CHAPTER 2

C^2 Communications Architecture

2-1. Introduction

a. The only purpose of C^2 is to implement the commander's will in pursuit of the unit's objective. The system must be reliable, secure, fast, and durable. It must collect, analyze, and present information rapidly. It must communicate orders, coordinate support, and provide direction to the force in spite of enemy interference, destruction of command posts (CPs), or loss and replacement of commanders. The ultimate measure of C^2 effectiveness is whether the force functions more effectively and more quickly than the enemy.

b. Force level information is exchanged by means of the network which is shown in Figure 2-1. The Army Tactical Command and Control System (ATCCS) is an integrated system of equipment, software, information, and staff. This system allows tactical commanders and staff at each of the five battlefield functional areas to plan and control their operations and to coordinate these with other functional commanders. ATCCS consists of the automated C^2 systems for the battlefield functional areas and the communications links between and among the control systems.

c. Information management is the policy, process, and procedures used to manage information systems and services. It includes, but is not limited to, resources and activities that create, gather, manipulate, classify, store, display, retrieve, secure, transmit, disseminate, or access elements of information. Elements of information may be visual, aural, or electrical. Information management occurs at strategic, theater/tactical, and sustaining base levels.

(1) Strategic information is required by theater Army, joint or combined commands, defense, and other federal agencies to execute national policies and theater goals.

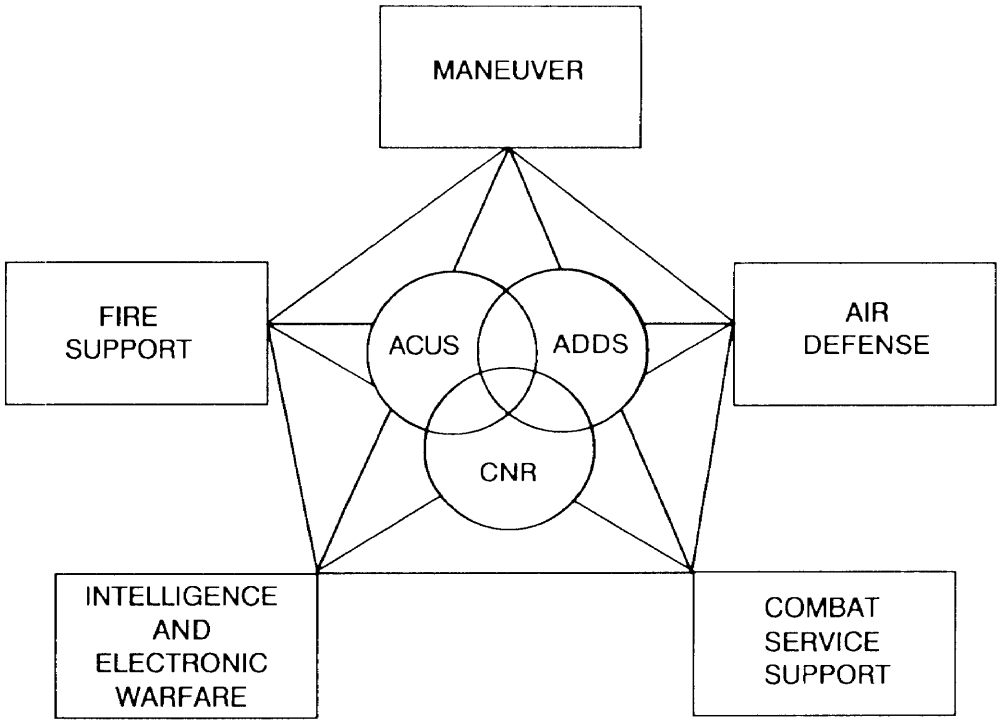

Figure 2-1. ATCCS.

(2) Theater/tactical information is used in the theater of operations, normally at corps level and below, and is required to conduct maneuver warfare. Tactical information includes unit status, unit employability, fire support capabilities, supply routes, key terrain, avenues of approach, and Threat disposition, capabilities, and intentions. It includes information systems needed to direct, coordinate, and support combat power during peace, transition to war, and conflict. This information is processed from the fighting position to the successive command headquarters of the joint, unified, specified, or combined commands.

(3) Sustaining base information is primarily concerned with base operations and training. Sustaining base information systems function during peace, mobilization, deployment, employment, and sustainment of the fighting force.

d. Personnel responsible for information management coordinate, process, and manage information vertically between the strategic, theater/tactical, and sustaining base; and horizontally and vertically between the five major functional areas. The effectiveness of this force level information exchange network is the key to the Army's success to fight IAW the four basic tenets of ALB. The tenets are initiative,

agility, depth, and synchronization. The ALB C^2 system must facilitate the commander's ability to operate, delegate authority, and exert leadership from any critical point on the battlefield.

e. The Information Mission Area (IMA) has five disciplines: automation, communications, visual information, records management, and printing and publications. As defined below, the five disciplines encompass strategic, theater/tactical, and sustaining base information. The IMA responsibilities of the assistant division signal officer (ADSO) address only those aspects of the tactical environment, systems, and services.

(1) Automation is implementing processes or procedures using automated electronic equipment in tactical and nontactical environments. The technologies include, but are not limited to micrographics, word processing, copiers, printing, communications, decision aids, and general-purpose data processing.

(2) Communications is disseminating information through transmission, emission, or reception of signs, signals, writing, images, sounds or data of any nature using audio, visual, electro-optical, or electromagnetic systems.

(3) Visual information is using sound and visual material or processes to communicate information. Visual information includes, but is not limited to, motion pictures, still and motion photography (combat camera), television, audio, graphic art, and audiovisual libraries.

(4) Records management is managing and maintaining documentation. It includes distribution, use and disposition, storage, declassification, and the implementation of responsibilities under the freedom of information and privacy acts. Media includes correspondence, reports, forms, directives, publications, electronic mail/messages, mail, magnetic tape/disk, and electro-optical storage/retrieval. The Information Services Support Office (ISS0) was formerly the administrative services branch/division. The ISS0 is responsible for the Battlefield Information Services (BIS).

(5) Printing and publications is the process for producing documents on media such as micropublishing, plate making, press work, photocomposition, and binding for issue and distribution. For the most part, this is accomplished through Signal Corps channels to the garrison/wartime director of information management.

f. C^2 communications is not limited to Mobile Subscriber Equipment (MSE). MSE is only one part of the equation. The Army provides the commander with the tactical communications architecture to support

corps and division C^2 on the battlefield. This architecture consists of --

- The Area Common-User Voice Network.
- The Combat Net Radio (CNR) System.
- The Army Data Distribution System (ADDS).

2-2. The Area Common-User Voice Network

a. Corps backbone system. MSE is the area common-user voice communications system in the corps. It is the backbone of the corps communications system and provides voice and data communications from the corps rear boundary forward to the division maneuver battalions' main CP and rear CP. It also provides commanders and staffs with a switched communications system which includes--

- Secure telephone service.
- Secure facsimile service.
- Secure mobile radiotelephone service.
- Secure data transmission.
- CNR network access.

b. Messenger service. There is no messenger service at the corps or division level. When messenger service is required, the signal office is responsible for determining routes and schedules. The G3 is responsible for tasking units for vehicles and personnel. To compensate for the lack of a record traffic system, user-owned and -operated terminals are relied on to transfer messages through the area common-user system. Subscribers dial the intended recipient and send the message.

c. MSE operations. MSE operations consist of five functional areas:

- Area coverage.
- Wire subscriber access.
- Subscriber terminals.
- Mobile subscriber access.
- Systems control.

The five functional areas represent the major roles and capabilities of the system. The first four describe equipment and capabilities available to the user for unit C². The fifth provides the signal commander with facilities to C² MSE assets. Appendix A shows typical site configurations.

d. Area coverage. The network of line-of-sight (LOS) multichannel radios and the interconnected local and long-distance switching nodes provide area coverage. Covering the battlefield with network access points and facilities to route communications to the desired subscriber (Figure 2-2) provides wide-area communications to commanders and staffs for C², sustainment, and operations and intelligence. Each MSE corps network includes at least two gateway connections to the echelons above corps (EAC) communications network and adjacent corps. Adjacent divisions in different MSE corps networks maintain at least one link between themselves.

(1) The heart of the MSE network is the node center (NC). Each NC consists of--

- One AN/TTC-47 node switch (NS). An operations group (OG) shelter and a switching group (SG) shelter comprise the NS.
- One node management facility (NMF).
- Four LOS AN/TRC-190(V3) ultra high frequency (UHF) radio assemblages.
- One radio access unit (RAU).
- One node support vehicle (NSV).
- Two 10 kilowatt diesel generators.
- Five 5 kilowatt diesel generators.

(2) The NS provides network tandem switching with flood search routing. The NS also can provide technical management of nodal communications facilities.

(3) LOS radios (AN/TRC-190(V)) provide the transmission media between NCs and the NS with its extension nodes. LOS radios also link the remote RAU to the NS. Substitute radio systems can be used for the AN/TRC-190 in specific applications where terrain is restrictive or extended range is desired. These substitutes can be either tactical satellite (TACSAT) or digital troposcatter (TROPO).

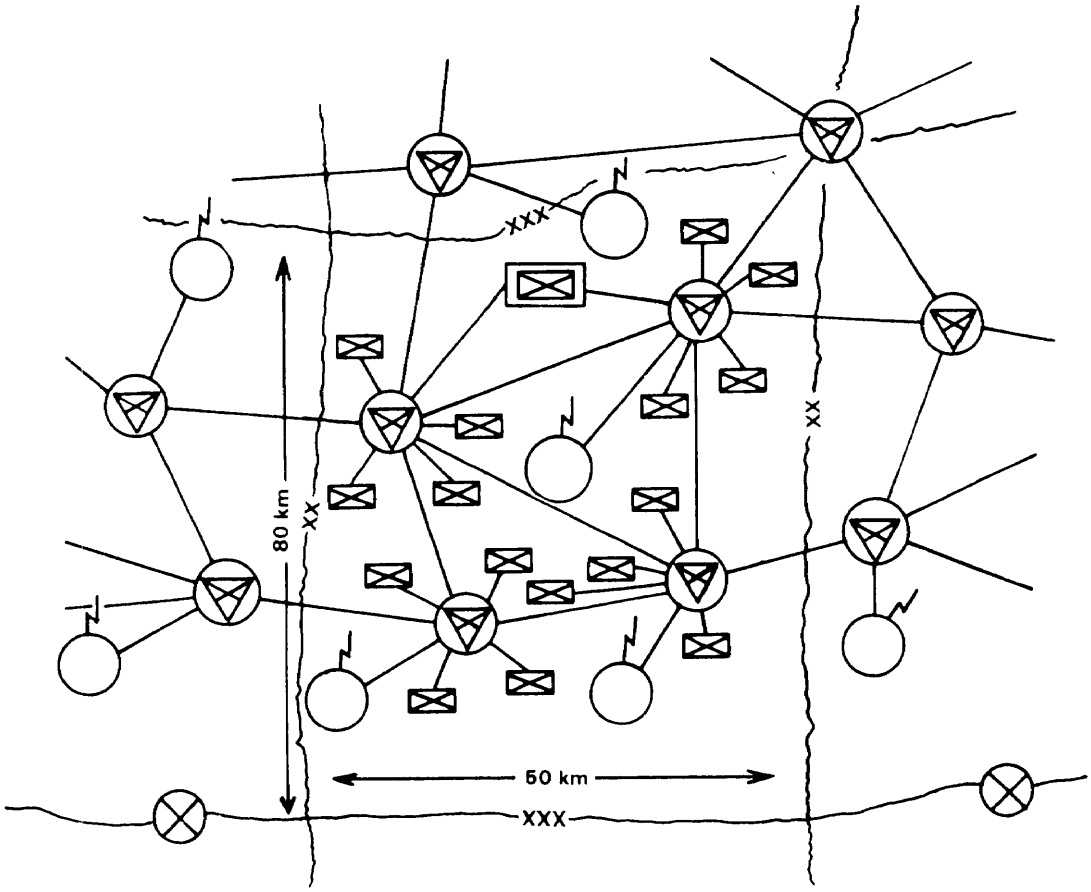

Figure 2-2. Typical division deployment. (Symbology is explained in Appendix B.)

(4) The RAU (AN/TRC-191) provides network access to mobile radiotelephone subscribers. The RAU can be deployed adjacent to an NC (local) or can be remoted by means of the LOS radio (AN/TRC-190(Vl)).

(5) MSE can interface with TACSAT (AN/TSC-85A and AN/TSC-93A) which can extend radio transmission range when LOS radio is unavailable or radio range is insufficient. TACSAT can provide an internodal link between widely separated NCs in the same corps or can install a gateway link between NCs of adjacent corps. TACSAT provides secure analog and digital transmission. Signal network managers can use TACSAT to deploy transmission assets forward during exploitation or penetration operations in the deep battle. TACSAT can provide a communications link with higher echelon elements such as theater Army or continental United States (CONUS).

(6) TROPO radio terminals (AN/TRC-170(V)) from EAC can be substituted for MSE LOS radios. The terminals provide secure transmission of analog and digital traffic over ranges from LOS to 240 kilometers (150 miles). Each of the two terminals can transmit one system of 8 to 144 trunks. Signal organizations use the terminals for node bypass and extended range communications. TROPO companies (heavy and light) are assigned to EAC units. TROPO (heavy) companies use the (V2) model with an optimum transmission range of 240 kilometers (150 miles). TROPO (light) companies use the (V3) model with an optimum range of 160 kilometers (100 miles). Transmission ranges largely depend on propagation factors.

e. Static access to the system. Wire subscriber access provides network access to static terminal users. The AN/TTC-46 large extension node switch (LENS) or the AN/TTC-48 small extension node switch (SENS) provides this service. Signal support of wire subscribers consists of installation, operation, and maintenance (IOM) of the NS, LOS radios, cable (CX-4566 and CX-11230/G), and junction equipment (J-1077 distribution box or TD-1234 remote multiplexer combiner (RMC)). The user is responsible for connecting the WF-16 field wire to the junction equipment and providing power for the RMC.

(1) The LENS provides local switching and network access for up to 176 digital subscribers. A large extension node (LEN) provides service for large concentrations of users, such as corps support command (COSCOM)/division support command (DISCOM) or corps/division main. The LENS consists of an OG shelter and an SG shelter. The AN/TRC-190(V4) LOS radio provides network connectivity.

(2) The SENS provides local switching and network access for 26 subscribers (AN/TTC-48(Vl)) or 41 subscribers (AN/TTC-48(V2)). A habitual relationship may be established and maintained between extension nodes including LOS teams and the division CP. The same relationship may be established with corps combat units' CPs (that is, armored cavalry regiment (ACR), artillery brigades, or air defense artillery (ADA) brigades) (Figures 2-3 and 2-4). While a habitual relationship may be desired (for tactical familiarity and ease in support), MSE extension nodes do not revert to a reserve role when the supported CP/unit assumes a reserve role. In these situations, MSE extension nodes are assigned a revised support role. Habitual relationships may be reestablished when the affected elements return to an active role. In the corps area of operations, essential C^2 facilities (division main CP, corps main CP, corps rear and tactical CP) should be provided dual LOS network connectivity. This entails assigning additional and redundant extension facilities (small extension nodes (SENs)/(LENs)).

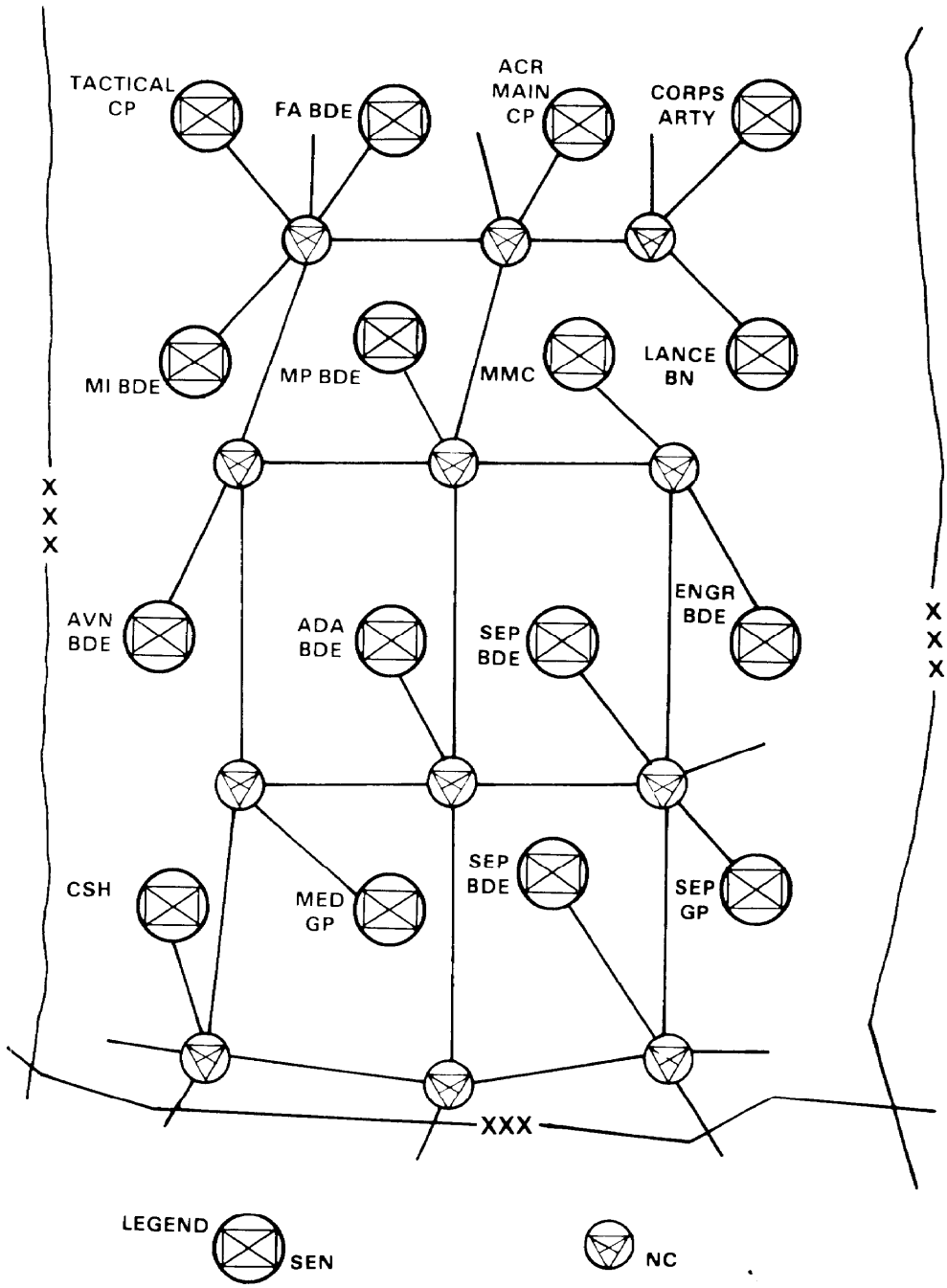

Figure 2-3. Typical corps SEN deployment.

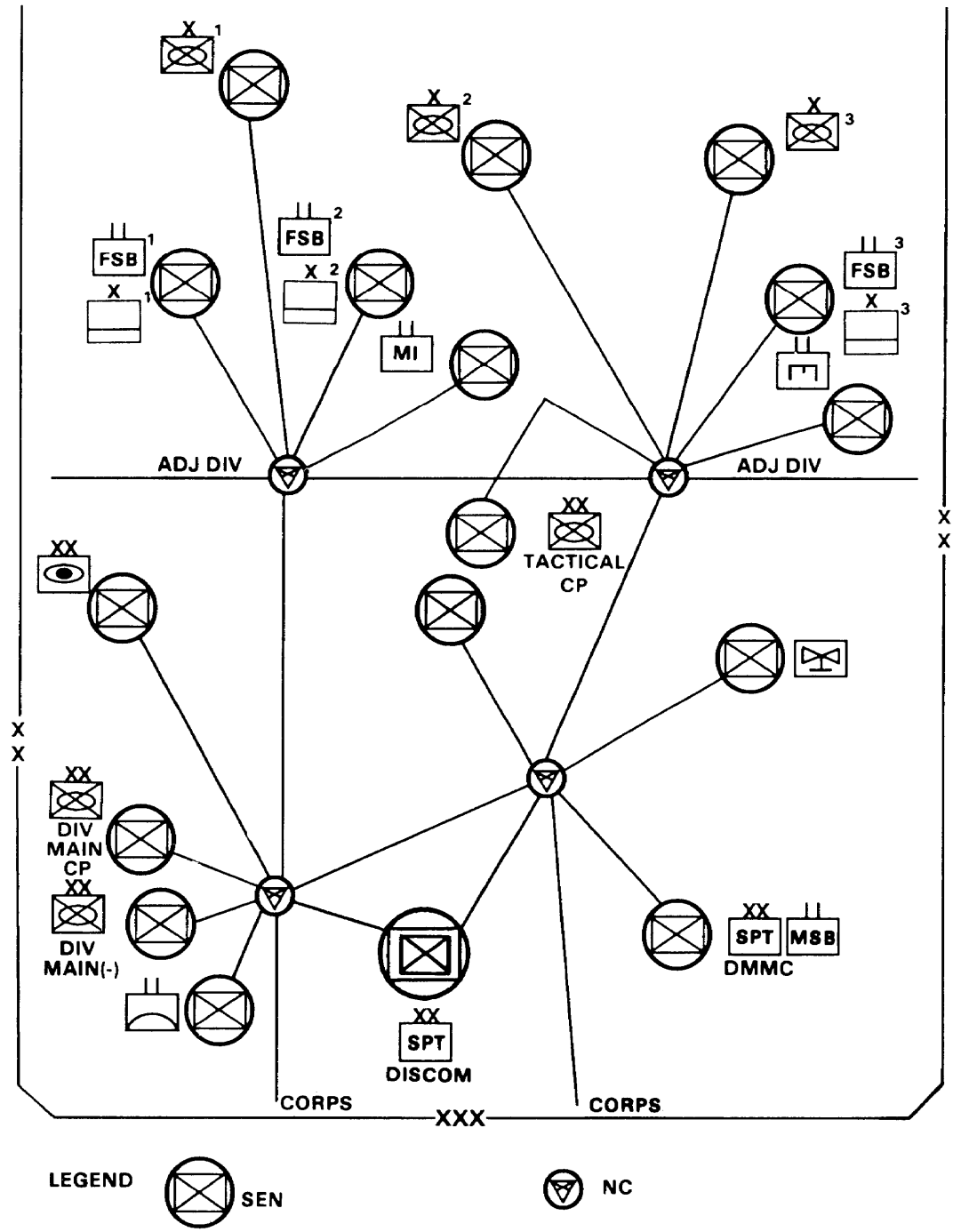

Figure 2-4. Typical division extension switch deployment.

(3) The AN/GRC-224 super high frequency (SHF) radio may be used to enhance CP survivability by remoting the LOS radio from the extension node switch and the supported unit.

f. Terminal equipment. The subscriber terminal functional area covers user-owned and -operated MSE equipment. Subscriber terminal equipment includes--

- TA-1035 digital nonsecure voice terminal (DNVT).
- TSEC/KY-68 digital subscriber voice terminal (DSVT).
- AN/UGC-144 communications terminal (CT).
- AN/UXC-7 lightweight digital facsimile (LDF).
- AN/VRC-97 mobile subscriber radiotelephone terminal (MSRT).

(1) Users are responsible for installing, operating, and maintaining their subscriber terminal equipment. The user is responsible for connecting and maintaining wire lines to the distribution box or RMC installed by the supporting signal extension node. Signal soldiers and leaders are responsible for ensuring the user is knowledgeable in procedures for completing connections and assisting with troubleshooting.

(2) Subscriber terminals provide the user voice and data access to the MSE network. Data terminals interface with the network through 16 kb/s data ports in the DSVT or DNVT.

g. Mobile access to the system. The mobile subscriber access functional area consists of signal and user equipment. This enables the commander and staff to communicate while moving throughout the battlefield.

(1) The user-owned component is the MSRT. The MSRT provides the user the capability to dial up and communicate with any discretely addressed MSE subscriber. The MSRT (AN/VRC-97) consists of a DSVT and an RT-1539(P)/G very high frequency (VHF) radio with a vehicle antenna kit.

(a) The RT-1539(P)/G MSRT radio and the RAU's radio are identical and interchangeable. In the MSRT or RAU, the radio operates in a full duplex mode with a high and low frequency band for transmit and receive channels. In the RAU, the radio transmits in the high band and receives in the low band. This procedure is reversed when the radio is used in the MSRT configuration. The MSRT has the following capabilities:

- Automatic random channel selection for each call.

- Automatic radio frequency (RF) transmit level adjustment.
- Automatic receiver sensitivity adjustment.
- Stand-alone field kit (SAFK).
- DSVT remote capability.
- Range extension using elevated antenna.

(b) The mobile subscriber uses the DSVT as the primary access terminal. The DSVT provides cryptographic facilities for the MSRT and has a 16 kb/s data port for interface of data devices (facsimile, communications terminal). The MSRT can be removed from the vehicle and operated using the SAFK.

(2) The mobile subscriber gains network access through the RAU. The signal planner deploys RAUs to provide battlefield coverage. One RAU can provide a 15 kilometer (9.3 mile) radius area coverage (planning range) in the area of operations (Figure 2-5). Following initial affiliation, mobile subscriber affiliation is maintained automatically as he moves from one RAU's range to another (Figure 2-6). If the mobile subscriber is engaged in a telephone conversation and leaves the servicing RAU's range, the conversation is terminated and must be redialed.

h. Network control. The AN/TYQ-35 system control center (SCC) is the primary signal C^2 facility for MSE network operations. (The current SCC is known as the SCC-1. In this manual, the SCC-1 is referred to as the SCC. During the fielding of the 7th Corps, the SCC-2 will be fielded and will completely replace the SCC-1.) The SCC provides the signal commander automated facilities to aid in network planning, systems engineering, network management, and dynamic operational management of all MSE materiel and personnel. Corps SCC assets are deployed on the basis of one per division and two per corps. FM 11-38 provides detailed information on SCC facilities and network management and control procedures.

(1) The corps SCC (including subordinate division MSE assets) controls the MSE network when deployed as a corps system. The concept of a corps-managed area network is a major change in signal doctrine.

(a) In a corps network, the network management/control element is the corps signal officer/brigade commander's headquarters. The corps signal officer is responsible for ensuring area communications support throughout the maneuver area of operations. It is expected that division MSE assets will require corps augmentation to fulfill this requirement.

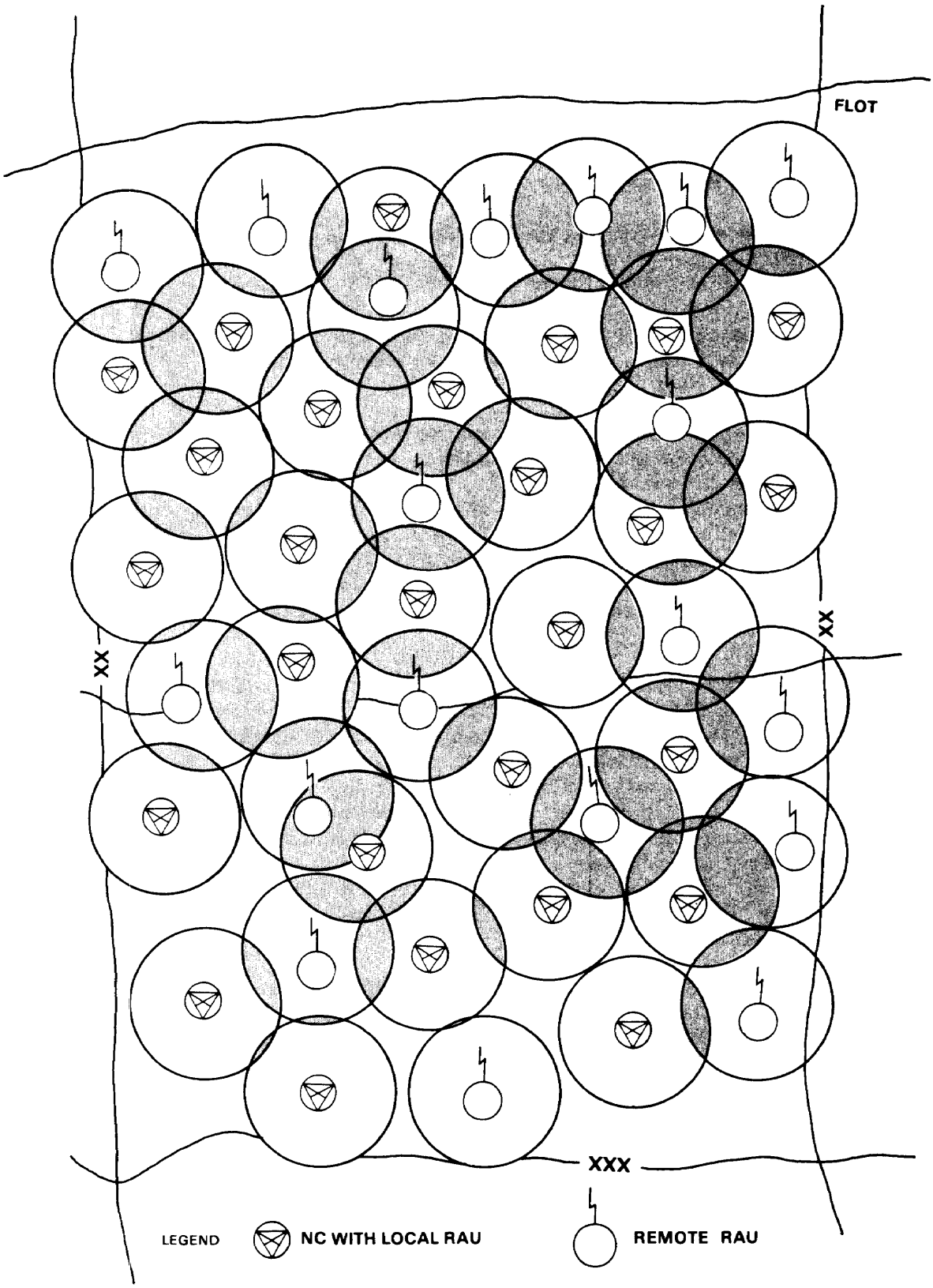

Figure 2-5. RAU deployment within a corps.

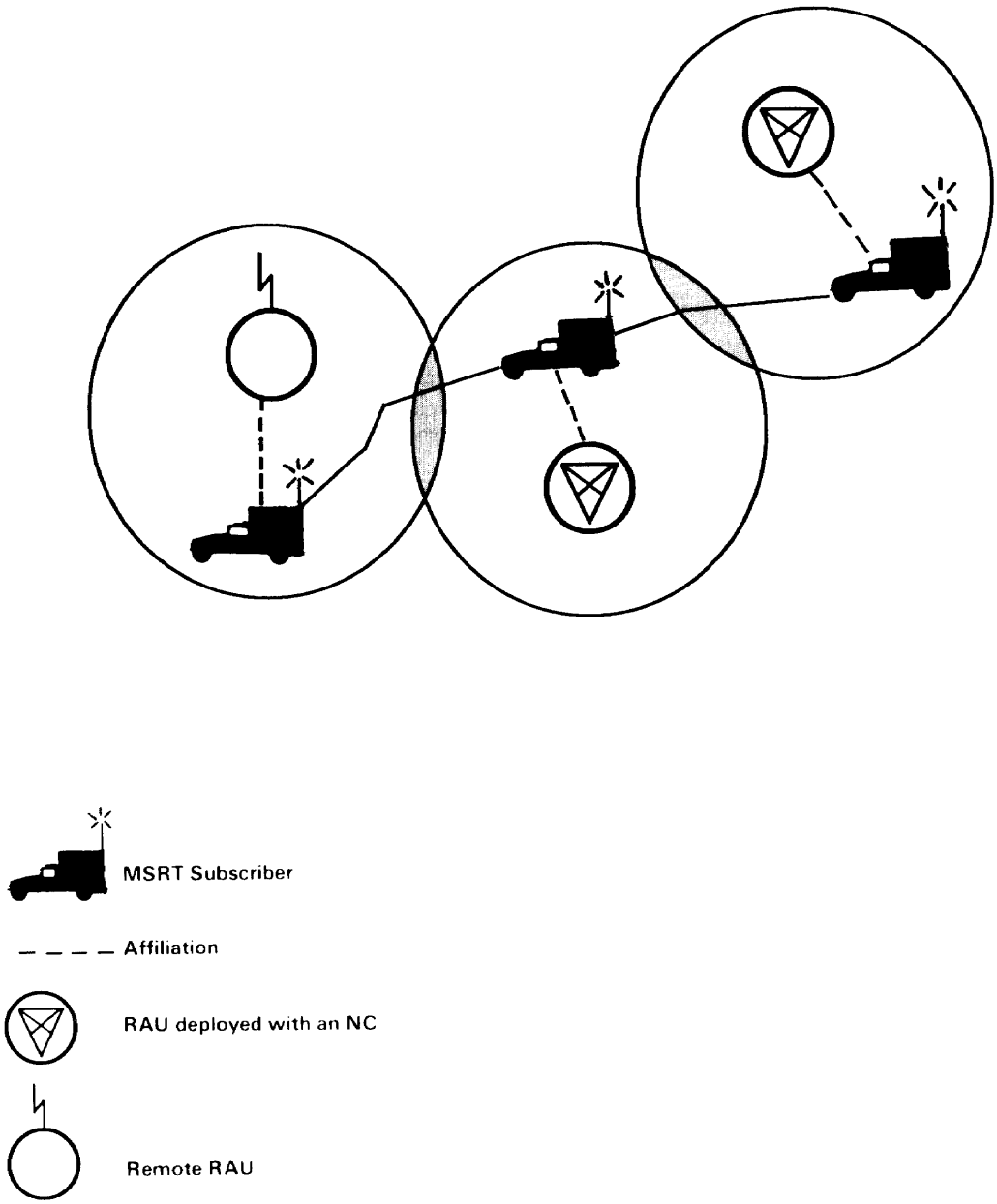

Figure 2-6. MSRT automatic reaffiliation.

(b) The division signal officer is responsible for using his unit's assets to support the C^2 needs of the division.

(c) The network manager designates one primary SCC and one alternate SCC. The primary SCC is responsible for corps network management and control functions. This is accomplished by using multiple-netted SCCs. Each one is responsible to the primary SCC as a potential alternate SCC and for discrete management/planning functions (for example, planning, frequency management, or team status). The division SCC is assigned an active role in performing specific and assigned network management tasks while subordinate to and under technical control of the corps primary SCC. It is necessary to provide management from corps level since it is that element which possesses the comprehensive corps MSE data base. The corps SCC AN/TYQ-35(V2) consists of a technical shelter, management shelter, and planning shelter.

(2) The division SCC AN/TYQ-35(Vl) consists of a technical shelter and a management shelter. When the division deploys independent of the corps, the management/control element is in the headquarters of the division signal battalion. The division SCC assumes the role of primary SCC when deployed without corps SCC support.

(3) The SCC deploys with an NC and gains network connectivity through the NS. The SCC is normally connected to the NS by .4 kilometer (.25 mile) CX-11230/G cable. Corps level SCC assets deploy with one SCC operating in the primary role and one in the alternate role to provide redundancy. The primary SCC updates the network data base in the alternate SCC automatically every seven minutes.

(4) The NMF AN/TSQ-154 provides the node commander (platoon leader) a shelter from which to direct nodal operations. The NMF contains the AN/UGC-74 data terminal used for sending reports to and receiving orders from the SCC. The NMF is the network interface between the SCC, the NCs, and the LENs.

(5) The network control terminal (NCT) AN/GGC-66 is the corps area signal battalion commander's interface with MSE system management operations . It is the means by which the commander follows the movement and status of his teams when they are deployed in the MSE network. The NCT is issued on the basis of one per corps area signal battalion.

2-3. CNR

a. The CNR system provides a communications means, independent of MSE, for C^2 within the corps in the division maneuver brigades, CS units, and CSS units. The primary role of the CNR is voice C^2 for the commander at brigade and below. The secondary role of the CNR is to provide a means of data transmission. When a CNR net is used for voice and data traffic, transmission quality may be degraded. If this occurs, consider designating the unit CNR nets as data-only or voice-only nets. The CNR architecture is based on having two types of single-channel systems: amplitude modulated (AM) and frequency modulated (FM). Examples of such radios include the AN/VRC-12 and the AN/GRC-106 radios. The future CNR architecture is also designed around two separate radio systems, each having unique characteristics and capabilities. These are the--

- Improved high frequency radio (IHFR).
- Single-Channel Ground and Airborne Radio System (SINCGARS).

b. IHFR provides the commander a tactical high frequency (HF) radio for C^2 in the corps and division. IHFR extends and complements the VHF-FM communications network. At this time, there is no requirement or capability for IHFR to interface with MSE. IHFR supports secure voice systems requiring a long-range capability and replaces the AN/PRC-47, AN/PRC-74, AN/GRC-165, and the stand-alone AN/GRC-106 radios. IHFR is fielded in three configurations:

- AN/GRC-193A (100 or 400 watt selectable (vehicular) HF radio).
- AN/GRC-213 (20 watt manpack/vehicular HF radio).
- AN/PRC-104 (20 watt manpack radio).

c. SINCGARS is a new family of VHF-FM radio sets which provide secure voice and data transmission capability to the commander. SINCGARS radio sets replace VRC-12 series radios on a one-for-one basis. The Battlefield Electronic CEOI System (BECS) is the frequency management tool for SINCGARS. SINCGARS can transmit voice and data across a broad frequency spectrum using a frequency-hopping technique. This technique results in a decreased threat of degradation associated with nuclear/ nonnuclear combat and electronic countermeasures (ECM). SINCGARS interfaces with MSE through the net radio interface (NRI) located in selected SENSs or LENSs. Table 2-1 shows the SINCGARS replacement plan (as determined through the operational facility (OPFAC) process).

Table 2-1. SINCGARS replacement plan.

SINCGARS MODEL	CONFIGURATION	REPLACES
AN/PRC-119	MANPACK	AN/PRC-25/77
AN/VRC-87	VEHICULAR SHORT-RANGE	AN/VRC-53/64
AN/VRC-88	VEHICULAR SHORT-RANGE DISMOUNTABLE	AN/GRC-125/160
AN/VRC-89	VEHICULAR LONG-/ SHORT-RANGE	AN/VRC-12/47
AN/VRC-90	VEHICULAR LONG-RANGE	AN/VRC-43/46
AN/VRC-91	VEHICULAR LONG-RANGE DISMOUNTABLE SHORT-RANGE	AN/GRC-160/125 AN/VRC-46
AN/VRC-92	VEHICULAR DUAL LONG-RANGE (RETRANSMIT)	AN/VRC-45/49
AN/ARC-201	AIRBORNE TRANSCEIVER	AN/ARC-54/131 AN/ARC-114 AN/ARC-186 (VHF-FM)

d. CNR operations in the MSE signal brigade/battalion are conducted in six networks. These nets provide the signal commander a means to communicate C^2 information and engineering of signal assets. Companies operate their own command/engineering nets but may not have their own SENs and RAUs operating in the same net. SENs and RAUs operate in the net of the company operating the NS to which they are connected. Node management communications are always accomplished on the company command/engineering net of the company to which they are assigned/ operational control (OPCON). NSs and LENs normally operate on their battalion's engineering net. Figures 2-7 through 2-12 show the structure of radio nets in the corps and division signal battalion.

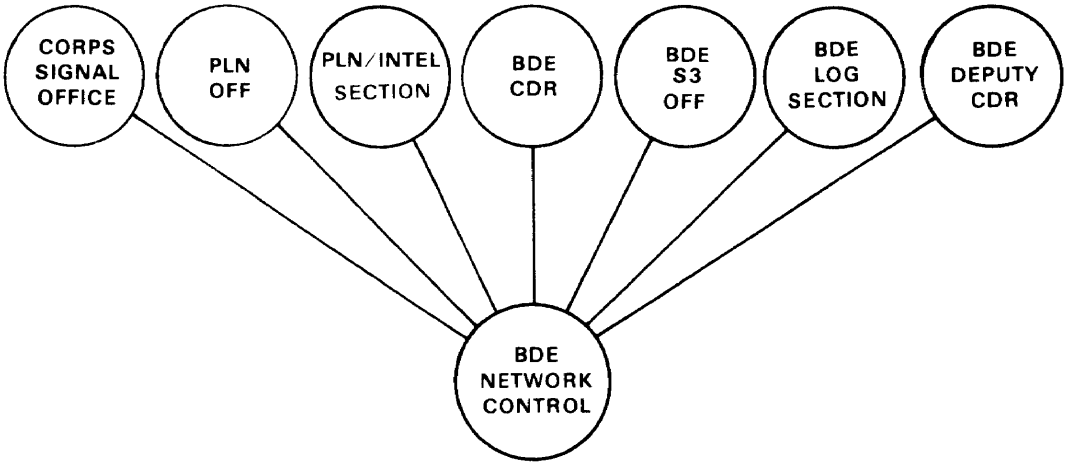

Figure 2-7. Corps signal brigade command/operations FM net.

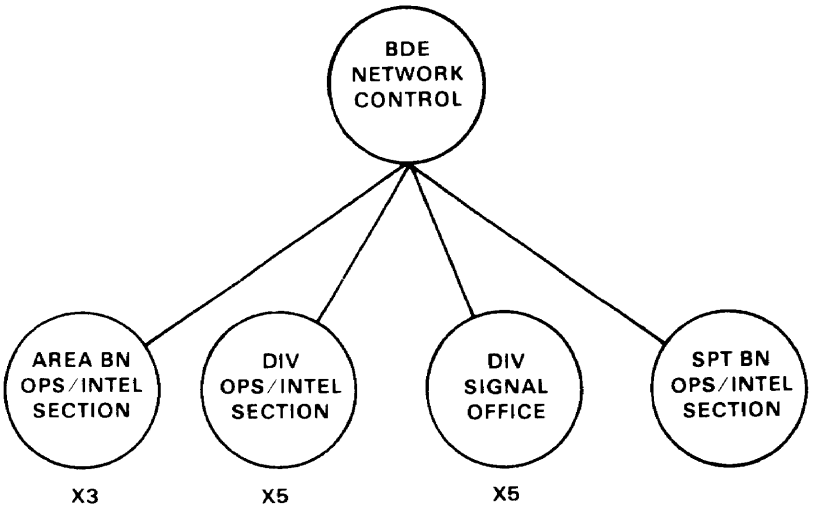

Figure 2-8. Corps signal brigade operations HF net.

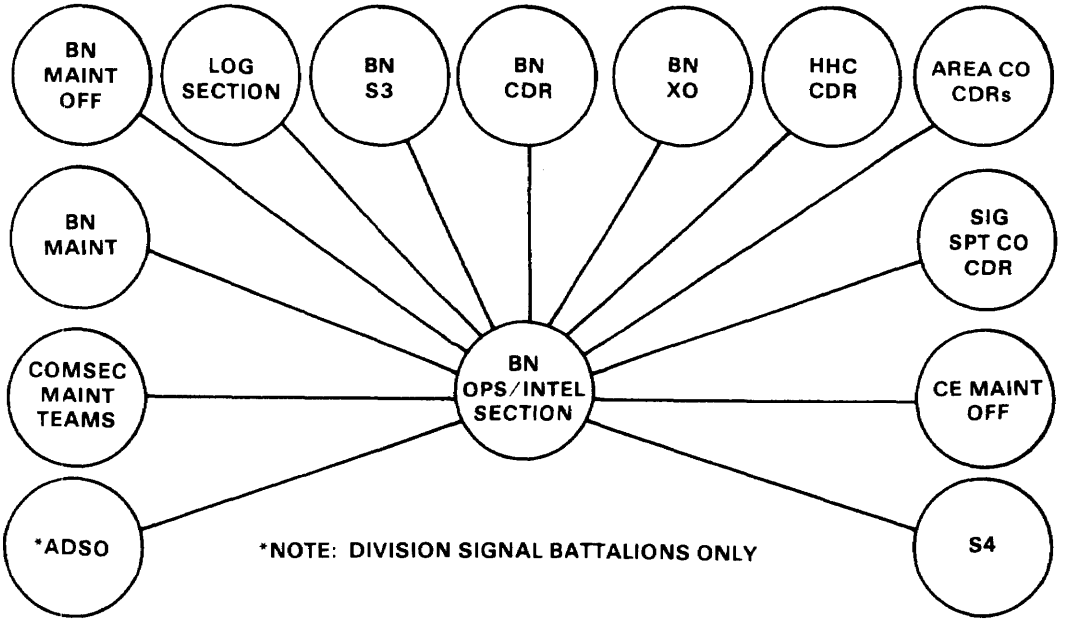

Figure 2-9. Corps and division MSE battalion command/operations FM net.

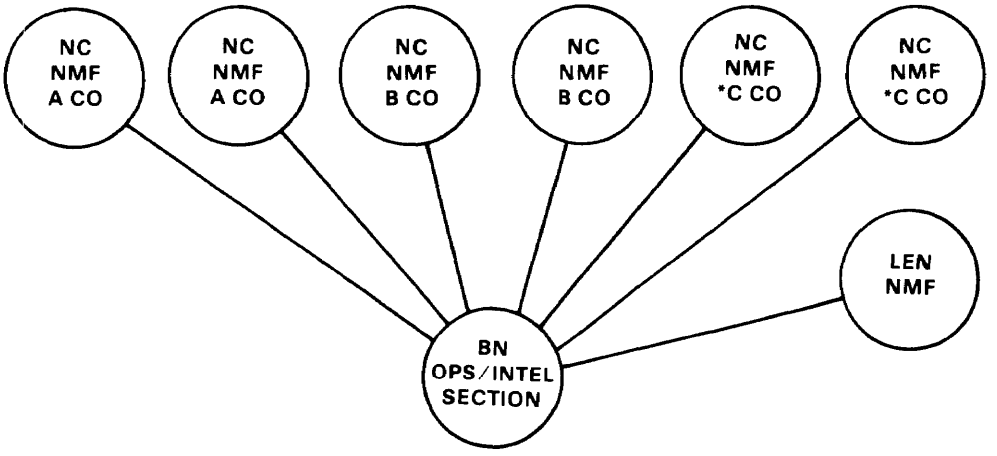

Figure 2-10. Corps and division MSE battalion's engineering net.

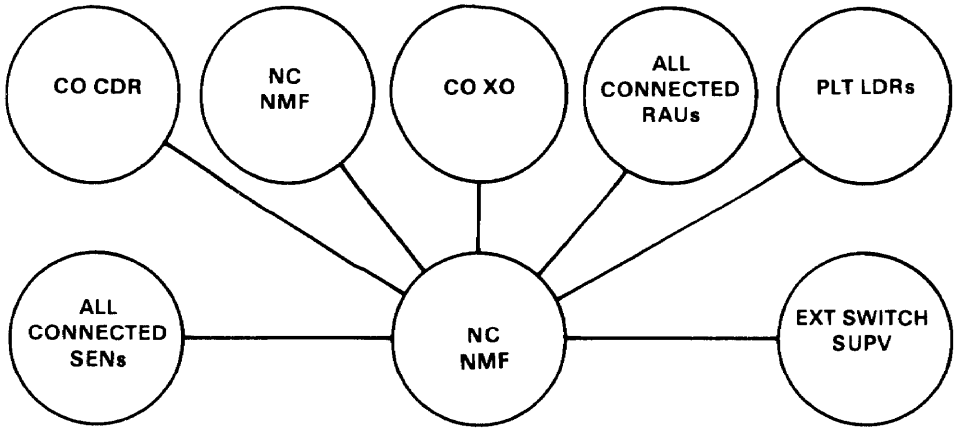

Figure 2-11. MSE company command/engineering net.

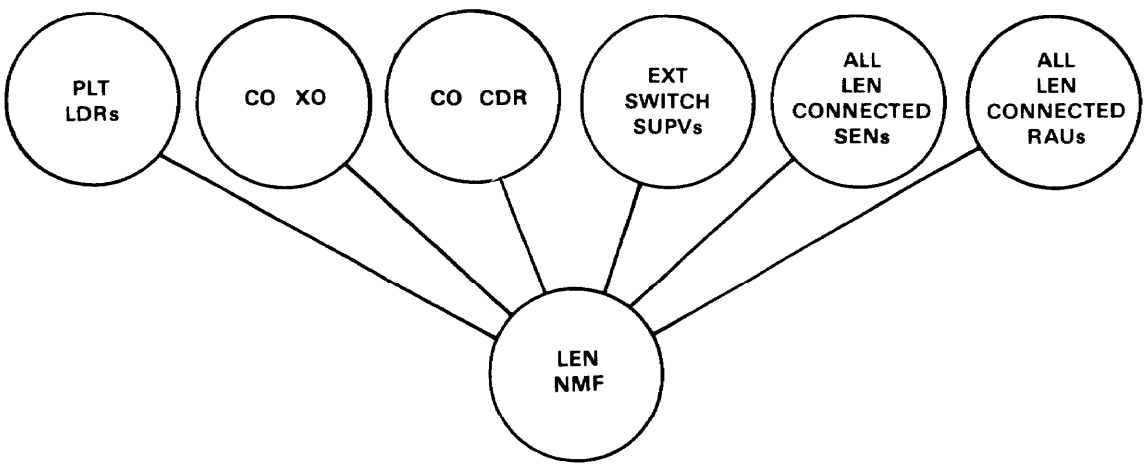

Figure 2-12. All MSE signal support companies command/engineering nets.

2-4. ADDS

a. Enhanced Position Location Reporting System (EPLRS) is a system for data distribution on the battlefield. EPLRS is a computer-based communications system designed to provide secure, jam-resistant, contention free, near real-time data transmission and distribution to subscribers. Additionally, EPLRS provides unit identification, navigational aids, and the automatic location reporting of tactical combat and CS forces. EPLRS uses integral dual level (CONFIDENTIAL/ SECRET) cryptographic security with over-the-air rekeying (OTAR), frequency hopping, and error correction encoding as ECM protection. An EPLRS community consists of a net control station-EPLRS (NCS-E) and up to 460 EPLRS user units (EPUU) operating on eight UHF frequencies from 420 to 450 MHz.

(1) Three host computer interfaces are available to connect data transfer devices to the EPUU. This allows direct information transfer from the sending computer to the receiving computer at data rates of up to 1.2 kb/s. These interfaces are--

- Standard interface X.25 - Most Army users and all new automated systems.

- Single-channel frequency shift keying (FSK) - Tactical Fire Direction System (TACFIRE), TPQ-36/37, automatic target hand off system.

- Data bus interface 1553 - Tracked vehicle and aviation applications.

(2) Division EPLRS architecture calls for 4 NCS-E and 12 EPLRS grid reference units (EGRU) to support a four EPLRS community array where each community covers a brigade-sized area. The NCS-E and GRUs are division signal battalion assets.

b. The Joint Tactical Information Distribution System (JTIDS) is an advanced radio system. It provides information distribution, position location, and identification capabilities in an integrated form for application to tactical military operations. The system distributes encrypted information at high rates and is resistant to jamming in a hostile electromagnetic environment. It can interconnect scattered sources and users of information. JTIDS also provides surface and airborne elements with a position location capability (within a common position reference grid) and a basic identification capability through the distribution of secure position and identity information.

c. The MSE packet network (MPN) is an ADDS using packet switching technology overlaid on the MSE area common-user voice network. With so many battlefield automated systems (BAS) on the AirLand Battlefield and their immediate need for a viable, responsive means of transmission, MSE was given the mission. The MPN will consist of packet switch nodes (PSNs) in each SENs, LENs, and NS. The PSNs form a network dedicated to data traffic. The user connects his BAS to the PSN at his location and sends data traffic to other authorized systems. Gateways connect the corps network to adjacent corps and EAC. Current plans require the BAS to use X.25 (standard) and transmission control protocol/internet protocol (TCP/IP) to ensure compatibility between systems/networks. The MSE system dedicates four trunks between NCs, two trunks on each link to a LEN, and one trunk to each SEN for connectivity. This allows a 16 kb/s flow of data from the SENS and a 64 kb/s flow from LENSs and NCs.

2-5. Battlefield Considerations

a. Deep operations are hampered by maneuver, fires, or command, control, and communications countermeasures (C^3CM). Complicated problems occur when the corps/division communications system must support a large maneuver unit with the mission of deep operations. Figure 2-13 shows a technique for extending MSE to provide C^2 for deep operations. MSE connectivity can be extended to the enclaves (islands of activity) through multichannel TACSAT, multichannel HF, TROPO, or host nation assets. There is an implied mission of enhanced site security in this scenario. Given the vulnerability of MSE sites to enemy action, communications redundancy becomes the key to success. TACSAT, HF, and FM must be included to complement MSE communications.

b. Close operations take place in the most lethal area of the battlefield. Because of the high potential for battle damage, signal planners must consider plans for renewal/recovery. MSE's flexibility and the SCC planning capability help signal leaders meet this challenge.

c. Rear operations present the signal leader with the most challenging problems on the AirLand Battlefield. These challenges exist in the need to provide area and site defense. CPs and signal sites have a greater responsibility for site defense. This means that all signal leaders must be tactically and technically proficient. Signal soldiers must reflect this tactical excellence. When the rear CP is deployed separately within the corps or division area, rear support can be provided by using a SEN from corps or division assets. Force CS and CSS are coordinated using a combination of MSE (area), FM and HF (CNR), and EPLRS (data).

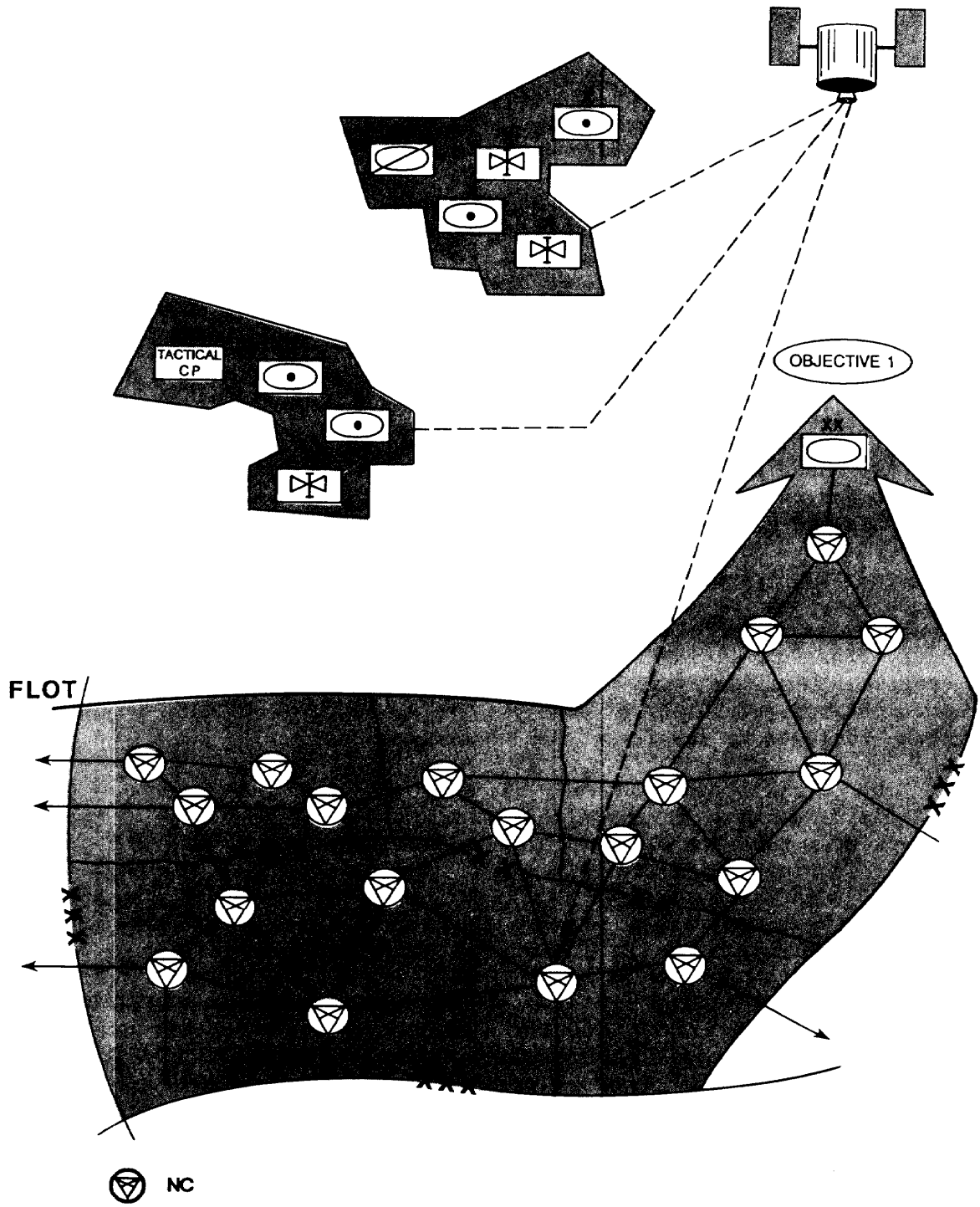

Figure 2-13. Extended MSE for C^2.

d. FMs 11-37, 11-38, 11-50, and 11-92 address node site requirements, MSE employment, and signal site security.

2-6. Conclusion

MSE is only one part of a three-part force communications architecture (see Figure 2-l). While corps and divisions require three types of tactical communications, MSE will carry the vast majority of the voice and data transmissions for these units to support C^2 and sustainment. MSE provides very limited support for corps and division deep operations. Its main contribution is to corps and division close and rear operations. With advice from the signal staff, the commander is responsible for using communications systems to best support his units. This support maximizes the units' chances for mission success.