning, e.g., mobility studies, contingency studies, posture problems.

For bases with government-owned telephone switches, the analogy between AFCC and a local telephone company is quite exact; for bases serviced by contracts with a local telephone company, there is more of a resemblance than a close analogy. In any event, AFCC base-level personnel do many of the same jobs as telephone company personnel:

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[1]The Western Electric Company has been a part of the AT&T system also, but it is not pertinent here because the Air Force does not require a manufacturing arm.

- Digging trenches and laying cables.
- Moving and installing telephones.
- Providing twisted-pair lines from place to place.
- Supplying operational and maintenance personnel.
- Keeping records of equipment installations.
- Providing facility maintenance.

Tasks at Headquarters level are also similar to corresponding tasks in a local telephone company:

- Setting standards for maintenance and operational actions.
- Coordination and planning of personnel training.
- Facility engineering.
- Planning for extensions and modifications to the plant.
- Conducting negotiations with long-haul carriers.

Thus, Hq AFCC resembles the corporate part of a local telephone company, and its field components resemble the installation/maintenance part.

The services supported by the cable plant of AFCC are exactly those of a commercial operating telephone company: fire alarm and other security services, data transmission, voice transmission, facsimile transmission, and sometimes broadband circuits.

Here the analogy fails, because there is no USAF organization similar to the telephone company laboratories, nor does the Air Force have a parallel to the AT&T corporate authority. There is no mechanism for performing the system-level technical and program planning activities essential to an orderly progression toward an on-base communication environment capable of exploiting modern communications technology. Nor is there an authority to assure technical and operational cohesiveness across all bases and MAJCOMs. The Air Force arrangement has worked in the past because it has essentially derived its on-base common-user communications environment from the commercial national system which brought technical cohesiveness and operational completeness.

The past cannot be extrapolated to the future, because too much of contemporary communications capability now resides with independent vendors, e.g., the many vendors of local area networks (LANs) or digital telephone exchanges. The Air Force can no longer simply turn to the "telephone company" for what it needs. Deregulation of the industry makes competitive considerations important, and the complexity of communications systems often extends beyond the purview of the local telephone company, e.g., LANs connecting to high-speed digital switches.

The Air Force, and in particular AFCC, must now become system-level planners, architects, and implementers. In the Air Force, no one presently is in charge of getting "there from here," nor does anyone have the authority to make it happen.

R&D Requirements

It is clear that a continuing stream of R&D is essential to support the continued growth and expansion of the commercial telephone network. What R&D is needed for Air Force on-base communication needs and how should it be supplied?

Obviously, there is an ample and extensive flow of commercial products that can be directly utilized on-base. There is likely to be little need, therefore, for AFCC or the Air Force to support R&D on new base-level-communications products. However, extensive system-level planning and engineering concerns must be faced, including

- Interface issues (e.g., between LANs and switched networks).
- Protocol issues between and among networks.
- Protocol issues for various services provided by the network and through it.
- Architectural issues for communication networks.
- Survivability for theatre bases.
- Security aspects of on-base communications at all bases.
- Vulnerability of CONUS base communications to terrorist and dissident attacks.

- Security within complex computer-communication networks.
- Mobility and transportability issues for systems that must be deployed.
- Interface and interoperability issues with NATO or other host-nation systems, e.g., power sources, data transmission arrangements, voice communications, all communications needs of host-nation and collocated operating bases.

Some technical features that can be satisfactorily provided by commercial equipment in the CONUS might be impossible to achieve with the same equipment in a combat environment. For example, the error-accommodation details of protocols--especially for long-haul communications or for communications served by host-nation telephone systems--are related to the quality of the service that can be expected. Protocols that might function satisfactorily in the CONUS could well be inadequate, even in peacetime, in a country with low-quality, high-error-rate communication channels. Even on Air Force-provided channels, CONUS protocols might fall short in wartime, because of enemy actions such as jamming or interference.

The evolution of airbase communications systems will require all the technical and system-level efforts of the Bell Laboratories over the years that have resulted in a cohesive national telephone network, that permit a variety of equipment to interface it, and that integrate independent long-line suppliers smoothly into the system. The Air Force must also provide for the corporate authority to make it happen, to advocate the funding for it, and to oversee its implementation.

AFCC's Position

AFCC has a special problem, however, relative to telephone operating companies or to industrial organizations. A local telephone operating company stipulates certain standards that must be met by anyone connecting to it. They include interface standards involving electrical details of signaling, physical arrangement of connectors, bandwidth restrictions, frequency response, and data-flow formats. These standards must be met whether the connection is from a LAN, a

telephone answering device, a telephone handset, or a computer terminal. Federal authority (the FCC) sets the standards and oversees them.

At the industrial level, a forward-looking organization, especially one with a contemporary management that understands the advance of technology, will usually have a corporate-level point of focus for all of its communication concerns. Therefore, LANs, office automation networks, voice traffic, data traffic, and computer systems are implemented in such a way that they fit smoothly together and afford whatever interconnectivity is required. There is a central authority to plan, standardize, and coordinate, and sometimes to implement.

In contrast, AFCC is at the mercy of multiple base tenants and host organizations. Historically, this has not caused a problem, since electrical and signaling details were simple and many interfaces were accommodated by the most flexible component of all--people (e.g., a torn-tape communications center, a switchboard plug-up between a telephone circuit and a radio link). But today a vast variety of communications and networking arrangements are available from commercial sources; interface details are much more complex, and interconnections are often one-to-many or many-to-one, and automated as well.

A CENTRAL POINT OF FOCUS

The lack of a central point of focus in the Air Force for many detailed communications matters is raising problems. Some issues are being accommodated because of spontaneous standardization among commercial suppliers (e.g., the RS-232 and similar interface standards, and the obvious requirement that all commercial vendors of computer-based switches must meet the established standards of the national telephone system). Unfortunately, there is no comprehensive array of the standardized interconnect arrangements that the Air Force, with 120 airbases, each going largely its own way now, will need. On the contrary, there are pressures against some aspects of standards; for example, it is competitively advantageous for LANs from various vendors not to interface one another--and they generally do not--although most of them do interface the telephone system. Thus, telephone technology is a de facto common denominator for interfaces among LANs.

If a base is to progress smoothly from its present situation to a future posture embodying contemporary and full-time communications services and arrangements, including digital switches, LANs, office automation installations, etc., some Air Force organization has to do for the diverse collection of communications users on each base what AT&T, with its corporate authority and the Bell Telephone Laboratories, have done over the years to pull all the initially independent telephone companies of the country into an integrated, technically cohesive system, and what the new Bell Communications Laboratory will do for the post-divestiture seven regional telephone companies.

In a way, the 120 CONUS airbases are analogous to the seven newly formed regional telephone companies. However, the latter are starting with a technically cohesive, uniform environment that has been under a central technical discipline for decades; *the airbases do not have such an advantage*. The new Bell Laboratory will start with 3000 people, about one-third of whom will be required to deal with technical cohesiveness, system engineering studies, and comprehensive standards. In view of this level of staffing, it takes little imagination to conclude that creating a unified on-base communication architecture, supported by appropriate technical, procedural, and operational standards, will be a major undertaking.

USAF OPTIONS

What options does the Air Force have for dealing with the issue? Its assets are the MAJCOMs, including AFCC; the specialized technical centers such as the Data Systems Design Office (DSDO);[2] functional-area centers such as the Air Force Manpower and Personnel Center and the Air Force Finance Center; the in-house laboratories, notably RADC; and the acquisition divisions of AFSC, notably ESD. The closest approach to a corporate authority is the Air Staff, in particular the Assistant Chief of Staff for Information Systems.

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[2]Formerly the Data Systems Design Center; now an office of the Air Force Teleprocessing Center.

A Strengthened AFCC

AFCC could become a centralized point of focus for on-base communications planning and system studies--and probably should, for the following reasons:

- AFCC is already deeply involved with bases.
- AFCC already has people on every base.
- The AFCC local contingent is an excellent interface for the flow of planning and system-study results to the base Command.
- The commanders of Communications Divisions are an excellent interface to Command Headquarters for planning and system-study results.
- AFCC understands the operational context of bases.
- AFCC has many important functions and organizational elements already in existence (including E&I squadrons).
- AFCC already must man, train, and plan to support new systems, both in the CONUS and abroad.

But such a projected role for AFCC would be significantly different from its historical role. AFCC would have to provide vigorous leadership; it would have to be the point of advocacy for issues not now on its roster of concerns; it would have to assure that appropriate R&D efforts were created, although it would not necessarily conduct them itself. In short, it would have to dramatically modify its historical image of a support-and-service command. It would have to provide aggressive Air Force-wide leadership in communications, computer, and information systems. It would have to handle appropriate system engineering, architectural R&D, and many other aspects of contemporary communications technology, and its mission statement would have to be changed to reflect this more central and expanded role.

AFCC has already moved away from a pure support-and-service posture for base-level computing affairs. There is a focal point for base-level computing matters at the DSDO; there are ongoing arrangements to assure that new computing needs are met; there are functional-area user/programming teams that implement new capabilities; there is a forum

in which technical and functional-area people can develop requirements. AFCC support of base-level ADP goes far beyond simply installing computers and providing operators and maintenance personnel. The Command and Control Systems Office (CCSO)[3] at Tinker AFB might be expanded to an equivalent leadership role for on-base communications.

One of the key elements of this approach is the establishment of a continuing R&D program to support base-level communications. This R&D effort will be directed primarily toward system-level issues such as interconnects, interface standards, protocols, gateways, addressing structures in networks, and the interplay among all of them. How might such R&D be achieved?

R&D funds could be provided to AFCC, along with R&D system-level people. This option has certain advantages. Service delivery organizations must maintain contact with the R&D world to keep abreast of new developments and to keep technical skills current. An R&D capability within AFCC would provide new in-Command career paths. As communications squadrons and groups are in a position to discover and diagnose problems and to develop requirements for new systems, AFCC would be in a position to set priorities for on-base needs, to be the advocate for its own initiatives, and to demonstrate the value of its products and its mission accomplishments.

There are also arguments against such a move. AFCC would have to develop a strong R&D arm; it would be a different Command, organizationally and in staffing. It would have to become an advocate for R&D funds and all of the budget review details this implies; it would have to interact with the Air Staff differently. An R&D mission, even though related to AFCC's primary communications thrust, would divert AFCC attention from its many present obligations.

Alternatively, AFCC might make alliances with existing Air Force R&D organizations, primarily within AFSC. An example already exists: AFCC and ESD/OCH have organized AFLANSPO, a joint venture to examine office automation and LAN matters. A wider variety of such arrangements would certainly be appropriate; there are many advantages. The staffing, management, and budgeting details for the conduct of R&D

[3]Formerly the Consolidated Communication Programming Center; now an office of the Air Force Teleprocessing Center.

already exist in AFSC/ESD. There are laboratories within AFSC (e.g., RADC) that have established families of contractors to do relevant work. And FCRC centers such as the MITRE Corporation exist to support AFSC product divisions.

On the other hand, AFSC product divisions and laboratories would have to be more nimble and much more responsive than the usual system-acquisition approach implies. The traditional practice of specifying requirements and having the system built to order is inappropriate, partly because of timeliness aspects but also because the base communications requirements (in the CONUS) will be largely met by selecting equipment from the commercial marketplace and stitching it together in an appropriate overall system architecture. AFCC does not need innovative new technologies and new system designs except possibly for OCONUS bases; it needs technical assistance in exploiting and combining the plentiful supply of commercial products with an overlay of system-level study, plus a little bit of specialized R&D.

The technical problems of base-level communications might be seen as mundane and prosaic by AFSC, and not challenging to the high-technology forefront-of-the-art activities with which it normally functions. AFSC does not have personnel at each airbase to discover and diagnose problems, or to develop requirements for new systems, but AFCC can supply them.

Aside from the technical implication of R&D, there is a particular interpretation of it for AFCC, namely, the preparation of technical plans, especially long-range ones. The activity might equally well be called "technical planning," but it will involve technology inputs and interaction with requirements, rather than programmatic justifications.

One function of long-range plans whose preparation involves examination of technical alternatives for an admittedly dimly known future is that of keeping these alternatives carefully arrayed against the calendar times at which decisions about them must be made. It is not necessary to make a decision for some event 15 years in the future if the response needed to achieve it will take only 5 years. The decision can be postponed accordingly. A long-range plan keeps events visible and flags them for attention at the proper time.

Long-range plans also provide the user community with a general picture of what is ahead, so that individual users can plan and implement their own actions accordingly and thereby maintain system-level cohesiveness. From this point of view, such plans can cue users to prepare mission-related arguments at appropriate times, or to provide revisions to the plan as their own needs change.

There are some special R&D issues that the commercial world is not likely to accommodate, but they occur at a system level, with architectural, networking, and interconnecting overtones. For example, communications arrangements for bases in combat theatres simply must be different from those for CONUS bases, because of the damage that can occur during conflict and because continuity of communications in spite of damage is essential for performance of the wartime mission. Hence, an R&D thrust may be needed that addresses special damage-resistant communications arrangements that will be needed for such bases. Another issue is the effect of chemical-warfare agents on communications gear and the consequences of BW/CW for operational communications systems. Does such a threat relate to the level of automation in the communications architecture? And again, can commercial equipment be "TEMPESTed"[4] and/or made rugged enough for combat theatre needs?

There is another aspect of R&D in which AFCC should properly be involved. This aspect is best illustrated by an example: A wide variety of paging devices are becoming available on the commercial market. One of these is a small self-contained printer that responds to digital transmissions from a central source and is designed primarily to convey short messages to field personnel. Such a device might be useful for on-base air operations. For example, it could be used to dispatch maintenance vehicles, to request parts from supply, or to direct personnel to waiting aircraft. However, this would be a significant departure from present procedures, and it is not clear that it would be operationally acceptable, even though it offers some advantages. For example:

[4]TEMPEST is the nickname for mechanisms that protect against undesired emanations from electronic equipment.

- The digital transmissions can be readily protected by encryption, eliminating the vulnerability of air operations to spoofing or deception. Anti-jam features could also be introduced as required.
- Flight-line personnel would have a written record of what is to be done; handwritten notes would be unnecessary, and human errors of memory would be offset.

On the other hand, this particular device is a one-way system, and to the extent that two-way communication is needed between the control points and the flight-line personnel and vehicles, it might be operationally unattractive.

An experiment is needed to evaluate ideas such as this and to explore more technically advanced ways to conduct airbase operations. The experiment clearly should involve AFCC, it might involve ESD, and it must involve one or more flying units. It is not the mission responsibility of ESD to conduct such experiments, and flying units need technical support to perform them. It seems appropriate for AFCC to bridge the gap and to take the initiative in formulating such an experiment and then to structure programmatic actions to implement successful results. An alliance, in the spirit of the AFCC/ESD alliance on LAN matters, is required between AFCC and an operational flying command and its units.

Command-Centered Planning

There is also a completely contrary option for communications planning: The Air Force could continue to operate substantially as it has, with MAJCOMs (and SOAs) charged with communications planning for themselves, not only for command-control, but also for general administrative and support traffic. Each type of base would have what the host Command believes desirable to support its mission needs. Under such a construct, AFCC would retreat even more deeply into a service-and-support role; it would become the "Air Force Regional Telephone Companies." It would supply circuits and operational services as requested; there would be little motivation for trained technical

personnel to stay within the Command, since career progress in a technology that is very fast-moving everywhere else would be stunted.

If individual Commands were responsible for on-base communications, there is every likelihood that each would go its own way. The usual prerogatives and jurisdictional protectiveness that organizations develop would probably assure such an outcome. There would be little consistency from bases of one Command to those of another; there could be serious problems for a tenant who moves from a base of one host to that of another. Interoperational problems would undoubtedly abound. Only to the extent that the commercial world develops a comprehensive set of standards would there be a force for technical cohesiveness.

THE PREFERRED OPTION

On balance, the disagreeable consequences of a Command-centered laissez-faire attitude toward communications planning and implementation seem so serious that the Air Force cannot risk such a choice. There is little argument that computing, in the most general way, has become an essential feature of Air Force activities; communications must be explicitly acknowledged as being of like importance. The two technologies have blended throughout the commercial and industrial world so thoroughly that planning for them and operating them usually constitute a combined effort under a common management structure. It must be so in the Air Force, as well, because communications, like computers, are central to the ability of the Air Force to fulfill its mission. On-base communications must be cohesively planned and coordinated, and tight technical consistency must be maintained.

The Air Force cannot afford not to identify a point of focus for base-level communications at the system level. AFCC is the natural choice for the reasons mentioned above. The time has come for AFCC to fulfill the responsibilities that the rapid advance of technology in communications and computers has thrust upon it. It must not wither; it must have a "whither" consonant with Air Force dependency on it.

IV. CONCLUSIONS AND RECOMMENDATIONS

The relevant Air Force assets to implement the preferred option described in Sec. III are the Assistant Chief of Staff for Information Systems; AFSC/ESD and its RADC laboratory, plus its FCRC support at the Mitre Corporation; and the AFCC with CCPC, DSDO, and possibly DSEC and FEDSIM. These are the organizations that collectively must do for on-base communications what the former AT&T structure did for the national telephone system. How can they function as a consortium for the benefit of base-level communications, and ultimately for base-level information systems?

CORPORATE AUTHORITY

The Air Force does not want and would not accept a czar for communications matters. Not only would it be contrary to Air Force cultural and doctrinal preferences, but it would intrude on preferred organizational alignments and would probably upset the distribution and balance of power among many organizations, notably the MAJCOMs. Nonetheless, the Air Force must have consistency of policy and a common technical discipline across both bases and MAJCOMs. Therefore, the "corporate authority" must be provided by a combination of Air Staff (AFSI) and AFCC actions.

The AFSI can:

- Set policy that will govern the overall way in which on-base communications will be handled.
- Establish standards that facilitate connectivity among systems and contribute to technical cohesiveness across bases.
- Sponsor technical actions on behalf of technical cohesiveness, e.g., creation of a standard products list for LAN technology that is acceptable throughout the Air Force.
- Participate with AFCC in bringing about its transition from service-provider to focal point for on-base communications, computing, and information systems.

- Participate with AFCC in the long-range planning and program development process.
- Serve as the Air Staff advocate for new relevant initiatives, and the general oversight manager for on-base communications, computing, and information system matters.

AFCC, on the other hand, must now do for on-base communications what the DSDO and its former authority relation with the Air Staff (AFACD) have accomplished for on-base computing and the information systems supported by base-level computers. AFCC can:

- Be responsible for the requirements process that will create a comprehensive statement of user needs for on-base communications.
- Bring together functional-area people and technical people to provide a forum for the resolution of user needs.
- Create truly long-term plans and examine technical alternatives to implement overall policy and guidance from AFSI.
- Initiate the necessary steps to examine technical aspects of standards promulgated by AFSI.
- Initiate appropriate R&D projects to examine issues that are unique to the Air Force, especially combat-theatre, on-base communication needs.
- Enhance and broaden the technical skills of communication groups and squadrons.
- Provide a timely flow of user requirements and both MAJCOM and USAF long-range goals to support better participation in planning.
- Take steps to assure the collection--and dissemination to interested parties--of data necessary to examine technical and architectural alternatives for on-base, common-user communication.
- Take steps to assure that the computer matters for which AFCC is responsible are closely integrated with communication matters throughout the command.

- Make arrangements with AFSC to obtain the support of ESD in relevant R&D efforts and system-level studies.
- Provide the leadership to create appropriate programmatic initiatives that are related to mission effectiveness and that therefore can properly compete with other demands for funding.

An alliance between AFCC and AFSI will also provide some aspects of the support the Bell Telephone Laboratories provided to the national telephone system, in particular, standards, preferred products, interconnection details, and interface arrangements. Unlike the Bell Laboratories, however, the AFCC/AFSI combination will also be the overseer and enforcer.

While some recommendation on the division of authority between AFSI and AFCC would seem in order, the present study examined only AFCC's role in base communications. AFSI and AFCC are presently holding discussions concerning the division of authority and responsibility, however, and it seems evident that there will be a resolution in the best interests of Air Force organizational relationships. The goal of such a resolution is clear: AFSI and AFCC must jointly provide the necessary authority to handle base communications--and also information systems--comprehensively across the Air Force.

REQUIREMENTS GENERATION

The issue of requirements generation is especially important because there is presently no effective mechanism to support such a critical function. What is needed is the analog of the environment at DSDO in which functional-area people--possibly supplemented by MAJCOM representatives, when warranted--closely interact on a continuing basis with technical specialists to identify requirements that are desirable and possible, and to examine technical alternatives for implementing them. Such a comprehensive statement of user requirements can then become an input to the creation of programmatic initiatives.

- **We therefore recommend that an AFCC initiative be undertaken to create a mechanism, in the spirit of DSDO, that can integrate functional-area and technical people, provide a forum that can adjudicate competing user needs, and generate a comprehensive statement of user requirements for on-base communications.**

Such a comprehensive statement of requirements, together with appropriate mission-related arguments, could become the basis for the planning process that yields MAJCOM- or SOA-supported improvement programs for base communications. It might be sufficient to bring functional-area people from MAJCOMs into an intimate relationship via an on-line computer system with technical specialists at CCSO, DSDO, EIC, Hq/AFCC, etc.; but at least initially, it is probably essential that all participants be physically collocated.

- **We further recommend that AFCC create a computer-based on-line user requirements database that will be continually updated and refined and that can be made available wherever necessary as an input to local (e.g., on-base) planning efforts.**

Initially, a distribution of printed output would certainly be a marked improvement over the present lack of comprehensive planning data; but in the long run, a dynamic database should be available via an appropriate computer network to planners or to anyone else who needs it. Inputs to such a database would be expected from MAJCOMs, SOAs, the Air Staff, communication groups or squadrons, and other present or future users of AFCC communications support.

The Engineering and Installation Center (EIC) currently maintains a database for scheduling its workload, which can be accessed electronically from some bases. The system that supports it might form the basis for a communications user requirements database.

Such a requirements document supported by a database can be used for the initial examination of architectural and other technical options. To proceed to a more detailed design, however, data that characterize traffic flows--both voice and data--on typical MAJCOM bases are highly desirable. Without such data, the architecture would have to be designed to permit ready expansion to accommodate growth in traffic flow and easy reconfiguration to accommodate redistribution of the traffic pattern.

- **We recommend that AFCC, with support from ESD (and its assets as appropriate), examine the possibility of collecting traffic characteristics and traffic-flow data for representative bases of each MAJCOM.**

COMMUNICATIONS R&D

Air Force-unique on-base communications R&D will be needed, and analytic studies must be performed to guide choices among alternative solutions. The AFCC must enhance its capability on the latter, but it is not reasonable for it to become an R&D installation.

- **We recommend that AFCC make appropriate arrangements with AFSC to acquire the support of ESD (and its assets) for certain communications-related R&D tasks and for occasional special studies that may be needed.**

There are precedents for such an arrangement. AFLC and AFSC have negotiated one, and AFCC has joint sponsorship with ESD for AFLANSPO. The arrangement, however, should be flexible and cooperative. AFCC should be able to request studies and support from ESD without extreme formality of interaction.

- **We recommend that AFCC make appropriate arrangements with flying or other operational commands to conduct joint experiments designed to assess the usefulness of contemporary communications equipment for flight operations.**

While this recommendation refers only to communications and flight operations, it is clear that a broader scope is appropriate: communications plus computing, flight, and support operations.

MISSION EFFECTIVENESS

Any AFCC-proposed programmatic initiative that must compete with other demands within the Air Force for approval and funding will have to be intimately related to the mission effectiveness of a particular MAJCOM, of theatre forces, or even of the entire Air Force. AFCC must supply the leadership that assembles the proper people from within the Command or any of its components, and from relevant MAJCOMs, SOAs, the Air Staff, etc., to address the issues. It must be prepared to do the necessary studies to establish the mission relevance of each proposed program.

The requirements process is the mechanism that the Air Force uses to select among competing demands for funding support. AFCC and a MAJCOM will have to cooperate in constructing adequate arguments to support each initiative. The relationship between the proposed program and the payoff to the Air Force--efficiency, peacetime cost savings, wartime sortie generation, combat-theatre-survivable information processes, or whatever--must be clearly stated, properly documented, and supported, ideally by analytic studies.

THE CONSEQUENCES

Unless AFCC steps out smartly to become the focal point for on-base communications, computing, and information systems, a large part of the Command will stagnate and fall short of providing essential operational support for the Air Force. The computer part of on-base information matters will continue to prosper; the Phase IV equipment upgrade program is well under way and properly managed, and it will be completed successfully. Appropriate functional capability and software improvements are now in the consideration and design stage.

Changes must be made in the communications part of on-base information systems to prevent the continuation of the present way of life, which is characterized by uncoordinated actions by base-level

organizations with their own funds, and downward-directed actions by each MAJCOM for only its own bases. Neither MAJCOMs nor anyone else is likely to support an AFCC proposal for communications improvements or upgrades in such an environment. Such a proposal would succeed only if some influential individual outside the Command were to make the case for an action--a rare occurrence at best. The risk is not one that the Air Force can afford.

- **Therefore, we recommend that the mission statement of AFCC be revised to reflect the broader and more responsible mission that AFCC must have for the Air Force.**

Appendix

DEPARTMENT OF THE AIR FORCE
Headquarters US Air Force
Washington DC 20330

AF REGULATION 23-32

6 March 1980

Organization and Mission—Field

AIR FORCE COMMUNICATIONS COMMAND (AFCC)

This regulation gives the mission and responsibilities of the AFCC.

1. Mission of AFCC:

a. **Overall Mission.** The AFCC mission is to provide communications-electronics (C-E), automated data processing (ADP), and air traffic control (ATC) support and services for the Air Force, other agencies, and designated command and control systems of the specified, unified, and component commands, as directed by the Chief of Staff, USAF.

b. **Elements and Objectives**

(1) Planning, budgeting, engineering, programming, installing, operating, and maintaining C-E, assigned ADP, and ATC fixed and nonfixed facilities.

(2) Providing central management of commonly engaged ADP activities, ADP resources, and US Air Force standard automated data processing systems (ADPS) assigned by HQ USAF. AFCC provides responsive support for assigned ADPS from conceptual stage to the end of operational life cycle.

(3) Analyzing present and proposed Air Force standard ADP, C-E, and ATC systems and facilities to make the best use of technology, economy, and compatibility with other systems, and responsiveness to US Air Force operational requirements.

(4) Providing software support for assigned C-E, ADP, and ATC systems including analysis, design, development, test, and maintenance.

(5) Organizing, training, and equipping combat communications units capable of worldwide deployment.

(6) Providing end-to-end technical systems management for assigned command and control systems.

2. Special Responsibilities and Instructions:

a. **USAF Responsibilities.** Under policies established by HQ USAF, AFCC:

(1) Serves as the Air Force single manager for base communications, air traffic control services, weather communications, US Air Force portion of the Military Affiliate Radio System, and common user telefacsimile services.

(2) Operates and maintains communications-electronics and ADP elements of the command and control systems for specified, unified, and component commands, as directed by the Chief of Staff, USAF.

(3) Serves as the Air Force agency to plan, program, budget, operate, and maintain those portions of the Defense Communications System for which the Air Force has operations and maintenance responsibilities.

(4) Serves as the agency responsible for controlling the use of the Federal Telecommunications System by Air Force activities. Budgets and funds for those services provided by the Air Force.

(5) Develops the USAF Plan for Telecommunications, and the Command and Control, and Communications Program Plan.

(6) Serves as the Telecommunications Certification Office for processing designated elements of expense/investment code (EEIC) 491/498 requirements to the Defense Communications Agency, except where exempted by HQ USAF.

(7) Programs, budgets, and accounts for US Air Force EEIC 491/498 for leased communications services.

(8) Develops and administers readiness measurement systems for assigned or gained C-E and ADP resources.

(9) Performs flight evaluations of air traffic services and air navigational facilities to support combat, contingency, and emergency operations. In peacetime, maintains a force capable of performing these evaluations.

(10) Manages the US Air Force notice to airmen (NOTAM) system.

(11) Represents DOD on the International Civil Aviation Organization Obstacle Clearance Panel Delegation.

(12) Serves as the Air Force evaluation agency for independent assessment of the effectiveness of ADPSs.

(13) Serves as the Air Force central acquisition agency for ADP systems and ADP systems elements.

(14) Incorporates HQ USAF approved integration and interface requirements for assigned ADP systems.

(15) Provides technical support and services throughout the federal government for simulation studies of proposed ADP systems and for computer performance and evaluation of existing ADPSs.

(16) Provides HQ USAF and the Office of the Secretary of Defense with ADP support and management sciences services.

(17) Provides staff support to HQ USAF for those activities where AFCC is designated as the executive agent.

(18) Conducts the Interservice Frequency Management School.

(19) Establishes and conducts Air Force professionalism programs for 30XX and 16XX career fields.

(20) Administers C-E Security Assistance Program.

(21) Maintains a capability for the technical evaluation of atmospheric surveillance radar sensors.

(22) Develops and maintains assigned Air Force

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automated systems and assigned communications software systems.

b **Budget Responsibilities.** Major commands (MAJCOMs) and separate operating agencies (SOAs):

(1) Budget and fund for nonpersonnel costs related to their base communications. Command dedicated EEIC 491/498 requirements are identified and justified by each MAJCOM and SOA and forwarded in each command operating budget; these requirements will also be consolidated by AFCC in a special US Air Force operating budget submission. AFCC combines EEIC 491/498 requirements in the annual Command and Control, and Communications Program Plan sent to HQ USAF.

(2) Budget for Class M (maintenance) and Class R (repair) projects for real property to all AFCC facilities.

3. Relationships With Other Commands and Agencies. AFCC maintains close working relationships with all MAJCOMs, services, and agencies. AFCC provides the communications and air traffic services staff for most MAJCOMs, intermediate level commands, services, and agencies. AFCC unit commanders serve as the C-E and air traffic control staff officer at base level and as the C-E representative to the base master planning board and the Command, Control and Communications Requirements Board. AFCC provides ADP related services to all MAJCOMs, services, and agencies.

4. Direct Communications. Direct communications is authorized between AFCC, Air Force activities, and outside agencies on matters concerning AFCC responsibilities.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL

LEW ALLEN, JR., General, USAF
Chief of Staff

VAN L. CRAWFORD, JR., Colonel, USAF
Director of Administration

SUMMARY OF CHANGES

This revision updates mission taskings and reflects changes required because of the Air Force Data Automation Agency, Air Staff, and ADCOM reorganizations (paras 1b and d) and reflects command designation change from AFCS to AFCC (all paras).

END

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