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THE ART OF COMMUNICATIONS SUPPORT

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Joint Military Operations Department.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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ABSTRACT

Communications support is a vital element at the tactical, operational, and strategic levels of operations. As commanders and functional staff officers come to rely heavily on communications technology and the information it conveys in the prosecution of wars and operations other than war, they should be aware of both the basic tenants of efficient and effective support and the potential vulnerabilities of these critical systems. Command and staff understanding and support is important as Communications or Signal Officers seek to balance operational design with functional requirements. This research analyzes the art of communications support to the warfighter. While many aspects of the operational art of war could be studied, it focuses on aspects of space-time-forces, select principles of war, operational planning, and training.

THE ART OF COMMUNICATIONS SUPPORT

"Congress can make a general, but only communications can make him a commander."
General Omar Bradley[1]

INTRODUCTION

The Gulf War and subsequent military operations other than war (MOOTW) have demonstrated the communications technological sophistication and advantages enjoyed by U.S. forces over real and potential adversaries during both joint and combined operations. Current trends seem to reinforce our growing dependence on information age technology. History, however, has shown that technologies in and of themselves have not changed warfare as much as the foresight of the commander and his staff to employ these advancements to optimum advantage in operational design.

THESIS

Current and future communications systems will change or have a profound influence on doctrine, force structure, and the design of military campaigns. As commanders and functional staff officers come to rely more heavily on these systems and the vast amounts of information that they have the potential to carry, a critical review of their affect on operational art is required with every application. While the information age portends an era wherein the fog of war may be lifted and friction reduced, this period might well introduce unintended vulnerabilities. These vulnerabilities not only render communication systems useless but, based on our increased reliance on their services, also leave a highly sophisticated force, tuned to these capabilities, without the resources or the structure to recover should they be lost. The challenge for the

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[1] U.S. Department of the Army, FM 100-5: OPERATIONS, Washington, D.C.: HQ, Department of the Army, 14 June 1993, pg. 2-15.

Communications or Signal Officer is to balance design and to implement systems which meet the information requirements of the joint force while protecting it from the deleterious affects of information warfare. This officer must have available both the ***tools*** of a standardized, interoperable joint system and the ***support of command*** to create a network which will meet the needs of all participants. This paper will focus on the art of communications support as a subset of the operational art of war.

BACKGROUND

Definitions* and Authority. Communications systems are a subset of the command and control (C2) systems which support operational command and control. A joint force commander (JFC) controls the C2 system to ensure that data and information get to the right place and at the right time.[2] The authority for the efficient and effective management of communication systems flows from the National Command Authorities (NCA) to the combatant or joint force commander.[3] Further, the joint task force (JTF) establishing authority ensures that communications systems requirements are supported; activities are coordinated; policy and guidance is prepared; and, systems compatibility is ensured. Hence, authority for the efficient and effective management of theater communications systems resides with the combatant commander-in-chief (CINC). Military Departments or Military Services provide interoperable and compatible communication systems, including personnel, training, and equipment maintenance to the combatant commanders.[4] A basic understanding of the definition of 'system' as well as the

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* Complete Joint Publication definitions are found in Joint Pub 6-0. These derivative definitions are provided to describe the subset 'communications' for purposes of this paper.

[2] The Joint Staff. Joint Pub 6-0: Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations, Washington, DC: The Pentagon, 30 May 1995, pg. vii.

[3] Joint Pub 6-0, pg. I-7.

[4] Joint Pub 6-0, pg. xi.

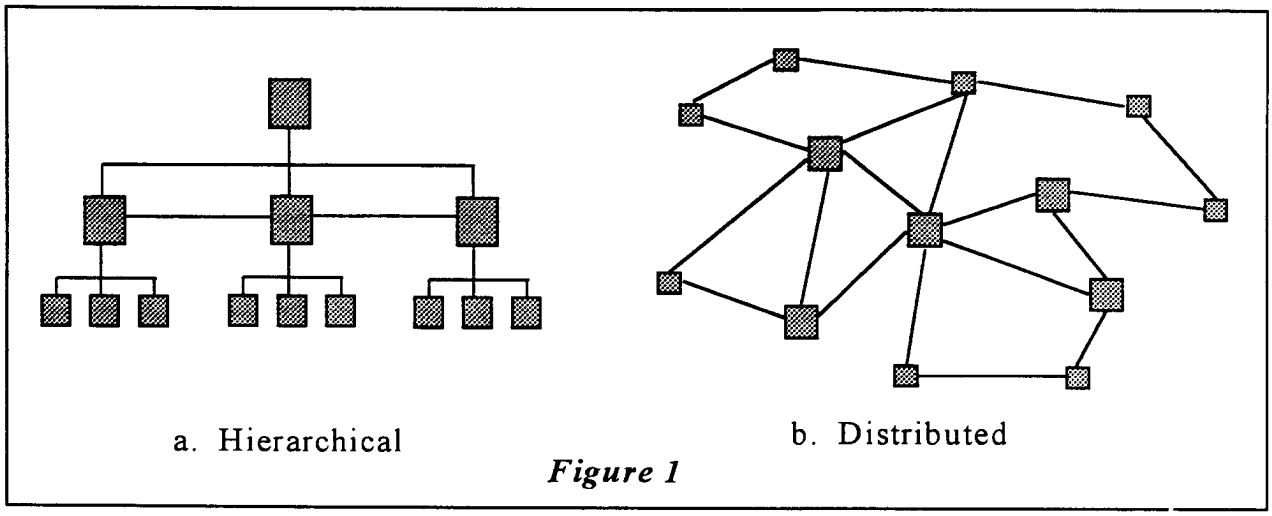
concepts of authority and support are crucial to the application of communications means at the operational level of war.

Means. Systems which support command and control are divided into four major components. ***Terminal devices*** such as computers, telephones, facsimile machines, radios, and video displays are the most recognizable components of the system. These components convert information into recognizable and useable form for the commander and his staff. ***Transmission media*** simply connect terminal devices. These include radio, fiber optic and copper wire systems. ***Switches*** (which could include data routers) move information from terminal devices through the transmission media either manually or automatically. And, finally, ***control*** systems facilitate management of complex networks. This paper will focus on switches and radio (including space based) systems inasmuch as a significant amount of effort is being placed on studying and evaluating the military applicability of such emerging capabilities as the backbone for communications support. All of these elements are combined to create the C2 system which supports joint military operations.

SYSTEMS DESIGN

Nodal operations. Historically communications support has been provided along purely Service or functional lines paralleling the operational chain-of-command. This hierarchical structure (figure 1.a) provided adequate support during an era where voice (telephone and radio) and slower messaging systems predominated and unilateral operations were the predicated norm, but they have proven neither efficient nor effective for current joint operations. Demand for higher speed data and video has outstripped many of our currently fielded tactical

communications systems, which are based on 1970's technology.[5] As requirements for joint systems interoperability have come to the forefront, we have steadily shifted to commercial systems and now employ a distributed architecture which more efficiently answers the needs of the force (figure 1.b).



a. Hierarchical b. Distributed

Figure 1

Concurrently, where practical, communications services are provided nodally by the predominant force element in the area. This *nodal* concept tends to facilitate installation and avoids duplication or needless redundancy while still providing the potential for a robust or survivable system of systems.

As newer systems are fielded, these nodal, distributed structures are supported by an "open systems" architecture used in the commercial sector.[6] Military writers have been touting these concepts as "...technology which offers the opportunity to make a quantum leap in military

[5] Joint Staff, SM-475-74, Joint Operational Requirement for Tactical Unit Level Switches, Washington, DC., 10 September 1974.

[6] Don Tapscott and Art Caston. Paradigm Shift: The new Promise of Information Technology, New York: McGraw-Hill Inc., Chapter 6.

power..."[7] Telephone and data switching services use this concept to provide efficient support by geographical area vice along Service or functional (i.e., logistics, intelligence, administrative, etc.) lines. The operational planner provides common services much like those in the commercial sector instead of installing an entire system (terminals, transmission systems, control, and switches) for each user. Efficient network design hinges not only on using systems economically but also on a common set of requirements and system standards.

Requirements. Inasmuch as all command and functional areas have the same basic requirements for voice, video, and data, one might argue that requirements derive from a common set of needs. Some elements of the force, such as special operations, reconnaissance and intelligence users, have historically stated required systems features which contribute more to security, i.e., low probability of detection and intercept. However, these attributes of communication systems have been an objective in most systems acquisition and may become more so as force protection has come to the forefront of operational design. Only cost constraints based on systems complexity have frequently separated such special requirements from implemented systems.

Requirements are still overtaking capacity. At the beginning of the Operation Desert Shield force deployment, there essentially was no existing U.S. military infrastructure in the region. By mid-January, the coalition had established one of the largest operational communications networks ever assembled. This network provided for the C2 of forces, dissemination of intelligence, establishment of an in-theater logistics capability and for myriad other combat service

[7] Commander Mark Tempestilli, U.S. Navy. The Network Force, Annapolis, MD: Proceedings, June 1996, pp. 42-46.

support activities. Despite this effort, the start of Operation Desert Storm made it clear that the requirement for communications outstripped the capacity. This was especially true for the large amounts of imagery and intelligence data bases that needed to be transmitted throughout the theater. These products required large bandwidth capacity circuits for transmission. The available circuits simply were not able to handle the magnitude of data.[8] This was due in part to dedicating transmission systems to functional users vice providing a priority based common user network. While it may be true that no matter how robust the system, some requirements will not be met to a users full satisfaction, systems performance has steadily improved since the close of the Gulf War.

Standards. A common set of requirements has not always led to common systems. "In Grenada we [Naval forces] did not have interoperability with the Army and the Air Force...[9]" The Grenada Operation set off a fury of effort to improve our acquisition and training in joint systems. It is now Department of Defense (DOD) Policy: That for purposes of compatibility, interoperability, and integration, all [communication] systems developed for use by US forces are considered to be for joint use.[10] Therefore, systems *standards* have and continue to be developed to facilitate common use. Standard or common systems facilitate force tailoring (or task organization) and foster teamwork in joint operations. Applying the nodal operations concept, any organization should be able to provide the nucleus system necessary for expedient command and control. A 'plug-and-play' backbone of standard communications media is the DOD goal.

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[8] U.S. department of Defense, Conduct of the Persian gulf War: Final Report to Congress, Washington, DC:U.S. Government Printing Office, April 1992, Annex K, pp. 543-575.
[9] James G. March, and Roger Weissenger-Baylon, Ambiguity and Command: Organizational Perspectives on Military Decisionmaking, White Plains, NY: Longman Ind., 1986, pg. 295.
[10] Joint Pub 6-0, pg. III-1.

Principles. As with most studies of warfare, there are a set of principles which have been developed: "...to ensure the continuous and uninterrupted flow and processing of information, joint warfighters must have [communications] systems that are interoperable, flexible, responsive, mobile, disciplined, survivable, and sustainable."[11] For purposes of this discussion, four principles are highlighted.

Flexibility is required to meet changing situations and diversified operations with a minimum of disruption or delay. It can be obtained by systems design (standardization), using commercial facilities, mobile or transportable...systems, or pre-positioned facilities.[12]

Communications systems must *respond* instantaneously to warriors' demands for information. They must be reliable, redundant (or robust), and timely. Military communication systems must be available when needed worldwide.

Communications systems and associated resources available to any JFC are limited and must be carefully used to best advantage. *Discipline* begins with the JFC focusing and balancing the joint force infrastructure based on predetermined needs for critical information. This ensures that limited communication systems and their associated forces and resources are employed to best advantage.[13]

Finally, national policy dictates the *survivability* of command centers through which decisions are transmitted to the forces in the field. While not practical or economical to make all systems equally survivable, the degree of survivability should be commensurate with the survival potential of associated command centers and weapon systems. Communication systems

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[11] IBID, pg. II-4.
[12] IBID, pg. II-6.
[13] IBID, pg. II-7.

survivability can be achieved not only through hardening, but also through dispersal or multiplicity of modes or a combination thereof.[14] Survivability is essential to effective, consistent command and control.

SYSTEM OF SYSTEMS

Stovepipes. "Stovepipes" or dedicated systems are the bane of systems designers and operators. Multiple lines of communication emanating from a single node do not necessarily support survivability. Providing individual circuits for command and operational functions is inefficient and affects the technicians ability to manage, and trouble shoot/restore circuit outages. Every user wants "their" circuit to be the #1 priority. In practice it is not possible to manage so many priority circuits with available resources principally because, as in all force organizations, communications troubleshooters have taken cuts. Focus on common systems is both practical and possible, leaving 'special' users to wait in queue especially during major systems outages.

Improved Designs. Fortunately, as we transition to more commercial applications, there are options available to downsize existing systems, improve systems efficiency, and reduce components to a manageable level while providing vastly improved service. The heart of such communications systems is a "smart" multiplexer that takes multiple user inputs and applies them to available communications means (figure 2). This concept is the core of Service initiatives, such as the Navy's "Copernicus" architecture, which will transition the Navy and other users from today's stovepipe systems toward and integrated global system.[15]

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[14] IBID, pg. II-8.

[15] Naval Annex to the Joint Task Force Tactical Communications Architecture. JIEO Report 8125, 26 April 1996, pg. ES-1.

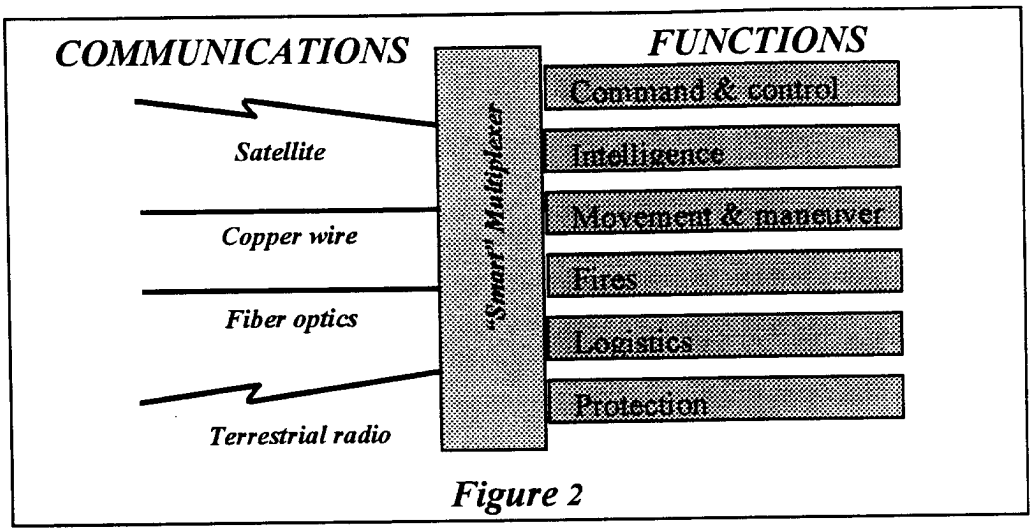

Figure 2

OPERATIONAL ART

Time, Space, and Forces. Admiral Metcalf summarized our tendencies in peacetime exercises and its impact on operations in Grenada. "If the objective is to make things work, then the conduct of the exercise will be optimized to show that the exercise will work. Unfortunately, in a crisis situation—a 'come-as-you-are' situation—they did not work..."[16] Communications is usually the weakest when it is needed the most, e.g., at the beginning of hostilities. When operating in an undeveloped or poorly developed theater of operations, it is imperative that communications elements have a firm grasp on joint requirements, train to standards, and deploy as early as possible in the strategic flow. At the operational level, the presence or absence of an underlying infrastructure affects operational tempo.[17] Some are promoting the idea that we can dedicate more deployment space to combat units and expedite transition to the attack by performing many support functions such as intelligence and logistics from distant sustaining bases

[16] March and Weissenger-Baylon, pg. 295.
[17] FM 100-5, pg. 14-5.

in the United States.[18] While the idea has merit and could conceivably produce leverage in both force application and deterrence, it is bankrupt without the means to communicate requirements out of and information into the theater of war. These "means" should avoid stovepiping as a wasteful expedient to integrated systems. Finally, space or geographic area, while an asset to the operational commander in terms of maneuver and force protection, presents significant challenges to the communications planner. Forces separated by distances over 100 miles require access to commercial, host nation wire or fiber optic cable support, heavy military microwave systems, and/or space based transmission systems to integrate dispersed elements. While space based systems offer the most in terms of flexibility and mobility, they are a limited bandwidth resource which must be carefully allocated.

Principles of War. The primary considerations for systems planners relative to the principles of war are: offensive, economy of force, unity of command, simplicity, and security. The principle of the offensive is best supported by having systems that are flexible and highly mobile, while adhering to the concepts previously discussed. Here a heavy reliance will be placed on radios for transmissions systems support. Bases of operations should be supported as much as possible with terrestrial means, freeing limited satellite resources for mobile elements. Geographic space is a critical factor in systems design. An expansive theater of operations at sea or on land may mitigate extensive use of terrestrial means, at which time tradeoffs will have to be made regarding functional requirements. Prioritization schemes and sacrifices in speed to accommodate needs across functional areas are dictated. A shift from defensive to offensive operations is facilitated through use of standard, nodal concepts. Herein lies one of the principle challenges to

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[18] Major General L. D. Holder, U.S. Army, Offensive Tactical Operations, *Military Review*, Fort Leavenworth, KS: Vol LXXIII, December 1993, No. 12, pg. 53.

military communicators. While civilian counterparts use many of the same concepts, they are not challenged with moving virtually whole cities over vast expanses of terrain while maintaining efficient and effective service.

Economy of force is supported in at least two ways. First, standard or common systems can be installed by any element within the force. Second, a robust communications system facilitates interaction of operational functions. Smaller forces which can perform across functional areas due to improved communications may be able to defend larger areas as supporting fires take the place of combat forces on the ground.

Unity of command is both an absolute requirement for communications support and a principle significantly supported by technical means. As previously discussed, there is by doctrine one source for validation of requirements and efficient use of resources—the combatant commander. His primary staff officer for support is the J6, charged with supporting and coordinating the efficient and effective use of communications means. In terms of arbitrating disputes regarding competing requirements, the commander has routinely delegated this functionality either to the J3 (Operations) or to the J6. Service functional responsibilities also vary. In some services, the Operations Officer is responsible for operational communications. In others, the '6' is the initial arbiter with ultimate decisions made either by the Commander or his Deputy/Chief of Staff. In either event, the communications officer becomes a focal point for action and in a theater of operations, all such actions must be worked through this staff element.

In terms of supporting unity of command, it is incumbent on communications planners to provide the most robust network possible or practical within physical constraints. Efficient and effective communications helps sort through the bureaucracy in a maze of complex requirements

for information and control. While one of the most important tasks of the commander may be to create a cohesive task organization and simplified chain of command, strategic or political considerations may not always allow this in practice. Good technical means of communication coupled with component and/or unit commander's desire to communicate and cooperate can work through a cumbersome organizational design.

Clear, uncomplicated plans contribute to mission success. They are also easier to relay over vast communications infrastructures. Concurrently, backbone support facilitates both design and implementation of communications systems, expediting connection to and use of systems to permit planning and operations. Simplicity is also a criteria for successful coalition operations. Communications systems designed to quickly and efficiently link allied forces with U.S. command and control are essential in combined efforts.

Finally, secure communications are important for both surprise and force protection. An enemy vulnerability is most valuable when it contributes to the elimination or degradation of the enemy's center of gravity. Enemy attacks on our communications infrastructure could be devastating in future conflicts. Non-secure communications can either give away a specific plan or provide order of battle information, capabilities and weaknesses in, among other areas, personnel and logistics. National policy requires that encryption devices be used over transmission systems supported by military satellites. Increasingly, regional CINCs are requiring security over all means, to include commercial systems. While most command, control, and intelligence systems maintain a high degree of operational security, logistics and other combat support functions are operating systems such for in-transit visibility and supply which transfer data worldwide in-the-clear. While it is not perhaps the communicator's responsibility to require

security, it is incumbent on the planner to provide the means with which to transfer such information in a secure mode. Most potential adversaries have the knowledge and means to use information as a tool both offensively and defensively. Increasing emphasis on the offensive asymmetric potential of information warfare may well drive a return to a fully secure requirement for communications security.

Operational Planning and Training. Communications support spans the continuum of tactical through strategic operations and from MOOTW through major regional or global conflict. While often considered as an adjunct or separate function, it is in fact the thread that ties operational functions or facets together. The operational communicator must phase and synchronize joint systems to mesh with the commander's campaign plan and the characteristics of each operational phase. As the force commander weights particular functions during each phase, limited communications resources are allocated accordingly. Planning must also consider sequential operations and branches. Communications must support the synchronization of all phases of the military campaign. Further, U.S. military systems must easily interface with commercial host nation and coalition systems. This is particularly important in the termination phase of armed conflict and is a key planning consideration in operations other than war. Military systems must be prepared to transition to commercial means as forces redeploy so that the communications architecture does not become an impediment to transition to civilian or other forces control.

As Admiral Metcalf has pointed out, planning and training must be both detailed and expansive. "Plans must be continually tested to ensure interoperability...given enough time,

anyone can make communications work."[19] Exercises should be structured to phase communications as they would be phased in an actual operation. Communications 'failures' or shortcomings should be expected and planned around. As U.S. forces become more reliant on information technology, we incur or introduce potential vulnerabilities. Realistic training should evaluate the impact of lost communications in order to adequately prepare the force for the friction commonly found on the battlefield. Building an expansive communications system to ensure exercise or operational success can also impinge on long term unit readiness and training. Commanders as well as communications planners should be cognizant of the high cost of providing communication services, especially over commercial means. Host nations frequently impose fees for terminating commercial satellite services in their countries. In the U.S. Central Command alone "landing" fees exceeded over $1.7m during FY 1996.[20] As governments look for ways to reduce debt and increase income, charges are being levied for use of the frequency spectrum. These costs in operations and maintenance funds should be balanced against the benefits accrued.

CONCLUSIONS

Proper design of a wartime theater and its subcomponents sets the foundation for achieving the desired objectives. Communications, like operational art, transcends all levels of war: from the strategic, through the operational, to the tactical. Without a comprehensive understanding of requirements and a standard set of tools to apply to the problem, communications design becomes fraught with potential pitfalls. As in every endeavor, command support and cooperation amongst providers is crucial to operations success.

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[19] March and Weissenger-Baylon, pg. 295.
[20] USCINCCENT GENADMIN message dtg R261700Z Feb 97, Commercial Satellite Communications Costs.

RECOMMENDATIONS

Common or interoperable communications systems which facilitate design and implementation should continue to be the goal of service and agency acquisition efforts. Staff cognizance for operational communications should be defined as a single source throughout the force. Inasmuch as the operations officer (J3, G3, N3, S3) plans and implements schemes at successive levels of command, it is recommended that this staff officer prioritize efforts and resolve functional disputes assisted by the communications staff.

Communications training in both schools and operational commands should be a realistic evaluation process of readiness and supportability.

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