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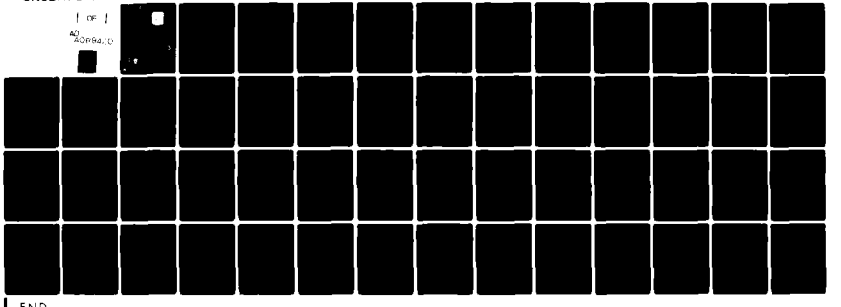

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NATO GROUND FORCES COMMUNICATIONS INTEROPERABILITY FROM THE AMERICAN PERSPECTIVE

by

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Signal Corps

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013

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The "layer cake" assemblage of ground forces from several NATO nations in the Central Region has resulted in unique communications interoperability requirements. Multiple political, economic, and military considerations make the early achievement of substantive standardization of communication equipment extremely doubtful, therefore emphasis logically must now be placed on the interoperability of current and projected near-range national equipment. Current experiences in Europe, both within the international atructure and the US elements, demonstrate that the American Army must: (1) prepare to fight a

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coalition war in Europe; (2) exercise centralized communication planning and management at Department of the Army level; (3) field only those items of tactical communication equipment which are proven by operational testing to be reasonably survivable and maintainable under wartime conditions; (4) plan for and provide augmentation communications assets to US ground forces committed to combined operations with elements of other nations; and (5) prepare combat units to fight effectively with less communications support.

USAWC MILITARY STUDIES PROGRAM PAPER

NATO GROUND FORCES COMMUNICATIONS INTEROPERABILITY FROM THE AMERICAN PERSPECTIVE

INDIVIDUAL STUDY PROJECT

by

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26 May 1980

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PREFACE

This individual study project was produced under the aegis of the US Army War College. The author elected to participate based on his experiences with tactical communications within the NATO structure, and his conviction that the development of a basic understanding by the combat arms leader, of the myriad of problems associated with international tactical communications interoperability, is key to effecting needed improvements in this vulnerable area. The study was conducted without the constraint of any national or international agency or service. The outstanding assistance of NATO personnel serving at various levels within the Central Region was a major factor in the successful completion of this project.

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EXECUTIVE SUMMARY

This paper was written to provide the American combat arms leader with a good overview understanding of communications interoperability problems facing NATO ground forces today in the Central Region. The review is non-technical in scope and presents only a representative sample of communications interoperability issues as they are today. This effort does not purport to be a comprehensive study of all NATO ground force communications interoperability concerns. Total NATO ground force communications interoperability as a subject is simply too vast for this single study. Additionally, unit identifications and some operational specifics have been intentionally omitted in this paper in order that the report can remain unclassified, and, therefore, enhance the main objective of making the overview information available for the consideration of a wide range of combat arms leaders.

One portion of this review looks at several broad examples of communications interoperability problems being experienced at various levels of command within the NATO structure today. Another part of the paper addresses the status of tactical communications within American units. The premise is that a basic understanding of the American tactical communications posture is necessary to complete and balance the review of the international aspects. The review ends by concluding that the American Army should: (1) prepare to fight a coalition war in Europe, as well as possible within given assets; (2) exercise strong, centralized communication planning and management at Department of the Army level; (3) field only those items of tactical communication equipment which are proven by operational testing to be reasonably survivable and maintainable under wartime conditions; (4) plan for and provide augmentation assets to support required communications interoperability in those situations in which US ground forces are committed to

combined operations with elements of other nations; and (5) prepare combat units to fight effectively with significantly less communications support than is currently authorized and utilized on field exercises.

PART I

BACKGROUND AND SCOPE

Even the novice observer, a person with little or no tactical communications background, must sense that the multitude of national ground forces assembled in NATO's Central Region face unique obstacles to achieving effective military operations together. Figure 1 depicts the coalition "layer cake" formation of units now poised in defense of the West. Indeed the communications challenges range far beyond what would be experienced by the army of any single nation deployed alone.

The Central Region consists of two army groups. The Northern Army Group (NORTHAG) serves as the NATO control headquarters for corps-size land forces from four separate nations (five including the possible deployment of an American corps from CONUS as the army group reserve), and has territorial responsibility for roughly the northern half of the Federal Republic of Germany. Ground force responsibility in the southern portion of the German Federal Republic belongs to the Central Army Group (CENTAG), which exercises NATO control over army elements representing three sovereign nations. Each of the army groups has the additional considerations associated with combined operations with non-NATO French forces, should an actual crisis result in the commitment of French elements in support of NATO military efforts.

Our recent national recognition that the Western nations face a Warsaw Pact adversary who enjoys an increasing superiority in hardware quantity and quality, points out with crisp clearness the need for the NATO ground forces to operate together with maximum efficiency. To this end renewed attention over the past few years has been directed towards broad goals of standardization and interoperability. In the generic sense, standardization and

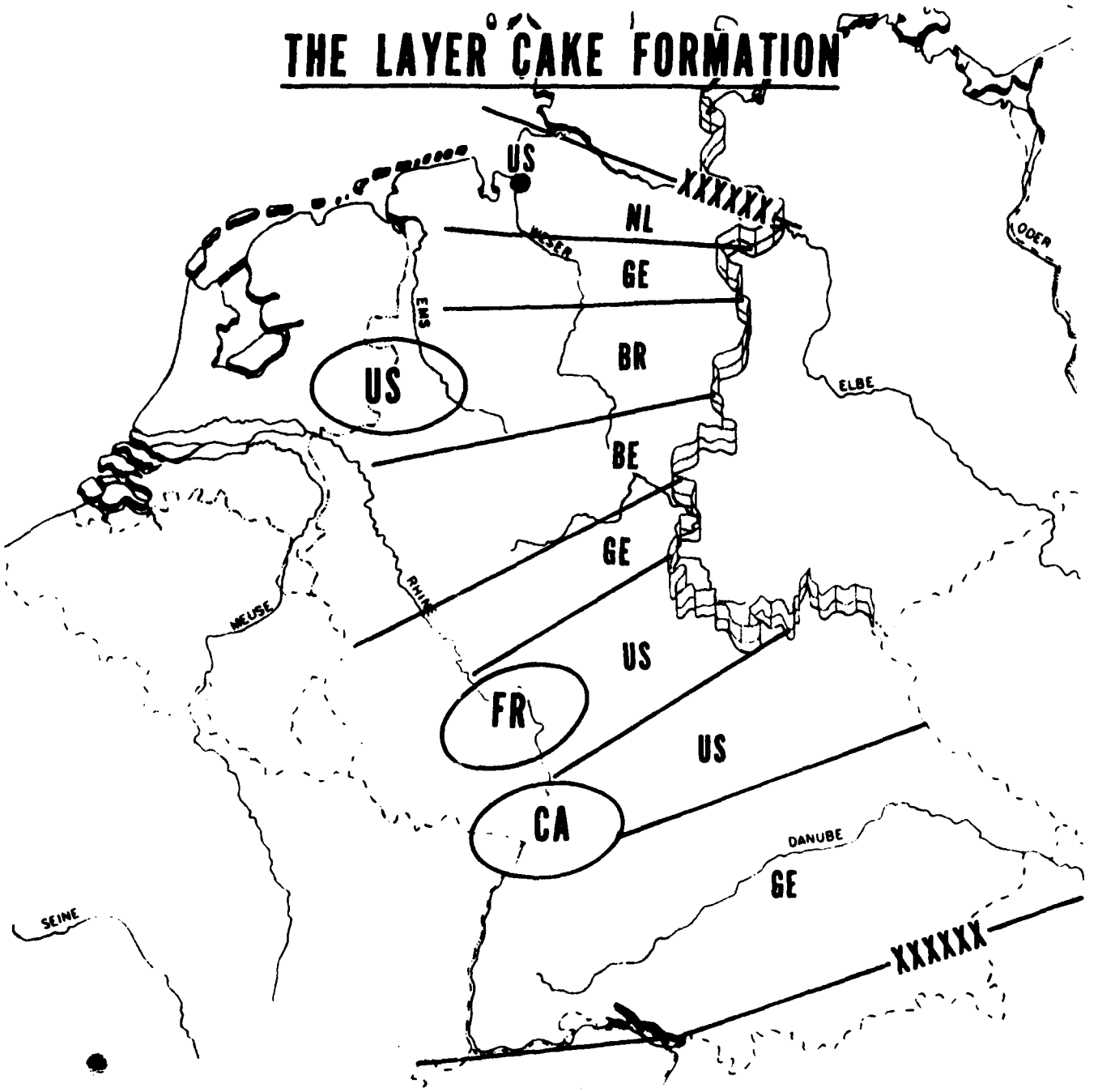
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Figure 1

interoperability are terms associated with a wide range of efforts to achieve the degree of operational interaction and support between two or more allied units that approaches what would be experienced if all the units concerned were of the same nationality.

Pragmatically, comprehensive standardization among the NATO ground forces is not achievable in the near range. Significant political, military, economic, and technical considerations make standardization progress painfully slow. No coalition logistics concept exists in the Central Region today. Support of the fielded forces remains a national responsibility. With some rare exceptions, the major powers contributing ground forces in the Central Region do not use standard communications equipment. Naturally equipment standardization, as well as reaping tremendous maintenance and logistical advantages is theoretically a very effective way of achieving interoperability goals. Large-scale standardization not being reasonably obtainable in the near-range, however, a look at communications interoperability as it is being experienced with the NATO equipments now fielded is more appropriate.

Communications interoperability issues are normally extremely involved and complex, characteristics which lead to the bemusement and frustration of military leaders in their search for solutions. While the fact that there are NATO communications interoperability problems is generally recognized, it is rare to find a good understanding of even the scope of the difficulties being encountered, and the corrrsponding threat to effective combat operations. Unfortunately, the career soldier is unaware of the principal associated issues unless he or she has been exposed to recent NATO experience, and even then an individual's experience is likely to have been limited to a

relatively narrow spectrum. It is hoped that this essay will help the reader achieve a broader understanding by providing an overview of current NATO ground forces communications interoperability concerns.

For this examination communications interoperability will be defined as the ability of the various allied national tactical communications systems, in support of the NATO land forces in the Central Region, to provide and accept communications services from the other national systems, such that the services so exchanged enable the supported land forces to operate effectively together. Throughout this discussion it should be remembered that interoperability is not a goal in itself. Communications interoperability is only a part, but an essential element necessary to achieve the real objective, the optimization of the NATO ground force fighting capability within the constraints imposed by current and reasonably projected resources.

This examination is made for and with the American combat soldier in mind. Its purpose is to assist the supported combat soldier in understanding some of the issues and difficulties involved. The discussion is non-technical, and it is written from the American perspective.

Realistically, the presentation of NATO ground forces communications interoperability concerns is incomplete without some comment on the status of ground forces support communications within the American Army. For this reason Part II of this discussion addresses the current status of NATO communications interoperability, while Part III looks briefly at the American tactical communications capabilities.

The material used for this examination came from experience gained while working with tactical communications at the corps level in the Federal Republic of Germany, and from a series of interviews and discussions with

representatives of several nations and headquarters within the NATO military framework. The interviews were conducted during and immediately following a major NATO command post exercise conducted in early 1980. This time was selected so that the issues discussed would be fresh in the minds of the personnel interviewed.

Many of the observations made herein are critical. These comments are made constructively, and are not in any way intended to denigrate the tactical communications soldier of any nation or headquarters. Quite to the contrary, operating within the various policy and resource constraints present today, the progress NATO soldiers have made towards meaningful communications interoperability has been impressive, and clearly displays the initiative, innovation, and professional determination to satisfy military requirements as well as possible with the assets available. The bulk of the changes and improvements needed to significantly enhance NATO communications interoperability must be effected in the force planning, equipment design, and asset allocation activities which lie beyond the immediate influence of the field soldier.

Lastly, it must be stated what will soon be obvious to the reader. This effort to gain an understanding of the current NATO ground force communications interoperability capability is only a broad overview. It is not comprehensive, nor can it be considered a complete study of all communications interoperability issues. Much more time than the week dedicated to travel between and interviews at, the scattered NATO headquarters would have had to have been devoted in order to obtain data sufficient for a truly comprehensive study. Nonetheless, it is hoped that this effort will help provide a step in the direction of understanding some of the difficulties

being encountered in the ground soldiers' efforts to achieve effective communications interoperability in NATO's Central Region.

PART II

LAND FORCES COMMUNICATIONS IN THE CENTRAL REGION

Reference to tactical communications is normally meant to mean the communications utilized in the zone forward of the corps rear boundary. This zone is also an appropriate place to begin an examination of communications interoperability in NATO's Central Region. Looking back from the Forward Line of Troops (FLOT) where the ground forces are in contact with the enemy, the corps headquarters is the highest purely national headquarters in the NATO operational chain. Therefore it is natural to expect that the communications elements supporting the higher headquarters, the army groups and above, would have been structured in consideration of the unique requirements associated with international wartime communications. Indeed this has been done with varying levels of success, and a discussion of that will be presented later. It is at the corps and lower tactical levels, however, that many fundamental communications problems surface because it is at these levels that the standardly structured national TO&E (Table of Organization and Equipment) units are deployed, and must operate effectively together.

Before proceeding, it is important to understand the basic categories of equipment which are provided for tactical communications. These categories are essentially the same across the NATO international spectrum in the Central Region. The workhorse of tactical communications between the various levels of command from the brigade level up, is the multichannel radio system. In the American forces this system is frequently referred to as PCM (Pulse Code Modulation) radio. A multichannel radio link is one on which a number of separate communications circuits, or channels, can be simultaneously carried.

Normally 12 or 24 channels are available in a single radio link, and the channels are used to carry a variety of different types of circuits, such as dedicated "hot line" or point-to-point telephone circuits, common user switchboard circuits, and message center teletype circuits.

Backing-up the multichannel radio is the HF (High Frequency), or RATT (Radio Teletype), radio. As the name implies, hard copy messages can be transmitted as well as voice. In addition to being used as a back-up communications means between brigade and higher headquarters, RATT is also used exclusively in some other tactical roles, such as between widely spread-out artillery and engineer units.

The third and last radio category is FM (Frequency Modulation). In the American forces this is the VRC-12 family of soldier carried and vehicular mounted radios which is the communications equipment yeomen between and among the brigades and their maneuver elements. In addition to these radio systems and nets, the only other tactical communications means currently available are surface and air couriers, and use of the established commercial telephone network.

Greater detail concerning the three general categories of tactical radio communications is included in the overview of American tactical communications, which constitutes Part III of this treatise. The brief descriptions given above, however, provide sufficient background to permit an examination of some of the current communications interoperability problems in the Central Region.

To start it is important to note that the NATO nations have adopted a Standardization Agreement (STANAG) which specifies that the responsibility for the provision of tactical communications is from the superior to the subordinate headquarters, and from the left to the right between adjacent

units. These principles coincide with established doctrine for American ground forces. At the level of the basic single channel radio categories considered, the FM and RATT radios, communications interoperability is technically achievable, since the radio sets used by the various nations have at least a partial frequency match capability and will generally work together. This is not enough, however, to achieve interoperability. Communications-electronics operating instructions vary widely between NATO nations, as do the code systems used. As an example, the American forces use a centrally-produced (by the National Security Agency), computer-generated document which changes frequencies, alfa-numeric unit call signs, and codes periodically, whereas German forces use a much more decentralized approach in which proper names are used as call signs, and the call signs and frequencies are changed irregularly on order. While the NATO Army group headquarters provide their subordinates with separate NATO communications operating instructions for communicating between the forces of different nations, the forces involved normally require additional equipment and manpower to operate in the international nets, and are faced with the difficult task of training soldiers to operate simultaneously under two systems.

A significant FM and RATT associated problem sometimes discounted by Americans is that presented by the different national languages. There is a tendency for Americans to take for granted the other nationals' ability to communicate fluently in English. While the European soldiers assigned to the various international headquarters normally have impressive English language skills, the same abilities are not generally present at the lower tactical levels where FM radio and RATT communications are paramount. The problem associated with the different languages supports a school of thought

that effective FM and RATT communications between units of different nationalities requires specially picked operators on designated nets, and that there is essentially very little to gain by striving for further FM and RATT equipment interoperability. The unconstrained ability of a lower level of one nationality to jump into the operating net of another national force could lead to great confusion.

Another situation which impacts effective international FM net operations is associated with the American forces' use of secure equipment with FM. In general FM secure equipment is not utilized by the other nations, and in any case, there are now no NATO standards set for FM secure equipment. This is not a problem at the Army group level since FM equipment is normally not used above corps level due to radio distance limitations. In the case of a division of one nation assigned to a corps of another nationality, an existing situation which will be examined in greater detail later, an obvious interoperability problem does exist.

Tactical teletype equipment is secured by a NATO standard device and, therefore, the secure operation of the teletype portion of RATT communications is achievable between forces of the various nations. The major interoperability problem experienced with RATT communications concerns the operating speed of the teletypewriters used. The NATO standard operating speed is 66 words per minute while American machines are designed to operate at 60 words per minute. A conversion kit, which consists primarily of a replacement worm gear, has been designed but has historically been difficult to obtain in sufficient quantities by the field units. A recent large order acquisition of the conversion kits should help the situation immensely[1] however, the confusion and lack of flexibility resulting from the requirement to have teletype machines operating at

different speeds within a tactical communications center will persist. The American units must retain their US transmission speed (word per minute) capability in order to interface with national theater Army communications facilities. The theater Army communication facilities are an extension of national systems anchored in CONUS, and were not designed and built with the tactical zone interface in mind. Generally these US support systems also required a message formating procedure different from the NATO standard, another complicating factor.

One very effective method of overcoming FM and RATT communications interoperability problems between combat units is the provision of adequately staffed and trained liaison teams, on a two-way basis, between adjacent and higher-lower forces when they are of different nationalities. These liaison teams should be equipped with the FM and RATT communications equipment commensurate with the tactical level represented. The liaison team member should be linguistically capable in the receiving unit's native language and, to practice the exercise of their functions regularly, should live with the receiving forces in garrison as well as the field. Of course this commitment takes significant skilled manpower, and principally for that reason, liaison is normally established only during exercises and then at a minimal level. As an exception permanent liaison has been established between an American corps and a German division which has been assigned to it.

A desirable NATO objective would be to achieve command and control interoperability at the brigade level. By this it is meant that a brigade level organization of one nation should be deployable as an effective subordinate of a division of another nation. Naturally a corps commander would want the flexibility to cross attach brigades to meet tactical requirements.

From the American perspective, this seems a reasonable requirement with regard to the Canadian brigade currently in Germany, or the German division currently assigned to an American corps. Likewise the cross attachment of battalion-size artillery units with nuclear delivery capabilities to a national force without such a capability is a reasonable expectation.

Generally speaking, American communications doctrine fixes the ownership of FM equipment, and some RATT equipment, with the unit serviced. The same is not the scheme for multichannel communications equipment. For the deployment of multichannel equipment, the responsible unit, in consonance with the higher to lower and left to right agreements already mentioned, provides the terminals at both ends of the system. The word terminal here is intended to include both the radio and the modulating equipment used to superimpose the multiple communications circuits on a single radio signal. Actual used operated equipment, such as the telephones and teletypewriters, are normally provided by the unit serviced. Under the American doctrine, substantial multichannel equipment is organic at both the corps and division levels.

In accordance with a recent American redefinition of communications doctrinal responsibilities and organizations at the corps level, the corps establishes two multichannel networks. One, a former responsibility of the theater Army, is a grid system which is primarily designed to support the administrative and logistics functional areas. The other is a multichannel command and control network which, using the corps main as a hub, ties in the major subordinate commands, the corps tactical command post and the corps rear headquarters, normally located adjacent to the corps support command. The corps provided multichannel radio links extend into

a division's zone only to designated interface points such as the division main, the division support command, and in some cases, the division tactical command post or a division communications hub. In consonance with NATO agreements, the corps should also install a multichannel link to the adjacent corps to its right. Similarly, the division will tie the division's major subordinate commands together via multichannel links and should provide a multichannel communications tie with the division to the right. Most American corps and division multichannel systems carry a number of dedicated point-to-point, or "hot line" circuits between essential command and control staff elements such as the corps G-3 to the division G-3, and the corps to the division intelligence analysis cell. These dedicated circuits may be voice or teletype or both.

The American Army's use of multichannel circuits is more extensive than that of its European allies. The German army system offers a good contrast. In the German army the deployment of multichannel links generally is a corps level responsibility. The concept uses centers on an extensive grid network which is deployed throughout the corps area of responsibility and extends into the division zone. This network carries command and control as well as administrative and logistical traffic. Using this multichannel network, the German corps supports its subordinate divisions by providing them with a multichannel radio path between the respective division mains and division rears. The German division does not have the capability of providing a multichannel tie of its own to the adjacent division on the right in accordance with the NATO agreement. Under German doctrine, such a link would be available only through the corps provided network. If the adjacent divisions concerned are organic to two different German corps,

then the multichannel tie between them is provided through network connections established at the corps level.

Keeping in mind the doctrinal and organizational differences just discussed, it is now time to look at some specific examples of multichannel communications interoperability difficulties now being experienced in the Central Region. In one case observed a German division is on line adjacent to and to the left of an American division. The responsibility for a multichannel link at the division level rests with the German unit which does not have the organic capability. As a result the American division has, on some exercises, provided this communications link out of its own assets without augmentation, and therefore, sacrificed another portion of the division communications mission. In this particular situation, the German responsibility is recognized, and special authority is being sought within the German defense system to acquire and provide the required multichannel equipment to the German division so that the left to right responsibility can be satisfied. There is good evidence that the German army will eventually cover this void, however it must be noted that this specific problem has existed for several years. Multichannel equipment is extremely expensive, and that is one of the causes for the delays that are typically experienced throughout NATO. This particular example should not be taken as an indictment of German participation in NATO communications matters. On the contrary, the Germans are at least as responsible as other NATO members, including the United States, and it will become clear in the following paragraphs that the responsibility for various communications interoperability voids falls at the feet of several nations.

Other communications interoperability concerns result from the assignment of a German division to an American corps. As pointed out earlier,

by doctrine the German division relies on its superior corps to provide a multichannel link between the division main and rear. The American corps concerned currently provides this link, but it does so without augmentation of its communications assets. The use of corps multichannel assets in this manner, coupled with the fact that the US corps have none of the tropospheric equipment called for by doctrine, has resulted in a performance shortfall on other tactical communications responsibilities. The corps does not provide a second, redundant multichannel system to the German division main or a division signal center, a service which is provided to the other divisions in the corps. Also this American corps is unable to fulfill its doctrinal and NATO responsibility of providing a multichannel link with the adjacent corps on the right, in this case a German corps. This particular requirement is currently being satisfied for static exercise deployments, primarily through the use of commercial communications lines which are leased. For major exercises, and for its general defense plan, the multichannel assets of the corps are totally committed. There are no assets available to establish the doctrinal multichannel link with a LANCE element, should one come directly under corps control, without reducing service elsewhere.

The assignment of a German division to an American corps has also resulted in some RATT and FM communications interoperability difficulties. In general the German army does not utilize the large number of radio single channel nets used by American forces, and they therefore have less equipment. For this reason, and because FM secure equipment is not utilized by the German army, the American corps provides the German division with all of the FM and RATT equipment and operators normally organic, in accordance with American doctrine, at the division level.

As mentioned in the preceding paragraphs, the extra requirements placed on the American corps in order to achieve acceptable communications interoperability with the German division are now being satisfied without augmentation. The result is a significant denigration of other essential communications missions. The American corps has attempted for the past two years to obtain an appropriate communications augmentation slice to support the interoperability requirements, but has not been successful due to current day budget and manpower constraints.

There is another good example of the type of communications interoperability issues that arise when the forces of one nation are subordinated to the higher headquarters of another nation. An American corps has the mission of cross attaching a number of artillery battalions to an adjacent German corps. The American artillery battalions will provide a nuclear delivery means to the German corps. The artillery units would not be deployed together, but would be broken-up by the German corps commander and assigned in support of different German divisions. Assuming that the German corps commander will provide the necessary operational communications links with his own organizations assets, the American corps commander is still faced with the problem of supporting these artillery elements out of his sector with those services which the Germans cannot supply. Good communications between the American artillery units and the American corps base are necessary if this support is to be responsive. Reliance on a tie-in through the existing German and American multichannel systems would most likely not be satisfactory due to current interface problems. These interface issues will be addressed in more detail in the following paragraphs. The principle current means of communications, therefore, through which the

high priority American artillery battalions can tie in to their support base is RATT. This is a poor solution since, due to its technical characteristics, RATT communications are very vulnerable to enemy countermeasures.

Considerable attention has been given recently to the attainment of interoperability between the various automatic dial, or touch tone, battlefield systems in being or envisioned for use by the various national ground forces in the Central Region. Technical agreements have been reached concerning interfacing standards for the allied equipment. At the current time only the German and American armies have automatic voice switching capabilities forward of the corps rear boundary, and deployment is not complete in either of these armies. The design of the equipment which is now fielded was accomplished prior to the current interoperability agreements, with the result that the two national systems are now only marginally interoperable. Specifically, calls can be made from one system to the other with operator assistance, but the subscriber to subscriber dial feature is not functional between the systems. Follow-on American equipment, prototypes of which are currently undergoing operational tests, is designed to meet NATO interface standards. Fielding of this new voice switching equipment is certainly several years away. In the interim the Americans, and some of the other allied forces, plan to field interface units which will make existing automatic voice switching equipment interoperable. The fielding of some of this equipment should begin next year and this will be a significant step toward the enhancement of communications interoperability.

So far the examples of communications interoperability problems have been limited to those of German and American units. This is reasonable as they are representative of the difficulties which confront, or will confront,

NATO ground forces. Several reasons support this premise. German and American army elements together make up the bulk of the NATO ground forces, and they are employed in both army group sectors of the Central Region. So far only the Germans and Americans have agreed to the assignment of a division of one nation under the corps of the other. The German and American armies are currently the only two military partners with fielded automatic voice network equipment forward of the corps rear boundary.

A full study of all communications interoperability difficulties that have been experienced or that are forecast as force structures change, would naturally include a comprehensive consideration of the British, Dutch, and Belgium, as well as French, forces. France, of course, does not play an official role in the current NATO military command structure, but the employment of French forces would surely be a significant factor for the West in the event of open East-West hostilities. Consideration must be given to the employment of corps-size French elements on line with the current allied forces. Looking specifically at communications equipment, the Belgium army is expected to eventually adopt automatic voice switching equipment being developed by the French, while the Dutch will probably utilize a variation of the German equipment.

Above the NATO corps level in the Central Region, tactical operational control rests with the two army groups. The term operational control is used here, rather than command, since the responsibility to support fielded forces remains a national obligation. The nature of communications interoperability issues changes to some degree above the corps level because here, as previously noted, we find communications systems that were designed with international use in mind. No longer is the prime concern the interface between distinct and separate national systems.

It is readily apparent that the adequacy and reliability of the communications systems used by the NATO army groups are extremely important in determining the overall effectiveness of these international headquarters and the national forces they control. Because of the distances that are involved, FM radio communications is not utilized between the army groups and their respective corps. Minimum RATT communications are planned between army group and the corps, with use of this mode envisioned for emergency and back-up situations. The low traffic volume capacity of a RATT net makes this means of communications inadequate for normal army group control of its subordinate units. Heavy reliance is therefore placed on the voice and teletype circuits which are carried over multichannel systems.

The task of providing tactical multichannel communications within the Central Army Group falls to an organic signal support group which consists primarily of one German and one American battalion. A work division has been established under which these communication elements operate a basic backbone network which tie together the peacetime headquarters, a wartime first position bunker complex and several selected communications node locations. A transportable, alternate army group headquarters and the subordinate corps are tied into the nodes by army group communications elements during deployment in accordance with the higher to lower NATO agreement previously mentioned. The CENTAG multichannel design does achieve a reasonable degree of redundancy through alternate routing possibilities and, during exercises, the system has proven itself to be generally reliable in the static scenario. CENTAG communications as a whole does have, however, several serious shortcomings which have the potential of adversely affecting the interoperability of this international force. The communications equipment supporting the army group bunker position, a well-known location, are

completely exposed and therefore would be extremely vulnerable in the event of hostilities. Replacement equipment is not readily available. While this army group also deploys a transportable alternate headquarters, sufficient communications equipment does not exist to provide the army group with other than a marginal jump capability. Unlike internal German and American multichannel communications systems, NATO army group links are not bulk encrypted. Therefore the circuits passed over these systems, other than the teletype and minimal telephone circuits encrypted separately, are clear text transmissions. Depending on the equipment distribution, a national corps headquarters field command post now has as few as a single telephone capable of secure voice communications with its superior army group.

The Northern Army Group's approach to the requirement to establish multichannel communications with its corps differs from that of its southern neighbor. All teletype and voice circuits directed downward from the army group pass through a single hub location which serves a voice and message switching and relay function. As in CENTAG there are no automatic voice switching or multichannel radio bulk link encryption capabilities in the NORTHAG system. The NORTHAG hub does have an automatic message switching capability which has been successful on exercises under controlled, static conditions. The sustained maintenance of this basically commercial automated equipment in a hostile environment is suspect. The current NORTHAG multichannel network provides for no redundancy should the single hub be destroyed. On paper the NORTHAG communication design, a British concept, calls for the deployment of two interconnected hubs to eliminate the obvious disadvantage of a single communications chokepoint. A series of asset constraints, however, has led to the single hub design which exists today. Multichannel radio link

responsibility in NORTHAG is divided between a British element, which provides the service from the army group main, bunker, and alternate locations to the switch hub. A German communications element extends multichannel links from the hub down to the corps. NORTHAG, like CENTAG, currently has only marginal jump capability of the army group alternate field headquarters. Further, NORTHAG does not now have the organic communications capability to provide a multichannel link between the switch hub previously discussed, and an additional corps. This is a very important point in view of the possibility of an American corps serving as the NORTHAG reserve. NORTHAG like CENTAG does supplement its tactical communications to the corps with prescheduled commercial lines. These circuits terminate at positions in the vicinity of, but not at, the corps' defense positions. The corps then need only extend the circuits from the commercial pick-up points to their field command posts. This procedure is practiced in NORTHAG, and it provides the army group with limited communications links until the multichannel radio systems are established.

Currently the NATO communications links from the army groups back to their next higher headquarters, Allied Forces Central Europe (AFCENT), consists of fixed station microwave multichannel systems supplemented with some leased circuitry. There is very little redundancy or survivability engineered into the existing system. Planning for a new and comprehensive NATO Integrated Communications System (NICS), has been ongoing for over 10 years and this system, when completed, is designed to meet the political as well as the command and control communications requirements of NATO civil and military authorities. The network will tie-in national capitals as well as NATO military headquarters down to the army group level.[2] The

corps will also be connected into this network. The project is scheduled for completion in the 1983 to 1985 timeframe, and will provide for voice and teletype data automatic switching. Still, however, bulk encryption techniques will not be utilized. Secure voice conversations, therefore, will be limited to those with special secure telephone instruments. This feature will preclude the army group and higher NATO headquarters from connecting directly with national corps main switchboards, as it is envisioned that eventually most of these switchboards will be operated in a secure mode. Some national doctrine, including that of the US, precludes secure and non-secure circuits from being handled by the same switchboard due to the danger of a cross connection and electrical induction. In spite of this, the new NATO system will have survivability and redundancy features not now present, and will replace most of what is now a collection of NATO funded communications systems.

In truth not much more than lip service attention was paid to communications interoperability until about ten years ago, when the growing threat helped the allies to realize that effective communications were absolutely necessary if NATO was to achieve a credible coalition warfare capability. An example of the decentralized planning in the past is evidenced by the fact that both of the army groups in the Central Region had set out to independently seek a replacement for their own multichannel links to the corps. If allowed to proceed, of course, this could have led to an even greater variety of equipment being utilized by the two army groups than is now the case. The efforts of the army groups have now been combined within NATO so that the equipment finally procured will be the same for each army group. These new systems are to precede the fielding of NICS equipment. Technically speaking, however, the new tactical equipment, depending on who wins the competitive international bidding, could be of

a different national manufacture than that of the nations providing the army group communications soldiers for the mission. This would naturally result in unusual training and maintenance requirements, and at this point it can only be hoped that these factors will receive due consideration when the actual buy is made.

Most encouraging is the fact that some mechanism now exists within the NATO structure through which communications interoperability problems can be surfaced and receive proper attention. A Central Region Communications Interoperability Working Group was established in the late 1970's to deal with appropriate communication issues, and a fourth meeting of this group was held in February 1980. The communications working group appears to provide a needed forum for the surfacing of interoperability problems. How successful the group will be remains to be seen. True commitment to communications interoperability will mean the agreed to sacrifice of what are normally national prerogatives and economic interests. Such agreements are understandably very difficult to negotiate.

PART II

FOOTNOTES

1. Harold Brown, "Rationalization/Standardization within NATO," A Report to the United States Congress, January 1980, p. 24.

2. Ibid., p. 21.

PART III

AMERICAN GROUND FORCES TACTICAL COMMUNICATIONS IN THE CENTRAL REGION

As stated in an earlier segment of this discussion, it is not realistic to attempt to form a balanced impression of the status of ground forces communications interoperability in NATO's Central Region, from the American perspective, without including a brief analysis of the tactical communications posture of the participating American units. That is the objective of Part III.

First, a review of some of the basic communications equipment characteristics is appropriate. The FM radio (VRC-12 series) currently in use by US units has a near line-of-sight limitation at all but very close ranges. Under good line-of-sight conditions, a properly functioning radio with the proper antenna can be reliably used over a maximum distance of approximately 30 kilometers. In addition to the increasing maintenance concerns associated with the aging radio series and the fact that it is routinely employed over distances greater than that for which it was designed, a serious shortcoming of FM radio field operations today is the paucity of associated secure equipment. FM radios are used most near the forward edge of the battle area, in a very dynamic and radio-dense environment. Secure equipment is now available only to protect selected primarily operational nets in the division and corps areas. Many other nets are operated in clear text, and are utilized close enough to the line of contact that enemy intercept is a very real possibility. Of great concern are system engineering nets used by supporting communications units during the movement, installation, and troubleshooting of the primary multichannel systems in the zone from the brigade all the way back to the corps. These nets are extensively used by communications operators,

and carry information on the movement and location of all major headquarters and fire delivery control means. Depending on the distance from the forward line of troops, the vulnerability to jamming and, probably more importantly, intercept can be very high. A new family of secure equipment is currently being fielded to American units in Europe, and if the current proliferation plan is followed, sufficient secure equipment will be available in the next few years to secure all sensitive nets. There will be difficulties during the conversion period since the old and new generation secure equipment do not function together, and secure equipment requires that the FM radio used be in a higher state of maintenance than if only clear voice were being passed. Between now and the time that the new secure gear is fielded in quantity, the limited FM secure capability is a clear communications weakness among the American forces. A discussion of FM would not be complete without mentioning that a follow-on series of FM radios is also under development, but a near range impact of this program on battlefield communications capabilities is not predicted.

American communications users frequently speak poorly of their RATT equipment, and most of the complaints are related to maintenance difficulties of the old radio and teletype items which comprise the RATT units. At least as critical, however, are the dangerous deployment techniques which are currently being used in some areas. The RATT radio is a high power amplitude modulated set designed for long range multidirectional transmissions. Its characteristics are such that it is relatively easy to jam, intercept, or locate. A NATO agreed-to standard specifies that RATT equipment operating at normal power will not be located within 16 kilometers of the major headquarters being supported.[1] This restriction is routinely disregarded in many American units, and the transmitting equipment is

removed only from the immediate view of the headquarters. Frequently the reason for this is the functional user's requirement for the remote operation of the RATT, that is, the placement of a teletype device in the headquarters main command post through which a transmission can be made over RATT equipment located outside the headquarters perimeter. It is not practical under dynamic field conditions to provide a remote capability in a timely reliable manner over a 16 kilometer straight line distance, and it is for this reason that many American headquarters have slipped into the extremely dangerous habit of colocation or near-colocation with high energy radiating RATT equipment. The only reasonable solution currently attainable is for the maneuver or functional headquarters to be separated from the RATT terminals, and to accept the degraded service resulting from having traffic moved by courier between the command posts and the radio sites.

While many of those in US Army tactical unit leadership positions are impressively aware of FM and RATT characteristics and shortcomings, knowledge outside the communications community understandably falls off sharply with the multichannel systems and the various types of communications devices, e.g., telephones, teletypewriters, and voice and message switching capabilities which depend upon the communications paths provided over the multichannel systems. The difference in familiarity is understandable since FM and RATT equipment is readily found within maneuver and support units, whereas multichannel equipment is generally organic only to communications elements. The capabilities and limitations of the multichannel equipment currently fielded in the Army must be better understood by the user, as these are essential factors to consider both in current day battlefield operations and in the planning for the battlefield automated functional systems now

under development, which are highly dependent on the existing multichannel communications networks. The provision of reliable, dedicated circuit paths for the timely and accurate electrical exchange of data essential for the proper functioning of many of the envisioned automated command and control, including intelligence, systems is now a marginal capability at best.

By virtue of their nature, a multichannel network takes considerable time to move and install. The radio signal emission is directional, and rigidly dependent upon line-of-sight between antennas for systems operating in the higher frequency ranges. Because of the line-of-sight requirement, a multichannel link between tactical headquarters frequently has to be routed through relay positions. The addition of relays adds to the complexity of the system, and therefore normally means that more time will be required for its installation. It should also be kept in mind that a multichannel radio relay site is normally manned by only two to three communications soldiers to provide the required around-the-clock operation. It is frequently placed on hard to get to high ground in order to obtain the required line-of-sight. These radio relay sites must be considered extremely vulnerable to disruption from the air or ground.

Reliability of multichannel communications is improved considerably, the availability of equipment permitting, by the intelligent design of a network providing alternate routing opportunities. This can be a very complex effort, particularly if, as is common, several supported units are on the move at one time and the new locations are not yet determined. Ideally a tactical unit headquarters about to move will require, for operational reasons, that the existing multichannel link to its current location remain on the air, until an advance or jump element selects the new location and a

multichannel link to it is provided. While this is operationally sound, the paucity of multichannel equipment in the American units in Europe today, versus the missions imposed on communications units, results in a number of important tactical headquarters being without a multichannel communications jump capability. The minimal level of critical multichannel equipment in the field today is particularly worrisome in view of the inordinate delay involved in securing replacement equipment. It recently took over two years for a corps-level, multichannel radio terminal, that had been destroyed in an accident, to be replaced. This fact is extremely critical in view of the fact that American communications units have essentially no backup multichannel equipment on hand.

The division-level, multichannel equipment is newer and essentially easier to install than that found at higher levels. A principal advantage enjoyed at the division level is that the equipment is operated in a relatively low frequency range, which allows the antennas to be mounted on short masts below tree top level. A disadvantage is that the division sets are very susceptible to mutual interference, a significant problem in the crowded European environment.

The current model corps-level, multichannel equipment has been in the inventory over twenty years, and is operated at a high frequency range so as not to interfere with the division systems. Corps-level, multichannel equipment is scheduled for replacement in the next few years, but while the new configuration will ease maintenance problems and provide some engineering advantages to the operator, the radios will continue to be used in the high frequency range. This means that absolute line-of-sight is demanded for most operations, and that mandates the erection of large, multichannel antennas

clearly above tree top level. The paucity of multichannel equipment in view of the imposed mission requirements leads to the employment of critical radios on prominent ground so that they can be used at maximum range. In this mode the radios are easily detected and would most likely be quickly subjected to enemy action. In the manner in which corps-level, multichannel equipment is currently deployed, it is not unreasonable to assume that half of the equipment could be neutralized within the first few days of intense combat.

The aspect of easy detectability also raises a real fear of pinpointing the headquarters being serviced by a multichannel system terminal. Undeniably that is exactly what is happening in many cases now. The intuitive alternative of locating the multichannel terminals significantly away from the headquarters being serviced is not now viable, as the ability to install cable communications between the multichannel terminal and a command post is severely limited. A compact, short-range, low-power millimeter wave length radio to provide the multichannel terminal to command post link is currently under development and, when fielded, will provide some relief to the problem. At the same time, the use of this additional radio will complicate the path a given circuit into the headquarters must follow.

The automatic switching of both voice and teletype circuits is an area which desperately needs attention at the tactical unit level. Because of a current general distrust of service to the customer requiring operator assistance through one or more switchboards, the use of dedicated or "hot line" circuits between principal staff agencies, e.g., a corps G-3 to division G-3 point-to-point circuit, has become the norm in most units. The use of dedicated circuits is extremely expensive in terms of assets as it totally monopolizes a given path on the multichannel system, and should only be

considered if the shared use of common user circuits cannot reasonably satisfy the user's requirement. In truth, common-user service through manually assisted switchboards has frequently been characterized by inordinate, frustrating delays. Automatic switching units may well provide an answer to this problem, if the multichannel links themselves are reliably available. In consonnance with their fielding of an automatic switching system which started approximately two years ago, German army doctrine now provides for no point-to-point circuits.

In trying to extract benefits from the German experience for American use, it is necessary to note some critical differences in both German equipment and doctrine from their American counterparts. The German doctrine and equipment development were coordinated, and provided for a multichannel network characterized by alternate circuit paths through multiple switching nodes. The equipment is designed for the field, however, initial indicators are that German signal units do require assistance from their civilian development contractor for maintenance. American division-level, automatic voice switchboards are currently being fielded in Europe and it is too early to evaluate their performance. These new switchboards are being issued generally on a one for one replacement basis with existing manual boards, and no doctrinal changes have been published to fully capitalize on their speed of operation.

Significant changes are currently underway at the corps level as the corps communications assets are converting from a single, inordinately large battalion to a signal brigade. Some former theater army theater assets are becoming organic to the corps. As a result the corps will have the assets for essentially all of the multichannel communications systems operating within the corps zone and behind the divisions' rear boundaries. American

corps communications doctrine is lagging far behind, as exemplified by the fact that current doctrine still calls for all command and control multichannel links to be routed through a single hub at corps main. This means, for example, that the multichannel link between the corps tactical command post and the subordinate division, are all to be routed through the corps main, hardly an enhancement of redundant communications.

Automatic voice switching equipment was issued at the corps level approximately four years ago, and with the formation of the new corps signal brigades, each corps will have five of the switchboards. Unfortunately, the current automatic switchboard in the hands of the corps is marginally suitable for operation in a dynamic, hostile environment. The bulk of the automatic board is commercial, off-the-shelf equipment, which has been mounted in a 2½-ton truck. A limited number of military operators and maintenance personnel are authorized for each unit, but experience has shown that considerable outside civilian technical experience has been required to keep the switch operational during field exercises. The automatic voice switch configuration is outfitted with two high BTU commercial air conditioners which must function even in cool weather to sustain operation of the processor. Since the air conditioners are not military standard equipment, spare parts are generally not available. The next maintenance support level above the battalion for the electronic processor components is depot. The configuration has proven itself extremely vulnerable to power source fluctuations, common under field conditions, and the vibrations associated with road movement.

In consideration of the costly nature of point-to-point circuits as discussed earlier, thought is now being given at corps level to using the available automatic switching assets to construct an automatic switch network

somewhat on the German army order. This network would carry administrative and logistical, as well as command and control traffic and, theoretically, render point-to-point circuits unnecessary. This approach has not yet been attempted on a large exercise, and it is not now possible to definitely predict success or failure. For certain, however, this undertaking should not be attempted without full realization of the extreme vulnerability of the automatic voice switchboards now in the corps.

A replacement for the corps-level, automatic switchboard is currently undergoing development, and it is assumed that the new configuration will be fielded in four to five years. This new switchboard is one of the first major items to be managed under the Joint Tactical Communications Office (TRI TAC) and it is being engineered to be interoperable with NATO standards.

There is currently no tactical automatic switching capability organic to the American corps or divisions, although a corps-level system is under development under the TRI TAC program. Currently all tactical messages must be punched onto a paper tape by a message center clerk. The tape is then fed into a sending machine. Message switching is accomplished by taking a received punched tape from the receiving machine and putting it into another teletype for sending. This time-consuming and laborious procedure has been referred to as the tyranny of the message center. In the high volume environment commonplace in the tactical zone, the speed of message transmission today is directly controlled by the speed of message center typists. There is currently no standard facsimile transmission capability in the American Army, however, the equipment is under development and should be fielded within the next couple of years.

The foregoing overview of tactical communication shortcomings in

American units today is intended to serve as an alert to some of the risks that are associated with the overreliance on electronically transmitted communications on a dynamic battlefield. Currently US forces attempt to install, move, and operate with considerably more communications support than any of our allies. Operation in a war environment will, without question, result in a quantum denigration of the communications means currently available for field exercise use. The wise commander cannot allow the command and control of his unit to become so centralized and communications dependent that it becomes largely ineffective in a communications austere environment.

PART III

FOOTNOTE

1. United States Army, Europe, and Seventh Army, USAREUR Pamphlet 105-1, p. 5.

PART IV

SUMMARY AND FUTURE IMPLICATIONS

This non-technical paper was written with the American combat arms leader in mind in an effort to help him gain an overview understanding of some of the communications interoperability problems facing NATO ground forces in the Central Region today. Since the study does not address all communications interoperability problems and issues being encountered, a task too great for this single treatise, the specific examples cited in the paper are to be considered representative, and not a comprehensive, collection of all interoperability difficulties.

After a brief review of the basic types of communications equipment utilized in support of ground forces, a series of examples were presented which illustrate typical communications interoperability problem areas in the international NATO environment. Then a closer internal look was taken at the status of tactical communications capabilities within the American units now participating in Europe. Throughout this paper the issues are discussed as viewed from the American perspective.

Since the illustrations already discussed have been presented with brevity in mind, it would be difficult to achieve a further summarization of specific issues and problems. Rather there are five general lessons, or conclusions, which can be drawn from the myriad of communications interoperability difficulties being experienced today. These are lessons which must be promptly and properly reacted to if the American Army, as a part of the NATO ground force partnership, is to be successful on the future battlefield.

Lesson 1: The American Army must be prepared for coalition war in Europe.

Unfortunately there is no single action that can be taken which will immediately resolve the major communications interoperability issues present today. Each issue normally consists of several complex facets which must be viewed in terms of various economic and political aspects, as well as the military utilization. America cannot solve the problems alone, but it must do its part by supporting efforts to develop reasonable NATO interoperability agreements, and by consistently fielding only communications equipment which meets the agreed to standards. Those who oppose the added expenditures required to make American tactical communications equipment interoperable with that of our NATO allies, frequently cite the fact that Europe is not the only place where the American Army must be prepared to fight. That is certainly true, but at the same time, there is no other place, except perhaps Korea, where if engaged our ground forces will be so mutually dependent on allied units. Improved communications interoperability in the Central Region will undoubtedly enhance the strength of NATO's coalition ground force. This in turn will strengthen the United States' ability to respond militarily worldwide, not denigrate it.

Lesson 2: Centralized communications planning and management must be executed at Department of the Army level.

American tactical communications units are frequently faced with different operating standards for interfacing within the NATO chain of command, as opposed to communicating with the US theater army elements. This confusing situation was surfaced in the main body of this paper, as well as the lack of cohesive doctrine which should logically accompany the ongoing fielding of new automatic vice switching equipment.

These matters are symptomatic of the fact that significant communications interoperability problems, on a national scale, reside within the US Army itself. This condition seriously frustrates efforts to find solutions at the international NATO level.

In the past the planners of many of the US worldwide communications and functional systems which terminate in the theater army zone of responsibility, have chosen cost-effective, commercial system designs and equipment, without proper recognition of the required interface with tactical equipment. In short, the artificial boundary between the strategic and tactical communications missions must be overcome. It is hoped that the Department of the Army, Office of the Assistant Chief of Staff for Automation and Communications, established within the last three years, will be able to provide the central control needed. The American Army has paid a heavy price for the past absence of a DA major staff element with the charter to act as a responsible communications focal point. Without strong centralized management, the current national and international interoperability problems are likely to get worse as military communications systems, and the functional activities they support, become more complex.

Lesson 3: <u>The military communications systems supporting NATO field forces must be reasonably survivable and maintainable in an austere and dynamic combat environment</u>.

There is good credibility in the thought that a future war in the Central Region may occur with little warning. There will certainly not be the time available for mobilization on which America relied during the early days of World War II. There will not be a long lead time to transition communications systems to wartime status. This fact must be used to counter

proposals to pursue courses of action which focus on the tempting front-end economic advantages of equipment with poor survivability features, and for which a functional intergrated support plan has not been developed. The cost in readiness terms is unacceptable. The numerous shortcomings of the current American corps-level automatic voice switch is but one example. Fielding low density, key item equipment which is fragile and difficult to maintain is dangerously shortsighted, and could have horrendous implications for a unit which was thrown into battle on short notice.

Lesson 4: Command decisions which embody the use of international military communications, must be made only with full consideration being given to the communications interoperability requirements and the assets which will be required to satisfy those requirements.

Several specific examples have been presented outlining current situations in which a communications unit is required to satisfy an inordinate interoperability requirement utilizing existing table of organization assets. In each case the price paid was a denigration of that unit's ability to satisfy other portions of its tactical mission. It is clear from the several cases discussed that acceptable communications interoperability is achieved today in only those cases in which considerable specific planning and additional communications assets have been devoted to meet special requirements. Tactical units of brigade and division size cannot be successfully cross-attached between superior headquarters of different nationalities, and function at full potential without interoperable tactical communications. Failure to recognize this will result in a severe loss of combat power.

Lesson 5: The tactical unit commander must plan for and practice military combat operations under conditions of severely degraded field communications.

A tactical unit can expect to lose one-half of its multichannel assets in an intense European engagement, and there is now no capability of replacing major communications equipment quickly. There is no doubt that American tactical units can predict that they will be required to function in combat with considerably less communications support of all kinds than that now utilized on most field exercises. At the same time, emerging command and control, as well as functional support, systems are making army tactical units evermore communications dependent. Relatively few training efforts are directed toward combat operations in a communications austere environment. Recent attention has been given to the American Army's expanded use of the German commercial network, as a back-up to the tactical communications systems. This technique is used routinely by the German army, and has been too long overlooked by the Americans. The attrition of his tactical communications capability, will seriously denigrate a commander's effectiveness. The combat commander must train his unit to maximize its performance under these conditions. To do otherwise is to invite disaster.

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