CJCSM 6231.02A
1 August 1998

MANUAL FOR EMPLOYING JOINT TACTICAL COMMUNICATIONS

JOINT VOICE COMMUNICATIONS SYSTEMS

JOINT STAFF
WASHINGTON, D.C. 20318

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CHAIRMAN OF THE JOINT CHIEFS OF STAFF MANUAL

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MANUAL FOR EMPLOYING JOINT TACTICAL COMMUNCATIONS

JOINT VOICE COMMUNICATIONS SYSTEMS

References: See Appendix N.

1. Purpose. CJCSM 6231.02A provides information and guidance to personnel involved in the planning, engineering, installation, and management of circuit switches that are employed in support of joint exercises and contingency operations. The following major topics are addressed:

a. Tactical circuit switch technical and functional descriptions and features.

b. Numbering systems and plans and routing.

c. Network planning considerations.

d. Circuit switch planning and database entries.

e. Telephone subscriber and circuit switch interfaces.

f. AN/TTC-39 series switch trunk interfaces.

g. Circuit switch interface planning guides.

h. Red switch interconnectivity.

2. Cancellation. This manual supersedes CJCSM 6231.02, 29 December 1995, "Joint Voice Communications Systems."

3. Applicability. This manual applies to:

a. The combatant command or JTF J-6 directorate (or equivalent office) responsible for joint communications management in a deployed JTF.

b. Components and the assigned joint communications support organization in a JTF.

4. Request for Changes. Change recommendations to this manual should be forwarded to:

Joint Interoperability and Engineering Office
Attn: JEBBB
Fort Monmouth, NJ 07703-5613

5. Summary of Changes

a. Appendix H, devoted to the circuit switch routing task execution plan (CSR TEP), was deleted and its information was incorporated into other chapters and appendixes.

b. CSR TEP circuit cards information was moved from Appendix H to Appendix D.

c. Information about software registration was added.

d. CSR TEP planning factors were moved from Appendix H.

e. Old Appendixes D and L were deleted.

f. An Enhanced Switch Operations Program and Global Database appendix (J) was added.

g. A Theater Deployable Communications appendix (B) was added.

h. The information on the AN/TTC-39A(V)1 was moved from Chapters II and V to Appendix A.

i. Chapter III was revised to reflect the numbering and routing changes resulting from fielding of the circuit switch routing TEP.

j. Information on the secure telephone equipment (STE) was added to Appendix C.

k. Information on T1 and E1 cards was added to Section F of Chapter II.

l. A Duplication and Bypass (Appendix K) was added.

m. JPAL content from Appendix H was moved to Appendix L.

n. An introduction to Asynchronous Transfer Mode (Appendix M) was added.

o. Internet addresses containing additional information were added.

6. Releasability. This manual is approved for public release; distribution is unlimited. DOD components (to include the combatant commands), other Federal agencies, and the public may obtain copies of this manual through the Internet from the CJCS Directives Home Page--http://www.dtic.mil/doctrine/jel/cjcsd.htm. Copies are also available through the Government Printing Office on the Joint Electronic Library CD-ROM.

7. Effective Date. This manual is effective upon receipt.

For the Chairman of the Joint Chiefs of Staff::

DENNIS C. BLAIR
Vice Admiral, U. S. Navy
Director, Joint Staff

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CHAPTER I

INTRODUCTION

1. General. This chapter discusses the voice communications systems used in a joint tactical circuit-switched network to support joint task force (JTF) exercises and contingency operations. The cornerstone of tactical voice communications systems is the AN/TTC-39-based series of circuit switches (CS), which includes the AN/TTC-39A(V)1, AN/TTC-39A(V)3, AN/TTC-39A(V)4, AN/TTC-39D, and AN/TTC-39E. Therefore, much of this volume has been devoted to coverage of the AN/TTC-39 series and the hardware and software changes resulting from the Circuit Switch Routing Task Execution Plan (CSR TEP). Coverage is also provided on the unit level circuit switches (ULCS), AN/TTC-42, and SB-3865, developed under the Tri-Service Tactical Communications (TRI-TAC) program and the Army's mobile subscriber equipment (MSE) program, which provides area common-user support at echelons corps and below (ECB) and has a limited application at echelons above corps (EAC) (theater). Finally, information is provided on existing inventory analog equipment to ensure that the planner-engineer has a ready reference for interconnecting the new circuit switches with legacy inventory equipment.

2. Organization. This volume provides the necessary material and references required to support the planner-engineer in planning and engineering voice communications systems used in the generic JTF communications network depicted in Figure I-1. The relationship of this publication to the others in the CJCSM 6231 series is shown in Figure I-2. Emphasis is placed on the following areas:

a. Providing functional and technical descriptions of the AN/TTC-39 series, as well as ULCSs and MSE switches.

b. Planning and engineering considerations for a circuit-switched network. Information on interfaces between the AN/TTC-39 series circuit switch, AN/TTC-42, SB-3865, MSE, and existing analog switches and switch-boards are provided in Appendix E. Database entries and worksheets that must be considered for network planning are also discussed, along with guidelines for sizing trunk groups between interconnected circuit switches.

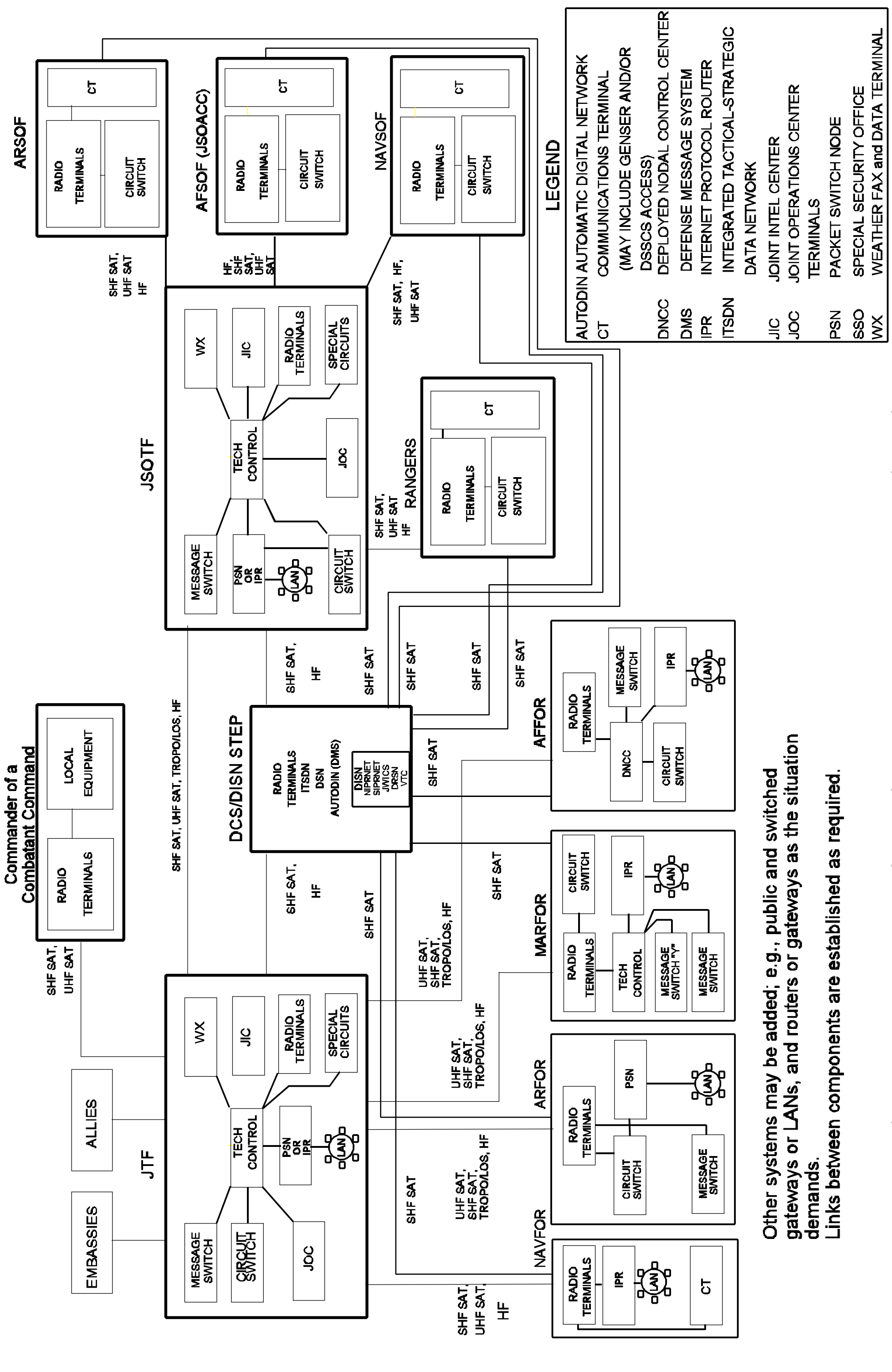

Figure I-1. Generic Joint Task Force Communications Systems

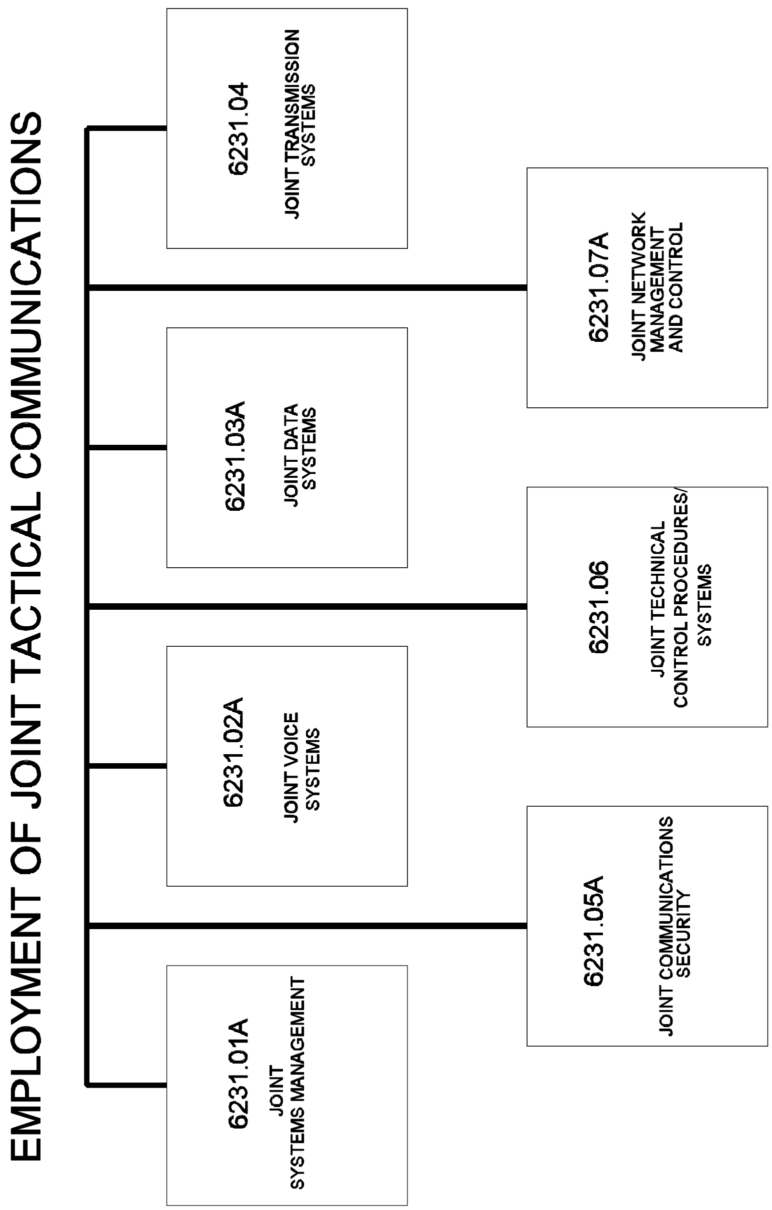

Figure I-2. CJCSM 6231 Publications

3. Tactical Circuit-Switched Systems. Commanders require highly sophisticated communication systems that are being fielded to meet C4 operational requirements. The trend toward greater use of digitized voice terminals and switching systems ensures increased capabilities for end-to-end security, flexibility, and responsiveness. As a result, the system planner-engineer must understand digital networks, systems, equipment and techniques, and joint interoperability requirements.

4. Joint Tactical Circuit-Switched Networks. A CBCS switch or the AN/TTC-42 can support the JTF HQ. Army forces (ARFOR) will employ the AN/TTC-39D. Air Force forces (AFFOR) will use the AN/TTC-39A(V)4. Marine forces (MARFOR) will use the AN/TTC-42 or, under the provisions of a memorandum of understanding with the Air Force, an AN/TTC-39A(V)4. The joint special operations task force (JSOTF) will use the AN/TTC-39A(V)3 or AN/TSQ-188. The Army special operations forces (ARSOF), Air Force special operations forces (AFSOF), Rangers, and Naval special operations forces (NAVSOF) will use the AN/TTC-39E (CDS), SB-3614A, or SB-3865 switchboards. In planning and implementing joint system requirements, the planner-engineer must pay special attention to the diversity of capabilities (and limitations) provided by these switches.

5. Network Management. When planning or reconfiguring a sophisticated circuit-switched network, the planner-engineer must be aware of all factors affecting its performance. CJCSM 6231.07A contains information that the planner-engineer may use to interpret circuit-switch status reports. This volume also provides details on managing an automatic, joint tactical circuit-switched network.

6. Software Registration. Information in this manual about CBCSs is based on the certified software baseline in use at the time of publication. Organizations employing switch multiplexer units (SMUs) or CDSs should notify the Executive Agent for Joint Tactical Switched Systems (EA-TSS) at the earliest opportunity if they intend to continue their use with appropriate certified software baselines. Telephone numbers are DSN 992-8052 or 8053, commercial (732) 532-8052 or 8052, DSN FAX 992-5513 or 3065, and commercial fax (732) 532-5513 or 3065. The notification is required so that a determination can be made whether or not the systems have the necessary post deployment software support (PDSS) agreements in place. Some users may be operating under the impression that systems they are employing are covered by PDSS when they are not. Organizations intending to purchase

circuit switches must coordinate their purchases with PDSS and other organizations prior to purchase to ensure proper software support. Organizations with ongoing acquisitions should contact PDSS at DSN 992-5838 to register their purchase and obtain upgrades and notices regarding software changes.

7. Additional Information. Information contained in this manual may change after this manual is published but before the next revision. Several organizations maintain home pages that contain the most current information and additional related information. Information pertaining to switch software and related procedures is maintained by EA-TSS at the following addresses:

http://eatss1.sed.monmouth.army.mil and
http://eatss.cecom1.army.smil.mil

The software engineering directorate home page is found at:

http://www.sed.monmouth.army.mil

Information about test results, lessons learned, and other information about tactical circuit switch testing is maintained by the Joint Interoperability Test Command at:

http://jitc-emh.army.mil and
http://207.132.160.252/honor/jitc.htm or
http://199.208.204.125/jitc.htm

The Joint Communications Support Element maintains current information relevant to its operations at:

http://www.jcse.macdill.af.mil

The Air Force "Index of Deployable C4I" is found at:

http://www.afca.scott.af.mil/seminars/xpxrman/indexp.htm

the Army Signal Command home page is located at:

http://138.27.190.13/asc_main.html

Network management information may be found at:

http://www.gordon.army.mil/tsmnm

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CHAPTER II

TACTICAL CIRCUIT SWITCH DESCRIPTIONS

1. Introduction. This chapter discusses the principal voice communications systems employed in a joint tactical circuit-switched network to support JTF exercises, deployments, and contingency operations. The current generation of major CS systems evolved from the Tri-Service Tactical Communications Program which began in 1971.

a. In the early 1980s, the Army and Air Force began fielding the AN/TTC-39, a hybrid switch with two space division (analog) switching matrixes (SDMX) and one time division (digital) matrix (TDMX). Fielding of the AN/TTC-39 significantly enhanced tactical voice communications, providing the capability to install a robust, hybrid (analog and digital) backbone network. This afforded the flexibility to interface with the myriad of automatic, semiautomatic, and manual analog switchboards in the Services' inventory. The concurrent fielding of enhanced digital transmission systems capable of extending large digital transmission groups (DTGs), initially maximized, but eventually outpaced the digital trunking capacity of the AN/TTC-39.

b. By the late 1980s, the Army and Air Force had begun transitioning to the AN/TTC-39A(V)1, a hybrid switch with one analog and two digital matrixes. In addition, the Joint Communications Support Element (JCSE) procured two AN/TTC-39A(V)3s, a downsized version of the AN/TTC-39A(V)1 with a single digital matrix. The AN/TTC-39A(V)3 operates using the AN/TTC-39A(V)4's operational software.

c. During Operations DESERT SHIELD and DESERT STORM, the Army, Air Force, and JCSE AN/TTC-39A(V)1s and the Marine Corps AN/TTC-42s were employed to establish the theater circuit switch network. In a theater devoid of a communications inventory, these switches successfully interfaced with and supported the strategic and tactical users, meeting the joint C4 operational requirements. Operation DESERT STORM coincided with the Army and Air Force fielding plans for divergent product improvements to the AN/TTC-39A(V)1, the AN/TTC-39D, and the AN/TTC-39A(V)4.

d. In 1991 and 1992, the Army began fielding the AN/TTC-39D to its EAC signal units. The initial version of the AN/TTC-39D was a fully digital, 16 kbps circuit switch that used flood search routing and a deducible directory numbering system to support its subscribers. Digital line termination units (DLTUs) replaced the space division switching group to interface analog trunks and loops with the digital matrix. The AN/TTC-39D was developed to support the Army's AirLand Battle operational concept and provide compatibility with the MSE system employed at ECB. Gateway area codes were required to interface flood search and deterministic routing networks.

e. Concurrent with the Army's fielding the AN/TTC-39D, the Air Force began fielding the AN/TTC-39A(V)4, a 32/16 kbps digital, deterministic routing switch, which, like the AN/TTC-39D, uses DLTUs to interface analog circuits.

f. The Marine Corps enhanced its circuit switching capability by replacing the AN/TTC-38 with the AN/TTC-42, a digital, deterministic routing switch that can operate at either 16 or 32 kbps. The Marine Corps also fielded the SB-3865, a digital, team transportable switchboard. Both switches also provide automatic and semiautomatic switching for analog subscribers and were developed as part of the TRI-TAC Unit Level Circuit Switch (ULCS) program. The Air Force has also procured the AN/TTC-42 and SB-3865.

g. In 1996, the Circuit Switch Routing Task Execution Plan (CSR TEP) began its incorporation in the following switches: AN/TTC-39D, AN/TTC-39A(V)4, AN/TTC-39A(V)3, AN/TTC-46, AN/TTC-47, AN/TTC-50, AN/TTC-39E (CDS), SMU, and Digital Switch (part of AN/TSQ-165). It was not implemented in the AN/TTC-39A(V)1, AN/TTC-42, SB-3865, and SB-3614A. (See Subsection 2 below.)

h. The focus of this chapter is those Service-level switches that will most likely be required to support JTF exercises or contingency operations AN/TTC-39A(V)3, AN/TTC-39A(V)4, AN/TTC-39D, AN/TTC-39E, and AN/TTC-42). It should be recognized that a non-TRI-TAC switch may be the initial switch employed; therefore, coverage of MSE, SB-3865, SX-50, Transportable TROJAN Mini Switch, and Digital Switch is also included. Information on the AN/TTC-39A(V)1 and existing inventory analog-based switchboards, such as the SB-3614 and SB-3614A, is found in Appendixes A and C respectively.

2. <u>Common Baseline Circuit Switches</u>

a. <u>Introduction</u>. The CSR TEP was proposed by the Army in 1993 as a result of the concerns expressed by the joint community regarding the fielding of the AN/TTC-39D at EAC. Introduction of the AN/TTC-39D, which operated at 16 kbps and employed flood search routing, required a gateway interface to interoperate with other joint circuit switches that operated at 32 kbps and used deterministic routing. Mixing flood search and deterministic networks required the use of separate area codes in each network. Because it was standard practice to employ deterministic switches in support of the JTF, employment of the AN/TTC-39D to provide this support would result in a proliferation of area codes and impose other operational limitations. Although it is possible to reconfigure the AN/TTC-39D to emulate an AN/TTC-39A(V)4 for deterministic routing, the Army chose not to procure the required AN/TTC-39A(V)4 tapes. In its place, the TEP was proposed. The TEP is incorporated in the following switches: AN/TTC-39D, AN/TTC-39A(V)4, AN/TTC-39A(V)3, AN/TTC-46, AN/TTC-47, AN/TTC-50, AN/TTC-39E (CDS), SMU, and Digital Switch (part of AN/TSQ-165). It was not implemented in the AN/TTC-39A(V)1, AN/TTC-42, SB-3865, and SB-3614A.

b. Specific Routing Problems. The CSR TEP solved the following basic routing problems.

(1) The AN/TTC-39D did not allow for tandem routing from a deterministic network and back into the same network using the same area code.

(2) Separate area codes were required between the AN/TTC-39D and PBXs, message switches, and other deterministic routing networks.

(3) Noncontiguous AN/TTC-39D and MSE switches required separate area codes.

(4) Routing into a deterministic network with one area code split into two pieces either through design or equipment failure was not possible.

(5) Crossing area code boundaries had to be done deterministically.

(6) Deterministic switches had to be placed in separate area codes.

(7) Flood search networks prohibited calls from exiting and reentering the same area code.

3. Routing Improvements

a. The CSR TEP provides software, resident in the Litton processor, which performs both the switching and flood search routing functions.

b. The AN/TTC-39D can operate at 32 kbps. Flood search routing has been placed in the AN/TTC-39A(V)3, AN/TTC-39A(V)4, and CDS/SMU switches.

c. Flood search software allows routing across area code boundaries using an improved flood search/deterministic routing scheme.

d. The flood search algorithm was modified to add the capability to base the gateway routing on the NNXX and/or a range of NNXX codes rather than only the area code. The NNXX code of the foreign switch must not overlap with the LNXX codes of local subscribers in the flood search network. The Global Block Numbering Plan (GBNP) (see Chapter III, paragraph 2q) must be implemented with the CSR-TEP to preclude NNXX contention between flood search and deterministic subscribers and to allow deterministic switches to route into the flood search network. (See Chapter IV, paragraph 14 for more details on CSR TEP planning.)

e. The TEP provides the following improvements to solve the gateway routing problems:

(1) Provide 5 home NATO (9YX) area/foreign NYX codes, each with 10 assignable pairs of NNXX codes (50 total assignments).

(2) All routes with one primary and two alternates.

4. Common Software Baseline. The TEP provides for a common software baseline for the switches noted in paragraph 1 above.

5. Flood Search Networks at 16 and 32 kbps. The TEP'd switches are capable of operation at either switch rate.

6. Hardware Changes and Improvements. See Table II-1 and paragraph 6, Appendix D.

7. Other CSR TEP Features

a. New online database save capability.

b. Switches can flood search on 16 or 32 kbps.

c. Expanded subscriber profile.

d. New command provides flexibility to manage subscriber entry into network.

e. Converted subscriber features.

(1) Elimination of abbreviated dialing.

(2) Reduction of compressed dial lists.

(3) Reduced zone restriction inside of area code.

(4) Preaffiliation lists for subscriber numbers.

Table II-1. Summary of CBCS Hardware Changes

	39D	39A(V)3	39A(V)4	NCS	LENS	FES	DS	CDS & SMU
Common Software to Operate Baseline	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MTT-Replacement Part of Retrofit Kit	No	Yes	Yes	No	No	No	No	No
MTT-Wiring Changes to TDSG Nest	No	Yes	Yes	No	No	No	No	No
MTT-Remove MTTs, Install Disk Drives	No	Yes	Yes	No	No	No	No	No
MTT-Install Two IOSL CCAs	No	Yes	Yes	No	No	No	No	No
Install RSB/DA CCAs & Number Required 1/	4	4	4	5	4 2/	5	4	0
Install RSBC CCAs & Number Required 1/	0	0	0	0	0	0	0	2
RSB/DA-Wiring Change to TDSG Nest	No	No	No	Yes	Yes	No	No	No
RSB/DA-Wires to CAP	No	No	No	Yes	Yes	No	No	No
RSB/DA-Cable for Workstation	No	No	No	Yes	No	No	No	No
Litton Quad Memory Card(s)	2	2	2	1	1	1	1 (Wiring Changes)	No
Removal of RSS-D	Yes	No	No	Yes	Yes	Yes	No	No
Blank Power Over RSS-D Location	Yes	No	No	Yes	Yes	Yes	Yes	No
AKDC PROM Update	No	Yes	Yes	No	No	No	No	No
Workstation Interface Controller (WIC) Required	No	No	No	No	No	No	No	Yes
Use Existing Tadiran VDT	No	Yes	Yes	N/A	N/A	N/A	N/A	N/A

1/ RSB/DA and RSBC CCA Quantities Reflect the Quantity Plus 1 Spare for Each Switch Type
2/ Provides 4 Flood Search DTGs Plus 1 DTA; Current LEN Only Supports 2 Flood Search DTGs Plus 1 DTA

SECTION A

AN/TTC-39A(V)3 DESCRIPTION

1. Introduction. The AN/TTC-39A(V)3 is a downsized variant of the AN/TTC-39A(V) 4. The AN/TTC-39A(V)3 uses the AN/TTC-39A(V)4 operational software. The JCSE has the only two AN/TTC-39A(V)3 switches.

2. Functional Description. The AN/TTC-39A(V)3 is a mobile, easily transportable automatic communications switching system used to provide automatic circuit switching service and nodal control functions to both analog and digital traffic. The system is modular, permitting the switch supervisor to reconfigure the switch with various mixes of analog and digital terminations. The switch accommodates 144 analog or digital single lines and 16 DTGs in a single switching module. The shelter contains the communications and nodal control equipment, including switching modules, COMSEC equipment, central processor group, magnetic tape units, common equipment group, line interface equipment, ALCG, atomic standard, modems, orderwire control panel, call service position (CSP) and supervisory control terminal, and intercom equipment.

3. Technical Description. The principal equipment in the AN/TTC-39A(V)3 is as follows.

a. TDSGM. There is a single TDSGM switching module. The TDSGM termination allocation is as shown in Table II-2.

b. CAP Panel and Supervisory Control Terminal

c. Floppy Disk Drives. There are two floppy disk drives in the AN/TTC-39A(V)3.

d. Central Processor Group. The CPG consists of two CPUs.

e. Common Equipment Group

f. Analog Line Conditioning Group

g. COMSEC Group. The switch contains the population of COMSEC equipment depicted in Table II-3.

Table II-2. TDSGM Termination Allocation

Function	Terminations
External local directly connected subscribers	76
External loop Mux/DEMUX subscribers	68
Subtotal external local subscribers	144
DTG group terminations	676
DTG group terminations	68
Subtotal external local/DTG terminations	722
CBU	30
CBU test (570 Hz test card)	1
Digital receivers/scanner test (shared)	28
CSP (signaling channel plus 2 voice channels)	3
LKG (32 plain text, 32 cipher text)	64
TSB, DSB	16
Monitor and test	3
Data communications interface	16
DSVT (shelter)	1
Remote VDT (direct connection)	1
DSDI (CSCE interface)	1
Reserved	21
CBU (2)	(5) (10)
TSB (4)	(4)
RSU (7)	(7)
Spare	53
Subtotal internal terminations	238
Total Terminations	960

Table II-3. AN/TTC-39A(V)3 COMSEC Equipment

COMSEC Equipment	Quantity
KG-81	12
KG-82	32
HGX-83A	2
HGX-84	4
KG-83	2
HGX-82	4
HGF-94	3
KY-68	1
KY-57	1
HGF-91	2
CEF	1
TEM	1

h. Line Interface Equipment

(1) Diphase Loop Modem A (DLPMA). The DLPMA is used to terminate diphase loops, such as the KY-68, TA-954, and TA-1042.

(2) Digital Line Termination Units. The switch is populated with the following DLTUs to terminate analog loops and trunks.

(a) 4WLTU - Four

(b) 2WLTU - Nine

(c) EMLTU - Two

(d) TCLTU - Two

(e) MFLTU - Twelve

(f) NILTU - One

(g) PSHTI - Four

(h) RSCD - One

(3) PSHTI

(a) External Interface. The PSHTI provides full duplex transmission of digital data signals for transmission rates of 16, 32, or 64 kbps and interfaces with the data communications network.

(b) Electrical Interface

1. In the trunk mode, up to four dedicated switch terminations are multiplexed or demultiplexed to form a serial data trunk data stream. Manual strapping is required to configure the PSHTI Mux/Demux for the definitions shown in Table II-4.

Table II-4. PSHTI Trunk Interface Definitions

Signal	Source	Destination	Description
Tx Data	PSHTI	SEP	Send Data
Tx Com	PSHTI	SEP	Send Common
Rx Data	SEP	PSHTI	Receive Data
Rx Com	SEP	PSHTI	Receive Common
Tx Clk	PSHTI	SEP	Send Timing
Rx Clk	SEP	PSHTI	Receive Timing
Sig Gnd	PSHTI	SEP	Signal Ground

2. In the host mode, three dedicated switch terminations are directly interfaced to three host data interfaces. These interfaces are directly connected to the RSCD CCA as described in 3 below.

3. RSCD

a. External Interfaces. The RSCD provides full duplex transmission of digital data signals for transmission rates of 16 or 32 kbps and interfaces with the data communications network. The transmission mode is conditioned diphase.

b. Electrical Interface. The RSCD CCA contains three circuits that provide full duplex conversion for the three host data channels. Each circuit provides conversion between RS-423, unbalanced, synchronous, 7-wire input and output of the PSHTI CCA, operating in the host mode, and a 4-wire, balanced, conditioned diphase external circuit. Table II-5 defines the conditioned diphase interface.

Table II-5. RSCD Conditioned Diphase Interface Definition

Signal	Source	Destination	Description
Diphase Data In	SEP	RSCD	Received Diphase Carrier
Diphase Data Out	RSCD	SEP	Transmitted Diphase Carrier

4. Patching

a. The AN/TTC-39A(V)3 patch facility provides normal through patch jacks for 144 loop circuits and for 12 TEDs, both input side and output side. All loop patching contains a monitor jack. In addition, 16 DTG ports require coaxial jumper plugs for normal operation. Jack terminations for both inputs and outputs of 12 analog line conditioning circuits are provided. Twenty six pairs of push-pin connectors are mounted on the SEP. No patching is provided for data communication circuits. All patching is used to provide loop backs for equipment testing, when required. Table II-6 depicts the TED-DTG assignments.

b. Loop patching is used to modify the normal SEP to LTU connection, to correct for external wiring deficiencies, insert line conditioning equipment in tandem with the line, or swap out failed equipment. Any loop may be patched to the push-pin connectors mounted on the SEP in lieu of its normal through connection to the SEP.

c. DTGs must be patched from equipment to SEP for normal operation. This patching is accomplished straight through using coaxial jumper plugs that contain a monitor jack. The normal arrangement may be modified to correct for external wiring deficiencies or to swap out failed equipment. TED patching is used to swap out failed TEDs or to bypass a TED that is not required for a given circuit.

Table II-6. AN/TTC-39A(V)3 TED-DTG Assignment

Wire Duct		
TED 1	TED 2	TED 3
DTG 1	DTG 2	DTG 3
TEM		
TED 7 DTG 4	TED 8 DTG 5	TED 9 DTG 6
TED 10 DTG 16	TED 11 DTG 17	TED 12 DTG 18
TED 13 DTG 19	TED 14 DTG 20	TED 15 DTG 21

d. Table II-7 is a listing of the AN/TTC-39A(V)3's common equipment.

Table II-7. Digital Common Equipment Addressing

Signaling Buffers DSB TT-110, TSB TT-117

Trunk Type	TSB	Address	Notes	Trunk Type	TSB	Address	Notes
TSB TSB	2 3	01-01 01-02		TSB TSB	17 18	07-01 07-02	
TSB TSB	4 5	01-03 01-04		TSB TSB	19 20	07-03 07-04	
TSB TSB	6 7	01-05 01-06		TSB TSB	21 22	07-05 07-06	
DSB DSB	8 9	13-00 13-01	2/ 2/	DSB DSB	23 24	15-00 15-01	2/ 2/
DSB DSB	10 11	13-02 13-03	2/ 2/	DSB DSB	25 26	15-02 15-03	2/ 2/
DSB DSB	12 13	13-04 13-05	1/, 2/ 1/, 2/	DSB DSB	27 28	15-04 15-05	1/, 2/ 1/, 2/

NOTE: This table shows the "Group A" configuration as delivered. The CEG tape may assign assets otherwise.

1/ Slot is wired, but DSB is not installed.
2/ DIBTS can be used in any usable TSB slot.

Table II-7. (Cont'd)

Digital Receivers, TT-113

#	Address	#	Address
1 2 3	14-58 14-59 14-60	10 11 12	13-63 04-63 05-63
4 5 6	14-61 14-62 14-63	13 14 15	06-63 15-63 07-63
7 8 9	01-63 02-63 03-63	16 17 18	08-63 09-63 10-63
--	--	19 20	11-63 12-63

NOTE: Digital receivers 1 and 2 are permanently assigned to the LCSP and RCSP 1, respectively. Digital receiver 21 is not used.

Conference Bridges, TT-120

TDSGM	1					
CBU LOC	A527		A529		A531	
	CBU 1	CBU 2	CBU 3	CBU 4	CBU 5	CBU 6
Port 1	13-08	13-13	14-12	14-17	15-08	15-13
Port 2	13-09	13-14	14-13	14-18	15-09	15-14
Port 3	13-10	13-15	14-14	14-19	15-10	15-15
Port 4	13-11	13-16	14-15	14-20	15-11	15-16
Port 5	13-12	13-17	14-16	14-21	15-12	15-17

NOTE: CBUs 5 and 6 are available but the cards are not delivered in the baseline unit.

Table II-7. (Cont'd)

Loop Key Generators, TT-123

Cipher	LKG #	Plain
02-00	1	13-18
02-01	2	13-19
02-02	3	13-20
02-03	4	13-21
02-04	5	13-22
02-05	6	13-23
02-06	7	13-24
02-07	8	13-25
03-00	9	13-26
03-01	10	13-27
03-02	11	13-28
03-03	12	13-29
03-04	13	13-30
03-05	14	13-31
03-06	15	13-32
03-07	16	13-33

Cipher	LKG #	Plain
08-00	17	15-18
08-01	18	15-19
08-02	19	15-20
08-03	20	15-21
08-04	21	15-22
08-05	22	15-23
08-06	23	15-24
08-07	24	15-25
09-00	25	15-26
09-01	26	15-27
09-02	27	15-28
09-03	28	15-29
09-04	29	15-30
09-05	30	15-31
09-06	31	15-32
09-07	32	15-33

SECTION B

AN/TTC-39A(V)4 DESCRIPTION

1. Introduction. The AN/TTC-39A(V)4 is a product improvement of the AN/TTC-39A(V)1.

2. System Improvements in the AN/TTC-39A(V)4. The AN/TTC-39A(V)4 is used only by the Air Force and JCSE.

a. The AN/TTC-39A(V)4 has a reduced card count from the AN/TTC-39A(V)1 and converts the switch to an all-digital configuration.

b. The space division switching group (SDSG) was deleted and the circuit switching function is for analog lines and trunks is performed by the ALTG. The ALTG provides interface capabilities by means of DLTUs. The DLTUs provide the interface between the analog lines and trunks and TDMX, eliminating the requirement for the SDSG. Elimination of the SDSG reduced the switch circuit card inventory by over 40 CCAs.

c. The NATO interface unit (NIU) is replaced by the NATO interface LTU (NILTU).

d. The LSCDM was deleted as it was no longer required because of changed subscriber requirements.

e. The switch will be upgraded to provide a fiber optic capability.

f. The switch was upgraded to CBCS software and flood search routing to help solve routing problems caused when mixing deterministic and flood search routing in the same network. There are now a maximum of six flood search links possible.

3. Functional Description. The AN/TTC-39A(V)4 is a transportable, automatic switching system housed in a modified S-280B/G shelter. The switch is designed to interface with the following systems and switches: (Table II-8 provides a breakout of the termination allocation of the AN/TTC-39A(V)4.)

a. AN/TYC-39.

b. AN/TTC-39 family of switches.

Table II-8. AN/TTC-39A(V)4 Terminal Allocations

Description	Quantity
External local subscribers-directly connected (60 DLTU terminations on ALTG)	64
External local (loop MUX/DEMUX) subscribers on DTG group terminations	176
Total external local subscribers	240
Loop MUX/DEMUX test terminations or DTG group terminations	5
DTG group terminations	467
Total external terminations	712
TSB, NSB, RSB, or DSB (only 28 are addressable)	30
LKG (32 plain text and 32 cipher text)	32
Digital receivers	20
Scanner test	6
DSVT (shelter)	1
CSP, signaling channel, and 2 voice ports	3
Monitor and test terminations	3
CBU, terminals assigned for six 5-port bridges	30
DSDI (CSCE interface)	1
VDTC--provision for operating with remoted	1
local VDT	1
Spare	61
Spare--connected to LDI terminal	3
No connection	12
Total internal terminations	248
Total TDMX terminals (15 TDMM, 64 local)	960

c. DSN.

d. DSN PABXs.

e. NATO analog.

f. AN/TTC-42.

g. SB-3614/SB-3614A.

h. SB-3865.

i. Commercial central offices.

j. Analog terminals and switches.

4. Technical Description. Following are the major equipment items located within the shelter.

a. Analog Line Conditioning Group (ALCG). The ALCG, in conjunction with the auxiliary line termination group (ALTG), provides line conditioning for up to 24 analog interfaces. It also provides delay equalization for up to eight analog interfaces. The ALTG provides interface capabilities for diphase loops, analog interfaces that use LTUs, and common-channel signaling for analog interswitch trunks. The ALCG consists of three major components: a patch panel, analog line conditioning equipment, and equalizers. Patching in the ALCG equipment puts separate line amplifiers in the field transmit (incoming) and field receive (outgoing) signal paths. Incoming line amplifiers are adjustable for gain and attenuation. Outgoing line amplifiers provide only amplification without attenuation. The equalizer, which is patched into the field transmit signal path, corrects amplitude and delay distortion.

b. AN/TTC-39A(V)4 Timing Subsystem. The redundant crystal oscillator has a stability of better than 1×10^{-9} per day over the specified operating and temperature range (-50° to +120°F). The stability of the atomic standard is $\pm 3 \times 10^{-11}$ per day. The rubidium clock's output frequencies are adjustable to within $\pm 1 \times 10^{-12}$ of the desired frequencies. The atomic standard has a rated accuracy of 1×10^{-11} per month and should be calibrated annually. The MTG receives a fault indication whenever the atomic clock fails to generate an accurate reference signal.

c. Central Processing Group (CPG). The CPG performs the functions of processing, routing, and switch control. The CPG contains peripheral interface devices to support operation and maintenance of the switch. The CPG is composed of the following:

(1) Floppy Disk Drives. Two floppy drives are located in the shelter. The floppy drives operate under the

control of two separate Input Output expander to SCSI link circuit cards (IOSL) located in the CPG controller nest.

(2) Processors. There are two processors in the CPG. Each processor is made up of an IOU, a solid-state memory, and a central processing unit (CPU). One processor serves as a backup to prevent operational downtime if the online processor fails. Each processor provides a volatile storage of 525,288, 32-bit words.

(a) Input/Output Unit (IOU). There are two IOUs that control and connect peripheral devices, CPU, and memory. The IOUs are redundant and can be operated independently of each other.

(b) CPU. There are two CPUs responsible for processor arithmetic and control functions.

(3) Status and Control Panel and Controller Nest. The controller nest contains circuit cards for the two MTCs (only one is used), one teletypewriter controller, and two controllers for local and remote VDTs. The nest also includes two COMSEC controllers and two SBCs that are not functionally part of the CPG.

d. VDT. The VDT consists of a visual display, a detachable keyboard, a card cage that contains controller and interface cards, and power supply assemblies. The VDT is the primary operator to machine CPG interface. The system also may be accessed by an RVDT.

e. CSP. The switch contains one local CSP and up to three remote positions located no more than 100 meters from the shelter.

f. Control and Alarm Panel/Control Electronics Module (CAP/CEM). The CAP/CEM panel provides a visual indication of current system status and configuration. The CAP portion provides a summary status display of the switch, and the CEM portion provides a section for manual selection of the processor controller/peripheral configuration. Included on the panel is a section that indicates the status of the redundant processors.

g. CEG. The CEG contains control and signaling equipment used with the TDSGM. The CEG provides facilities to switch, supervise, and signal analog and digital loops and trunks. Overall control of the circuit is provided by the CPG through the major components of the CEG, which include the following components:

(1) Switching Controller Group (SCG). The SCG provides control of the circuit-switched system by interfacing the CPG with the analog and digital switching groups. It provides the only system path between the CPG and these groups. There are two completely redundant SCGs. The SCG is composed of several individual device controllers that interface with a specific set of devices requiring access to and from the CPG. All device controllers, in turn, interface with a single controller (CPU central controller and interface adapter). The CPU central controller's function is to interface with the CPG and to control overall operation of the SCG. Both SCGs are accessible from either processor, under control of the CAP/CEM. The CAP/CEM selects which CPU interfaces with the SCG and enables the device controller through the CPU central controller in the selected SCG.

(2) Signaling Buffer Controller (SBC). The SBC provides the interface between the TSB, DSB, and CPG.

(3) COMSEC Controller. The COMSEC controller is a bidirectional device controller that links the COMSEC equipment with the CPG. The controller contains the circuitry necessary to perform a serial to parallel data conversion and to operate the COMSEC interface control unit (ICU). The COMSEC controller is redundant, and the selection of controller A or B is controlled by enable signals from the CAP/CEM. Either COMSEC controller is able to communicate with either CPU.

(4) Scanner-Controller. The scanner-controller provides the control functions, enabling the analog, digital, and dc scanners to transmit data to the CPU central controller.

(5) Receiver-Controller. The receiver-controller enables the digital receivers and the 570-Hz test card to transmit data to the CPU central controller.

(6) Fault Controller. The fault controller interfaces various status indicators with the CPG. Fault status words or bits are sent to the fault controller, which examines and encodes the status word before sending it to the CPU central controller. Only status changes are reported. Information received by the CPG from the fault

controller is used for diagnostics, corrective action, maintenance, and out-of-service markings.

(7) Matrix Controller. The matrix controller interfaces the CPU central controller with the TDMXs. The matrix transmit controller processes CPU central controller commands for the TDMXs; the receive controller processes the status returned from the TDMX.

(8) Sender/Special Devices Controller. This controller enables the CPU central controller to transmit data to the following devices and functions:

(a) Master timing generator.

(b) Intercept recorder.

(c) EUB selector.

(d) Test-generator controller.

(e) 20 Hz generator.

(f) Type II modem.

(g) CVSDs in CEG.

(h) TGM synchronization commands.

(i) TDMF configuration.

(j) DTG configuration.

(k) TSB.

(l) SPDVD/REMFM loop test.

(m) REMFM bit test.

(n) Switch-loop-common equipment MUX/DEMUX.

(o) CBU-CVSD rate change.

(9) Test Generator Controller. The TGC provides a test interface between the CPG and all controllers (including the TGC) of the SCG. Functionally, the TGC is built-in-test equipment used on a noninterfering basis to test and monitor the operability of each SCG controller.

(10) CPU Central Controller. The CPU central controller transfers data between SCG device controllers and the CPG. Data from the CPG is not stored in the CPU central controller, but is clocked directly from the CIC-11 interface adapter into the device controllers. Data to the CPG also comes directly from the device controllers through the CIC-11 interface adapter to the CPG. The CPU central controller allows only data transfers to and from device controllers enabled by the CPG.

(11) Switch Timing. Timing circuits provide all clock signals required to operate the circuit switch. They consist of one MTG, three LTGs, and one timing generator; all are redundant. The MTG generates four basic timing signals derived from a precision crystal oscillator, which is in the MTG oscillator assembly, which, in turn, is phase-locked to a more accurate source.

(a) The timing signals are slaved to the FRO or to one of four recovered clocks from predetermined DTGs (1, 2, 16, or 17). In the event of a degradation or failure in the primary MTG, the backup is used to maintain clock frequency continuity. Normally, timing will be derived from the FRO. If the FRO is not available, the output of the MTG is forwarded to LTGs.

(b) The MTG consists of six modules and two precision VCOs. The controller circuit, together with the MTG oscillator assembly, generates 12.288-MHz square waves, which are forwarded to the synthesizer circuits. They use this input to generate 18.432- and 16.384-MHz square waves and 100-Hz synchronization pulses.

(c) LTGs provide the required output clock frequencies for circuit-switched operation. The output clocks are derived from 12.288, 16.384, and 18.432 MHz input from the MTG. The 100-Hz synchronization input is used to synchronize the LTGs. All LTGs are redundant.

(d) The digital switching equipment contains two LTGs, one red and the other black. The red LTG provides the clock frequency for unencrypted, secure-call, processing. The black LTG provides the clock frequencies for encrypted, or nonsecure, call processing.

(e) The timing generator is used to derive low-frequency timing signals by counting down from a 4-kHz clock, provided by the LTG.

(f) Automatic switchover from the primary MTG to the backup occurs under either of the following conditions: (1) the fault detection circuits detect a frequency fault, or (2) the out-of-synchronization alarm circuit in the controller card detects a control voltage disorder in the MTG oscillator assembly. Automatic switchover from the primary LTG to the backup occurs when a fault is detected in the LTG. Under LTG switchover, the LTG receives its input from the backup MTG distribution driver.

(g) COMSEC equipment is located in the CEF HGF-85 and trunk encryption module assembly racks. The CEF houses six KG-81/94 TEDs. The trunk-encryption module assembly rack contains nine KG-94/KG-194 TEDs and three HGF-94assemblies. (See Table II-9.)

(h) There are two TDSGMs in the shelter that provide digital circuit-switched functions and interface connections to lines and trunks. TDSGMs provide external terminations for digital loops, DTGs, and analog loops and trunks via DLTUs.

Table II-9. AN/TTC-39A(V)4 HGF-85 Equipment Complement

Equipment	Quantity
Key Variable Generator, KG-83	2
LKG, KG-82	32
TED, KG-94 or KG-194	15
TUNA, HGF-91	2
Trunk Encryption Module	1
HGF-94	3
Control Unit, HGX-82	4
AKDC, HGX-83A	2
Interface Control Units, HGX-84	2 [1/]

1/ Two additional HGX-84s are mounted in the HGF-85 CEF.

5. DLTUs. Analog lines interface to the digital matrix by means of seven DLTUs. Five types of DLTUs are used to

terminate local analog loops and trunks. The NATO interface LTU (NILTU) is used as a remote NATO analog interface in the LTU, CV-4180(V)2/T. Following is a short description of these DLTUs. (See Tables II-10 and II-11 for listings of the switches' DTLUs and terminal equipment types, respectively.)

a. Four-Wire LTU (4WLTU). The 4WLTU has four circuits for terminating a variety of 4-wire analog loops and trunks.

b. Two-Wire LTU (2WLTU). The 2WLTU has four circuits for terminating 2-wire common-battery loops and trunks.

c. Twenty Hertz/Contact Closure LTU (TCLTU). The TCLTU has two circuits for terminating 20-Hz ring-down and dc closure trunks.

d. Multifrequency LTU (MFLTU). The MFLTU has two circuits for terminating DSN trunks that use SF supervision and MF, DTMF, or dial-pulse signaling. The MFLTU also terminates other trunks that use SF supervision (such as commercial offices).

e. E&M LTU (EMLTU). The ear and mouth (E&M) LTU contains two circuits per PCB for terminating 6-wire E&M trunks.

f. DLPMA. The DLPMA has four circuits for terminating digital telephones.

g. NATO Interface LTU (NILTU). Each NILTU has two circuits for terminating NATO analog trunks. The NILTU is normally located externally to the switch in the LTU CV-4180(V)2/T. (See paragraph 17, Chapter VII.)

6. Fiber Optic Accommodation. The switch has been wired to accommodate a future DTG interface to the fiber optic transmission system (FOTS). When the interface is operational, fiber optic modems (FOMs) will be added.

7. Programmed Features. Following are AN/TTC-39A(V)4 features not covered in Appendix A, Subsection B.

a. Numbering Plan. Each subscriber uses the same 7-digit numbering plan used by MSE. (See Chapter III, paragraph 2 for detailed discussion of numbering plans.)

Table II-10. AN/TTC-39A(V)4 Local External Subscribers

Type LTU and Line Type	Cards	Terminations
4WLTU 1, TA-341,TA-720,TA-838 (LB & CB) 25, AN/TTC-38, SB-3614A (confirmation signaling 26, AN/TTC-38, SB-3614A (tone-burst signaling) 28, TTC-39(V), TYC-39A (analog interswitch trunks) 30, CV-1918/1919 (converter trunks) 31, SB-3614 (3-digit PBX trunks) 32, AN/TTC-30 (5-digit PBX trunks) 41, SB-3082 trunks (1600-Hz ring-down) 42, SB-3082 trunks (1600-Hz dial pulse)	13	52
2WLTU 7, TA-236/WECO 5000 (2 W, CB, dial pulse) 8, WECO 2500,TA-838, TA-938 (2W, CB, DTMF) 9, TA-312 (2W, CB) 40, AN/TTC-4/5/22 (2W, CB, dial pulse)	5	20
EMLTU 46, Commercial (E&M, MF, wink start) 82, Commercial (E&M, DP, wink start) 83, Commercial (E&M, DP, timed start)	2	8 1/
MFLTU 34, DSN PNID access line 36, DSN MF 2/6 nonconfirmation 37, WECO 400 (SF, dial pulse) 38, AN/TTC-22 (ST trunk) 39, Analog NATO via NIU (CV-3478) 45, Commercial (SF, dial pulse) 66, DSN (MF 2/6 nonconfirmation)	2	4
TCLTU 12, TA-312 (20-Hz ring-down loop) 43, SB-22,86 (20-Hz ring-down trunk) 44, Commercial (dc closure)	6	12
DLPMA 03, DSVT 13, DNVT	36	144
Total local (single channel) terminations possible		240

1/ EMLTU card uses 4 terminations to connect two 6-wire E&M trunks.

Table II-11. AN/TTC-39A(V)4 Terminal Equipment Types

Terminal Type	Name	Quantity
Signaling Equipment And Pooled Equipment		
108	Routing Signaling Buffer (RSB)	3
110	DIBTS Buffer (DSB)	8 1/
113	Digital Receiver	20
114	570-Hz Test Card	1
117	Digital Trunk Signaling Buffer	20 1/
118	Digital Signaling Channel	
119	Loop Group Signaling Channel	5
120	Conference Bridge	6
121	CSP	1
122	RCSP	4
123	Loop Key Generator (KG-82)	32
Other Equipment		
125	TDMM	16
127	Digital Signal Generator (DSG)	2
128	Nine-Channel Mux/Demux (NCMD)	72
129	TTY Controller	1
131	Local VDT Controller (LVDTC)	1
132	Mag Tape Unit Controller	1
133	Switching Controller A	1
134	Switching Controller B	1
135	COMSEC Controller A	1
136	COMSEC Controller B	1
137	Signaling Buffer Controller A	1
138	Signaling Buffer Controller B	1
139	PPI	1
140	DTG	30
141	Switch Mux/Demux (SMD)	15
142	Loop Mux/Demux (LMD)	5
143	Remote VDT Controller (RVDTC)	1

1/ As delivered

b. Routing. The AN/TTC-39A(V)4 uses the common baseline software, which operates using flood search routing. (See subsection 2, Section D for a discussion of flood-search routing.) The AN/TTC-39A(V)4 can use deterministic routing also to override flood-search routing to external switches, such as SB-3614, SB-3865, and AN/TTC-42, which cannot process the MSE numbering plan.

c. Trunk Selection. The AN/TTC-39A(V)4 selects a route between the subscriber and called party by identifying a trunk-group cluster at each switch. Prefix codes and internal or traveling classmarks determine the subsequent selection of the specified trunks within that cluster.

d. Service Management Features. Since the AN/TTC-39A(V)4 is a flood search-based switch, the related features in Subsection 2, Section D apply for affiliation process, subscriber profiles, preaffiliation, blacklist, and duplication.

8. External Connections to the AN/TTC-39A(V)4

a. Field Cables 1 and 2 of the ALTG connect to the ALCG patch panel to provide access to analog subscriber lines that use analog line conditioning.

b. Field Cables 3-5 provide card slots, which allow DLTUs with two circuits per card, access to analog subscriber lines. Field Cables 6-8 are hardwired from the ALTG SEP to the ALTG's FIELD CABLE side. Field Cables 6-8 do not provide paired card slots. If two circuits per card DLTUs are used in these cables, two of the four circuits of the card slot are not available at the patch panel and SEP.

c. Tables II-12 and II-13 provide details on the field cable connections to the TDSGM and ALTG nest assemblies respectively.

9. Card Locations. Tables II-14 through II-27 list the PCB and NCMD and associated terminal assignment locations for the AN/TTC-39A(V)4 and AN/TTC-39D. Where differences exist between the two variants, they are so noted.

10. Location Nomenclature. Printed circuit card locations are indicated by equipment group (TDSGM, CEG, ALTG). The reference designation defines the position of the card within the group. The reference designation consists of the letter A, followed by three digits. The first digit defines the card nest level within the equipment group, not counting patch panels; row 1 is the highest level within the group. The next two digits define the card slots within the nest. Some cards take up two slots; locations of these cards are listed by two reference designations separated by a dash.

Table II-12. TDSGM 1 and TDSGM 2 Nest Assemblies

Field Cable Number	Terminal Number on Patch Panel	Row and Slot Number in Card Nest
1	T01, T02, T03, T04	A303
1	T05, T06, T07, T08	A304 1/
1	T09, T10, T11, T12	A305
2	T01, T02, T03, T04	A307
2	T05, T06, T07, T08	A308
2	T09, T10, T11, T12	A309
3	T01, T02, T03, T04	A311
3	T05, T06, T07, T08	A312
3	T09, T10, T11, T12	A313
4	T01, T02, T03, T04	A315
4	T05, T06, T07, T08	A316
4	T09, T10, T11, T12	A317
5	T01, T02, T03, T04	A321
5	T05, T06, T07, T08	A322
5	T09, T10, T11, T12	A323
6	T01, T02, T03, T04	A325
6	T05, T06, T07, T08	A326
6	T09, T10, T11, T12	A327

1/ In TDSGM 1 a 4WLTU is installed in location A304 for RCSP1 and 2 voice ports.

Table II-13. ALTG Nest Assembly

Field Cable Number	Terminal Number on Patch Panel	Row and Slot in Card Nest	Field Cable Number	Terminal Number on Patch Panel	Row and Slot in Card Nest
1	T01, T02, T03, T04	A101	4	T05, T06, T07, T08	A125
1	T03, T04	A102	4	T07, T08	A126
1	T05, T06, T07, T08	A103	4	T09, T10, T11, T12	A127
1	T07, T08	A104	4	T11, T12	A128
1	T09, T10, T11, T12	A105	5	T01, T02, T03, T04	A132
1	T11, T12	A106	5	T03, T04	A133
2	T01, T02, T03, T04	A108	5	T05, T06, T07, T08	A134
2	T03, T04	A109	5	T07, T08	A135
2	T05, T06, T07, T08	A110	5	T09, T10, T11, T12	A136
2	T07, T08	A111	5	T11, T12	A137
2	T09, T10, T11, T12	A112	6	T01, T02, T03, T04	A207
2	T11, T12	A113	6	T05, T06, T07, T08	A208
3	T01, T02, T03, T04	A115	6	T09, T10, T11, T12	A209
3	T03, T04	A116	7	T01, T02, T03, T04	A211
3	T05, T06, T07, T08	A117	7	T05, T06, T07, T08	A212
3	T07, T08	A118	7	T09, T10, T11, T12	A213
3	T09, T10, T11, T12	A119	8	T01, T02, T03, T04	A215
3	T11, T12	A120	8	T05, T06, T07, T08	A216
4	T01, T02, T03, T04	A123	8	T09, T10, T11, T12	A217
4	T03, T04	A124			

Table II-14. Scanner-Related Card Locations

Equipment Function	Unit Number	Frame or Module Location	Reference Designation	Card Type
Digital Scanner	1	TDSGM 1 (TDMM 1,2,3)	A511 A512	DSCNA DSCNB
	2	TDSGM 1 (TDMM 4,5,6)	A521 A522	DSCNA DSCNB
	3	TDSGM 2 (TDMM 7,8,9)	A511 A512	DSCNA DSCNB
	4	TDSGM 2 (TDMM 10,11,12)	A521 A522	DSCNA DSCNB
	5	CEG (TDMM 13,14,15)	A520 A521	DSCNA DSCNB

Table II-15. CEM/Peripheral Control Card Assignments

Card Type	Associated Equipment	Reference Designation
Control Electronics Nest		
CAPLP	--	A112 A114
CAP 1	Switches	A105
CAP 2	Lamps	A113
CLTU 1	CPU 1 CPU 2	A117 A118
CLTU 2	CPU 1 CPU 2	A116 A115
CLTU 3	--	A103 A106
CLTU 4	--	A107
CLTU 5	CPU 1 CPU 2	A109 A108
CLTU 6	Controller A Controller B	A110 A111

Table II-15. (Cont'd)

Card Type	Associated Equipment	Reference Designation
IOEIX	CPU 1 CPU 2	A137 A135
RST 1	CPU 1 CPU 2	A122 A120
VDU-9	CPU 1 CPU 2	A121 A119
CPG Controller Nest		
VTTYC	TTY	A317
VTTYC	Local VDT	A319
VTTYC	Remote VDT	A321
IOSL	Floppy Drive A	A322
IOSL	Floppy Drive B	A324
COMSA COMSB	COMSEC Controller A	A327 A328
COMSA COMSB	COMSEC Controller B	A330 A331
VTTYC	RSS (Transmit)	A335
VTTYC	RSS (Receive)	A336
STDIS	Timing Distribution	A341
SBCC	Signaling Buffer Controller A	A333
SBCC	Signaling Buffer Controller B	A334
RST-1	CPU-1	A339
RST-1	CPU 2	A340

Table II-16. CEG Controller Card Locations

Equipment Function	Unit Number	Location Designation	Card Type
Receiver Controller	A B	A329 A429	RCTLR RCTLR
Fault Controller	A	A307 A308 A309 A310	FLTCB FLTCB FLTCA DRREC
	B	A407 A408 A409 A410	FLTCB FLTCB FLTCA DRREC
Test Generator Controller	A	A317 A318 A319	TSTCC TSTCB TSTCA
	B	A417 A418 A419	TSTCC TSTCB TSTCA
Scanner Controller	A	A316	SCNRC
	B	A416	SCNRC
Special Devices Controller	A	A330 A331	SPDVA DRREC
	B	A430 A431	SPDVA DRREC
Sender Controller	A	A332 A333	SENDC DRREC
	B	A432 A433	SENDC DRREC
CPU Central Controller	A	A322 A323 A328	CPUCA CPUCB CPUCC
	B	A422 A423 A428	CPUCA CPUCB CPUCC

Table II-16. (Cont'd)

Equipment Function	Unit Number	Location Designation	Card Type
Matrix Controller (Transmit)	A	A311 A312	MXXCB MXXCA
	B	A411 A412	MXXCB MXXCA
Matrix Controller (Receive)	A	A313 A314 A315	MXRCB MXRCA MCLDR
	B	A413 A414 A415	MXRCB MXRCA MCLDR

Table II-17. TDMX Terminal Address vs. Associated Loop Modem/DLTU Locations

Rack	Field Cable	Card Slot	TERMINAL ADDRESS 1	2	3	4	Card	Term-inals	Card	Term-inals	Card	Term-inals
ALTG	1 1	A101 A102	13-38 13-40	13-39 13-41	13-40	13-41	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1 & 2 1 & 2	EMLTU NONE	1&3
ALTG	1 1	A103 A104	13-42 13-44	13-43 13-45	13-44	13-45	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1 & 2	EMLTU NONE	1&3
ALTG	1 1	A105 A106	13-46 13-48	13-47 13-49	13-48	13-49	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	2 2	A108 A109	13-50 13-52	13-51 13-53	13-52	13-53	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	2 2	A110 A111	13-54 13-56	13-55 13-57	13-56	13-57	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	2 2	A112 A113	13-58 13-60	13-59 13-61	13-60	13-61	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	3 3	A115 A116	15-38 15-40	15-39 15-41	15-40	15-41	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	3 3	A117 A118	15-42 15-44	15-43 15-45	15-44	15-45	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	3 3	A119 A120	15-46 15-48	15-47 15-49	15-48	15-49	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	4 4	A123 A124	15-50 15-52	15-51 15-53	15-52	15-53	4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	4 4	A125 A126	15-54 15-56	15-55 15-57	15-56	15-57	4WLTU/2WLTU	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	4 4	A127 A128	15-58 15-60	15-59 15-61	15-60	15-61	DLPMA/4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	5 5	A132 A133	13-34 13-36	13-35 13-37	13-36	13-37	DLPMA/4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	5 5	A134 A135	14-34 14-50	14-35 14-51	14-50	14-51	DLMPA/4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3

Table II-17. (Cont'd)

Rack	Field Cable	Card Slot	TERMINAL ADDRESS 1	2	3	4	Card	Term-inals	Card	Term-inals	Card	Term-inals
ALTG	5 5	A136 A137	15-34 15-36	15-35 15-37	15-36	15-37	DLMPA/4WLTU/2WLTU NONE	ALL	TCLTU/MFLTU TCLTU/MFLTU	1&2 1&2	EMLTU NONE	1&3
ALTG	6 6 6	A207 A208 A209	03-09 03-13 03-17	03-10 03-14 03-18	03-11 03-15 03-19	03-12 03-16 03-20	DLPMA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (1/) 1&2 (1/) 1&2 (1/)	EMLTU EMLTU EMLTU	1&3
ALTG	7 7 7	A211 A212 A213	03-21 03-25 03-29	03-22 03-26 03-30	03-23 03-27 03-31	03-24 03-28 03-32	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (1/) 1&2 (1/) 1&2 (1/)	EMLTU EMLTU EMLTU	1&3
ALTG	8 8 8	A215 A216 A217	03-33 03-37 03-41	03-34 03-38 03-42	03-35 03-39 03-43	03-36 03-40 03-44	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (1/) 1&2 (1/) 1&2 (1/)	EMLTU EMLTU EMLTU	1&3
TDSGM 1	1 1 1	A303 A304 A305	01-07 01-12 01-16	01-09 01-13 01-17	01-10 01-14 01-18	01-11 01-15 01-19	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (1/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 1	2 2 2	A307 A308 A309	01-20 01-24 01-28	01-21 01-25 01-29	01-22 01-26 01-30	01-23 01-27 01-31	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 1	3 3 3	A311 A312 A313	01-32 01-36 01-40	01-33 01-37 01-41	01-34 01-38 01-42	01-35 01-39 01-43	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 1	4 4 4	A315 A316 A317	01-44 01-48 01-52	01-45 01-49 01-53	01-46 01-50 01-54	01-47 01-51 01-55	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 1	5 5 5	A321 A322 A323	01-56 01-60 02-10	01-57 01-61 02-11	01-58 02-07 02-12	01-59 02-09 02-13	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 1	6 6 6	A325 A326 A327	02-14 02-18 02-22	02-15 02-19 02-23	02-16 02-20 02-24	02-17 02-21 02-25	DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU DLMPA/4WLTU/2WLTU	ALL ALL ALL	TCLTU/MFLTU TCLTU/MFLTU TCLTU/MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 2	1 1 1	A303 A304 A305	07-07 07-12 07-16	07-09 07-13 07-17	07-10 07-14 07-18	07-11 07-15 07-19	DLMPA/4WLTU DLMPA/4WLTU DLMPA/4WLTU	ALL ALL ALL	MFLTU MFLTU MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3

Table II-17. (Cont'd)

			TERMINAL ADDRESS									
Rack	Field Cable	Card Slot	1	2	3	4	Card	Term-inals Used	Card	Term-inals Used	Card	Term-inals Used
TDSGM 2	2 2 2	A307 A308 A309	07-20 07-24 07-28	07-21 07-25 07-29	07-22 07-26 07-30	07-23 07-27 07-31	DLMPA/4WLTU DLMPA/4WLTU DLMPA/4WLTU	ALL ALL ALL	MFLTU MFLTU MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 2	3 3 3	A311 A312 A313	07-32 07-36 07-40	07-33 07-37 07-41	07-34 07-38 07-42	07-35 07-39 07-43	DLMPA/4WLTU DLMPA/4WLTU DLMPA/4WLTU	ALL ALL ALL	MFLTU MFLTU MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 2	4 4 4	A315 A316 A317	07-44 07-48 07-52	07-45 07-49 07-53	07-46 07-50 07-54	07-47 07-51 07-55	DLMPA/4WLTU DLMPA/4WLTU DLMPA/4WLTU	ALL ALL ALL	MFLTU MFLTU MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 2	5 5 5	A321 A322 A323	07-56 07-60 08-10	07-57 07-61 08-11	07-58 08-07 08-12	07-59 08-09 08-13	DLMPA/4WLTU DLMPA/4WLTU DLMPA/4WLTU	ALL ALL ALL	MFLTU MFLTU MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3
TDSGM 2	6 6 6	A325 A326 A327	08-14 08-18 08-22	08-15 08-19 08-23	08-16 08-20 08-24	08-17 08-21 08-25	DLMPA/4WLTU DLMPA/4WLTU DLMPA/4WLTU	ALL ALL ALL	MFLTU MFLTU MFLTU	1&2 (2/) 1&2 (2/) 1&2 (2/)	EMLTU EMLTU EMLTU	1&3

____

1/ The MFLTU and TCLTU cards will work in these slots, but because they are packaged with only two circuits per card, the other two terminations will be unused.

2/ The MFLTU and TCLTU (TT 44 only) will work in these slots, but because they are packaged with only two circuits per card, the other two terminations will be unused. The 2WLTU and TCLTU (TTs 12 & 43) cannot be used on TDSGM 2 because the 90- volt, 20-Hz ring signal is not available.

Table II-18. TDMX-Related Card Locations

TDMM/TDMF Number			
TDSGM1	TDSGM2	TDMF Card Reference Designation	LINT n Card Ref. Designation (n= TDSGM Number)
1	7	A501	A502
2	8	A504	A505
3	9	A508	A509
4	10	A513	A514
5	11	A515	A517
6	12	A516	A519
13	15	A510	A502
14	--	A503	A505
18	--	A506	A509

Table II-19. Timing-Related Card Locations

Function	Unit Number	Frame Location	Reference Designation	Card Type
TDSGM LTG (Red)	A B	1 per TDSGM 1 per TDSGM	A421 A422	LTA LTA
TDSGM LTG (Black)	A B	1 per TDSGM 1 per TDSGM	A419 A420	LTA LTA
LTG Buffer (Red)	--	5 per TDSGM	A120 A220 A320 A423 A520	LTBF LTBF LTBF LTBF LTBF
CEG LTG	A B	CEG CEG	A420 A421	LT LT
Timing Generator	A B	CEG CEG	A320 A321	STGEN STGEN
ALTG LTG (Red)	A B	ALTG ALTG	A224 A225	LTA LTA
ALTG LTG (Black)	A B	ALTG ALTG	A222 A223	LTA LTA

Table II-19. (Cont'd)

Function	Unit Number	Frame Location	Reference Designation	Card Type
MTG	Primary	CEG	A710 A711/A712 A713 A718-A724 1/	MTGDR MTGSY MTCTA MTG Osc Assy.
	Back-up	CEG	A714 A715/A716 A717 A718-A724 1/	MTGDR MTGSY MTCTA MTG Osc Assy.
LTG Buffer (Red)	--	2 per ALTG	A122 A221	LTBF LTBF
Loop Clock	ALTG Loop Cable			
	1	ALTG	A107	LPCLK
	2	ALTG	A114	LPCLK
	3	ALTG	A121	LPCLK
	4	ALTG	A129	LPCLK
	5	ALTG	A138	LPCLK
	6	ALTG	A210	LPCLK
	7	ALTG	A214	LPCLK
	8	ALTG	A218	LPCLK
	TDSGM 1 Loop Cable			
	1	TDSGM 1	A306	LPCLK
	2	TDSGM 1	A310	LPCLK
	3	TDSGM 1	A314	LPCLK
	4	TDSGM 1	A318	LPCLK
	5	TDSGM 1	A324	LPCLK
	6	TDSGM 1	A328	LPCLK
	TDSGM 2 Loop Cable			
	1	TDSGM 2	A306	LPCLK
	2	TDSGM 2	A310	LPCLK
	3	TDSGM 2	A314	LPCLK
	4	TDSGM 2	A318	LPCLK
	5	TDSGM 2	A324	LPCLK
	6	TDSGM 2	A328	LPCLK

Table II-19. (Cont'd)

1/ The MTG assemblies are mounted one above the other in slots A718 through A724. The primary MTG oscillator assembly is the top assembly, and the backup MTG assembly is the bottom assembly.

Table II-20. Digital Receivers and Signal Generators-Card Locations versus TDMF/COM EQ and LDI Locations

			Associated TDMF/COM EQ Card Location		Associated LDI Card Location	
Equipment Function	Unit Number	DR or DSG Ref Desig	TDSGM/DSG Number	Card Ref Desig	TDSGM Number	Card Ref
Digital Receiver	1	A525	TDSGM 1	A503 & A327	1	A228
	2	A525	TDSGM 1	A503 & A237	1	A228
	3	A525	TDSGM 1	A503 & A237	1	A228
	4	A526	TDSGM 1	A503 & A237	1	A228
	5	A526	TDSGM 1	A503 & A237	1	A228
	6	A526	TDSGM 1	A503 & A237	1	A228
	7	A527	TDSGM 1	A501	1	A524
	8	A527	TDSGM 1	A504	1	A524
	9	A527	TDSGM 1	A508	1	A524
	10	A528	TDSGM 1	A510 & A232	1	A524
	11	A528	TDSGM 1	A513	1	A524
	12	A528	TDSGM 1	A515	1	A524
	13	A529	TDSGM 1	A516	1	A524
	14	A529	TDSGM 2	A510 & A232	2	A524
	15	A529	TDSGM 2	A501	2	A524
	16	A530	TDSGM 2	A504	2	A524
	17	A530	TDSGM 2	A508	2	A524
	18	A530	TDSGM 2	A513	2	A524
	19	A531	TDSGM 2	A515	2	A524
	20	A531	TDSGM 2	A516	2	A524
Digital Signal Generator	1	A522 A523	DSIGA DSG16 (16 kbps) 1/			
	2	A622 A623	DSIGA DSG16 (16 kbps) 1/			

1/ The AN/TTC-39A(V)4 also uses DSG32 (32 kbps).

Table II-21. TGM/DTG-Related Equipment

Equipment Function	DTG Number TDSGM 1	TDSGM 2	Card Reference Designation	Card Type 1/
Group Modem	1	16	A401	GPMDM
	2	17	A403	GPMDM
	3	18	A405	GPMDM
	4	19	A407	GPMDM
	5	20	A409	GPMDM
	6	21	A411	GPMDM
	7	22	A413	GPMDM
	8	23	A415	GPMDM
	9	24	A417	GPMDM
	10	25	A430	GPMDM
	11	26	A432	GPMDM
	12	27	A434	GPMDM
	13	28	A436	GPMDM
	14	29	A438	GPMDM
	15	30	A441	DNGPM
Cable Driver Modem GM	14,15	29,30	A439	CDMGB
Transmission Group Module/Orderwire	1	16	A402	TGMOW
	2	17	A404	TGMOW
	3	18	A406	TGMOW
	4	19	A408	TGMOW
	5	20	A410	TGMOW
	6	21	A412	TGMOW
	7	22	A414	TGMOW
	8	23	A416	TGMOW
	9	24	A418	TGMOW
	10	25	A429	TGMOW
	11	26	A431	TGMOW
	12	27	A433	TGMOW
	13	28	A435	TGMOW
	14	29	A437	TGMOW
	15	30	A440	DNTGM

1/ For a digital NATO cable interface DTG (not AN/TTC-39A(V)4), the GPNGPM card and the TGMOW card are replaced by a DNTGM card.

Table II-22. Equipment Function Vs. Associated Line Driver Interface Locations

		LDI Location		TDMM	
Equipment Function	Associated LDI Number	Frame	Reference Designation	Number	Associated TDMF Reference Designation
Time Division Switching Group Modified (TDSGM)					
LKG (Black)					
1 to 16	3	TDSGM 1	A228	13	A510
17 to 32	13	TDSGM 2	A228	15	A510
LKG (Red)					
1 to 8	1	TDSGM 1	A507	2	A504
9 to 16	1	TDSGM 1	A507	3	A508
17 to 24	11	TDSGM 2	A507	8	A504
25 to 32	11	TDSGM 2	A507	9	A508
Digital Receiver					
1 to 6	7	TDSGM 1	A234	14	A503
7	9	TDSGM 1	A524	1	A501
8	9	"	"	2	A504
9	9	"	"	3	A508
10	9	"	"	13	A510
11	9	"	"	4	A513
12	9	"	"	5	A515
13	9	"	"	6	A516
14	19	TDSGM 2	A524	15	A510
15	19	"	"	7	A501
16	19	"	"	8	A504
17	19	"	"	9	A508
18	19	"	"	10	A513
19	19	"	"	11	A515
20	19	"	"	12	A516
570- Hz Test Card	9	TDSGM 1	A524	14	A503
DSVT					
Shelter DSVT	10	TDSGM 1	A134	2	A504
CSP TDMX	10	TDSGM 1	A134	--	--
Voice/Signaling Ports	-- (CEG)	CEG	A403	14	A503

Table II-22. (Cont'd)

		LDI Location		TDMM	
Equipment Function	Associated LDI Number	Frame	Reference Designation	Number	Associated TDMF Reference Designation
LTU (ALTG)					
1-12	4	TDSGM 1	A229	13	A510
13-24	5	TDSGM 1	A230	13	A510
25-36	14	TDSGM 2	A229	15	A510
37-48	15	TDSGM 2	A230	15	A410
49-52	4	TDSGM 1	A229	13	A510
53-56	5	TDSGM 1	A230	14	A503
57-60	14	TDSGM 2	A229	15	A513
RSSD (See Note)					
1,3,5,7,9,11	6	TDSGM 1	A233	4	A513
2,4,6,8,10,DTA	16	TDSGM 2	A233	10	A513
Auxilliary Line Termination Group					
RSS					
(See Note)	2	ALTG	A206	--	--
1-4	3	ALTG	A226	--	--
5-8	4	ALTG	A227	--	--
9-11,DTA					
LTU (ALTG)					
1-12	2	ALTG	A206	--	--
13-24	3	ALTG	A226	--	--
25-36	4	ALTG	A227	--	--
37-48	5	ALTG	A228	--	--
47-60	6	ALTG	A235	--	--

1/ RSSD equipment applies only to AN/TTC-39D.

Table II-23. I/O Interface Cards

Card Function	Associated CPU or Controller	Frame Location	Reference Designation	Card Type
Control Transfer Logic I/O	CPU 1 CPU 2	CAP/CEM CAP/CEM	A121 A119	VDU-9 VDU-9
Local VDT	--	CPG CTRL	A319	VTTYC
Remote VDT	--	CPG CTRL	A321	VTTYC
Resistive Termination	CPU 1 CPU 2	CAP/CEM CAP/CEM	A122 A120	RST-1 RST-1
SCG IOX Adapter	CPU 1 SCG A SCG B	CEG CEG	A325 A425	CIC-2 CIC-2
	CPU 2 SCG A SCG B	CEG CEG	A326 A426	CIC-2 CIC-2
SBC IOE/IOX Adapter	CPU 1 Request and Data	CAP/CEM	A137	IOE/X 1/
	CPU 2 Request and Data	CAP/CEM	A135	IOE/X 1/

1/ Card slots A136 and 138 have no circuit cards installed. As fault isolation procedures are performed, operators should ignore any references to there being IOE or IOX cards in those slots.

Table II-24. Trunk Signaling Buffers and Related Type II Modems

				Type II Modem		
Unit[1/] Number	TDSG Number	Card Ref Des	TDMX Address	Unit Number	Frame	Reference Designation
1	1	A534	01-00	N/A	N/A	N/A
2	1	A535	01-01	N/A	N/A	N/A
3[2/]	1	A535	01-02	1	ALTG	A236,A237/A238
4[2/]	1	A536	01-03	2	ALTG	A239,A240/A241
5	1	A536	01-04	N/A	N/A	N/A
6	1	A537	01-05	N/A	N/A	N/A
7	1	A537	01-06	N/A	N/A	N/A
8	1	A538	13-00	N/A	N/A	N/A
9	1	A538	13-01	N/A	N/A	N/A
10	1	A539	13-02	N/A	N/A	N/A
11	1	A539	13-03	N/A	N/A	N/A
12	1	A540	13-04	N/A	N/A	N/A
13	1	A540	13-05	N/A	N/A	N/A
14	1	A541	13-06	N/A	N/A	N/A
15	1	A541	13-07	N/A	N/A	N/A
16	2	A534[3/]	07-00	N/A	N/A	N/A
17	2	A535	07-01	N/A	N/A	N/A
18	2	A535	07-02	N/A	N/A	N/A
19	2	A536	07-03	N/A	N/A	N/A
20	2	A536	07-04	N/A	N/A	N/A
21	2	A537	07-05	N/A	N/A	N/A
22	2	A537	07-06	N/A	N/A	N/A
23	2	A538	15-00	N/A	N/A	N/A
24	2	A538	15-01	N/A	N/A	N/A
25	2	A539	15-02	N/A	N/A	N/A
26	2	A539	15-03	N/A	N/A	N/A
27	2	A540	15-04	N/A	N/A	N/A
28	2	A540	15-05	N/A	N/A	N/A
29	2	A541	15-06	N/A	N/A	N/A
30	2	A541	15-07	N/A	N/A	N/A

1/ Unit number for DSB and TSB
2/ These units may be analog or digital. All other units are digital only.
3/ Slot A534 must not be populated.

Table II-25. Miscellaneous Equipment-Card Locations

Equipment Function	Unit Number	Frame Location	Reference Designation	Card Type
Essential User Bypass Selector	1	CEG CEG	A240 A241	EUBSA EUBSB
Intercept Recorder	1 2	CEG CEG CEG CEG CEG CEG	A533 A532 A534 A535 A536 A638	INTCP MESM1 MESM2 INTCP MESM3 MESM4
Conference Bridge	1 and 2 3 and 4 5 and 6	TDSGM 1 TDSGM 1 TDSGM 2	A239 A240 A239	CBU CBU CBU
CVSDs for Conference Bridges	1 and 2 3 and 4 5 and 6	TDSGM 1 TDSGM 1 TDSGM 2	A238 A241 A238	CVSDA CVSDA CVSDA
Timing Distribution	--	CPG ALTG TDSGM 1	A341 A201 A121	STDIS STDIS STDIS
Remote Fault Multiplexer	1-4 5-8	TDSGM 1 TDSGM 2	A214,A218 A219,A224 A214,A218 A219,A224	REMFM REMFM
Remote Special Devices Demultiplexer	--	TDSGM 1 TDSGM 2	A206,A210 A206,A210	SPDVC,SPDVB SPDVC,SPDVB
DSVT	02-62 1/	CEG	A405	DILPA or DLPMA
20-Hz Generator	A B	CEG CEG	A731/A732 A735/A736	20 HZG 20 HZG
20-Hz Generator Crossover	--	CEG	A734	20 HZX
570-Hz Test Card	--	CEG	A233	570TC
DSDI	14-36 1/	TDSGM 1	A136 A137	DECPU DEINT

1/ Designations listed are TDSGM terminal addresses.

Table II-26. Mux/Demux Card Locations and Associated Terminal Assignments

Function	Unit Number	Card Location TDSGM	Card Location Reference Designation	Card Type	Associated Equipment, Function, or Terminal Address
	1	TDSGM 1	A301	SWMUX	01-09 TO 01-61
	2	TDSGM 1	A330	SWMUX	02-09 to 02-25
	3	TDSGM 2	A301	SWMUX	07-09 to 07-61
	4	TDSGM 2	A330	SWMUX	08-09 to 08-25
	5	ALTG	A219	SWMUX	03-09 to 03-44
	1	TDSGM 1	A302	SWDMX	01-08 to 01-61
	2	TDSGM 1	A331	SWDMX	02-08 to 02-25
	3	TDSGM 2	A302	SWDMX	07-08 to 07-61
	4	TDSGM 2	A331	SWDMX	08-08 to 08-25
	5	ALTG	A220	SWDMX	03-08 to 03-44
	Loop Mux	TDSGM 1	A501	TDMF	01-00 to 01-63
		TDSGM 1	A504	TDMF	02-00 to 02-63
		TDSGM 1	A508	TDMF	03-00 to 03-63
		TDSGM 1	A513	TDMF	04-00 to 04-63
		TDSGM 1	A515	TDMF	05-00 to 05-63
		TDSGM 1	A516	TDMF	06-00 to 06-63
		TDSGM 2	A501	TDMF	07-00 to 07-63
		TDSGM 2	A504	TDMF	08-00 to 08-63
		TDSGM 2	A508	TDMF	09-00 to 09-63
		TDSGM 2	A513	TDMF	10-00 to 10-63
		TDSGM 2	A515	TDMF	11-00 to 11-63
		TDSGM 2	A516	TDMF	12-00 to 12-63
Switch Mux (Comm Eq)	Loop Demux	TDSGM 1	A231	SWMUX	13-00 to 13-63
		TDSGM 1	A236	SWMUX	14-00 to 14-63
		TDSGM 2	A231	SWMUX	15-00 to 15-63

Table II-26. (Cont'd)

Function	Unit Number	Card Location TDSGM	Card Location Reference Designation	Card Type	Associated Equipment, Function, or Terminal Address
Switch Demux	Switch Mux	TDSGM 1 TDSGM 1 TDSGM 1 TDSGM 1 TDSGM 1 TDSGM 1 TDSGM 2 TDSGM 2 TDSGM 2 TDSGM 2 TDSGM 2 TDSGM 2	A501 A504 A508 A513 A515 A516 A501 A504 A508 A513 A515 A516	TDMF TDMF TDMF TDMF TDMF TDMF TDMF TDMF TDMF TDMF TDMF TDMF	01-00 TO 01-63 02-00 TO 02-63 03-00 to 03-63 04-00 to 04-63 05-00 to 05-63 06-00 to 06-63 07-00 to 07-63 08-00 to 08-63 09-00 to 09-63 10-00 to 10-63 11-00 to 11-63 12-00 to 12-63
Switch Demux (Comm Eq)	13 14 15	TDSGM 1 TDSGM 1 TDSGM 2	A232 A237 A232	SWDMX SWDMX SWDMX	13-00 to 13-63 14-00 to 14-63 15-00 to 15-63
Remote SBC Mux/Demux	A B A B	TDSGM 1 TDSGM 1 TDSGM 2 TDSGM 2	A532 A533 A532 A533	RSBIN RSBIN RSBIN RSBIN	SBC A, TSB 1-15 SBC B, TSB 1-15 SBC A, TSB 16-30 SBC B, TSB 16-30
Remote Special Devices Demux	1	TDSGM 1	A210 A206	SPDVB SPDVC	TGM/GM 1-15 TDMF 1-6, 13, 14, 18 Loop Mux/Demux 1, 2 Comm Eq. Mux/Demux 13,14 Remote Fault Mux 1 TSB 1-15 CBU
	2	TDSGM 2	A210 A206	SPDVB SPDVC	TGM/GM 16-30 TDMF 7-12, 15 Loop Mux/Demux 3, 4 Comm Eq. Mux/Demux 15 Remote Fault Mux 5 TSB 16-30

Table II-26. (Cont'd)

Function	Unit Number	Card Location		Card Type	Associated Equipment, Function, or Terminal Address
		TDSGM	Reference Designation		
Remote Fault Mux	1	TDSGM 1	A219	REMFM	Error Count TGM 1-5 Presence LDI 1-8 Status TDMF 1, 2, 3 TGM 1-15 SPDVB Loop Test
	2	TDSGM 1	A218	REMFM	Error Count TGM 6-10 Presence TGM/GM 1-15 Status GM 1-15 TDMF 13,14,18 Fault Loop Mux/Demux Comm Eq. Mux/Demux
	3	TDSGM 1	A219	REMFM	Error Count TGM 11-15 Presence LDI 9, 10 CBU TDMF 4, 5, 6 Status TDMF 4, 5, 6
	4	TDSGM 1	A224	REMFM	Presence TSB/DSB TDFLC Status CBU LTA 1-4 Analog Scanner DTG 1-15 Fault TDMF 13, 14 clock
	5	TDSGM 2	A224	REMFM	Error Count TGM 16-20 Presence LDI 11-18 TDMF 7, 8, 9, 15 Status TGM 16-30 TDMF 7, 8, 9 SPDVB Loop Test

Table II-26. (Cont'd)

Function	Unit Number	Card Location TDSGM	Card Location Reference Designation	Card Type	Associated Equipment, Function, or Terminal Address
Time Division Fault Collector	6	TDSGM 2	A218	REMFM	Error Count TGM 21-25 Presence TGM/GM 16-30 Status GM 16-30 TDMF 15 Fault Loop Mux/Demux Comm Eq.Mux/Demux
	7	TDSGM 2	A219	REMFM	Error Count TGM 26-30 Presence LDI 19, 20 CBU TDMF 10, 11, 12 Status TDMF 10, 11, 12
	8	TDSGM 2	A224	REMFM	Presence TSB/DSB, TDFLC Status CBU LTA 5-8 Analog Scanner DTG 16-30 Fault TDMF 15, clock
	1	TDSGM 1	A529	TDFLC	TGM 1-15 GM 1-7 TDMF(TDMM) 1,2,3,13,14, ,18 TDMF(NCMD/SMD) 1,2,3
	2		A530	TDFLC	GM 8-15 TDMF(TDMM) 4,5, 6 TDMF(NCMD/SMD) 4,5,6
	1		A529	TDFLC	TGM 16-30 GM 16-22 TDMF(TDMM) 7,8,9,15 TDMF(NCMD/SMD) 7,8,9
	2		A530	TDFLC	GM 23-30 TDMF(TDMM) 10, 11, 12 TDMF(TDMM) 10, 11, 12

Table II-26. (Cont'd)

Table II-27. Nine Channel Mux/Demux Locations vs. Associated Terminal Assignments

TDSGM Number	NCMD Number	Associated TDMX Terminal Location	TDMF Reference Designation
1	1	01-08 to 01-16	A501
	2	01-17 to 01-25	A501
	3	01-26 to 01-34	A501
	4	01-35 to 01-43	A501
	5	01-44 to 01-52	A501
	6	01-53 to 01-61	A501
1	7	02-08 to 02-16	A504
	8	02-17 to 02-25	A504
	9	02-26 to 02-34	A504
	10	02-35 to 02-43	A504
	11	02-44 to 02-52	A504
	12	02-53 to 02-61	A504
1	13	03-08 to 03-16	A508
	14	03-17 to 03-25	A508
	15	03-26 to 03-34	A508
	16	03-35 to 03-43	A508
	17	03-44 to 03-52	A508
	18	03-53 to 03-61	A508
1	19	04-08 to 04-16	A513
	20	04-17 to 04-25	A513
	21	04-26 to 04-34	A513
	22	04-35 to 04-43	A513
	23	04-44 to 04-52	A513
	24	04-53 to 04-61	A513
1	25	05-08 to 05-16	A515
	26	05-17 to 05-25	A515
	27	05-26 to 05-34	A515
	28	05-35 to 05-43	A515
	29	05-44 to 05-52	A515
	30	05-53 to 05-61	A515
1	31	06-08 to 06-16	A516
	32	06-17 to 06-25	A516
	33	06-26 to 06-34	A516
	34	06-35 to 06-43	A516
	35	06-44 to 06-52	A516
	36	06-53 to 06-61	A516

Table II-27. (Cont'd)

TDSGM Number	NCMD Number	Associated TDMX Terminal Location	TDMF Reference Designation
2	1	07-08 to 07-16	A501
	2	07-17 to 07-25	A501
	3	07-26 to 07-34	A501
	4	07-35 to 07-43	A501
	5	07-44 to 07-52	A501
	6	07-53 to 07-61	A501
2	7	08-08 to 08-16	A504
	8	08-17 to 08-25	A504
	9	08-26 to 08-34	A504
	10	08-35 to 08-43	A504
	11	08-44 to 08-52	A504
	12	08-53 to 08-61	A504
2	13	09-08 to 09-16	A508
	14	09-17 to 09-25	A508
	15	09-25 to 09-34	A508
	16	09-35 to 09-43	A508
	17	09-44 to 09-52	A508
	18	09-53 to 09-61	A508
2	19	10-08 to 10-16	A513
	20	10-17 to 10-25	A513
	21	10-26 to 10-34	A513
	22	10-35 to 10-43	A513
	23	10-44 to 10-52	A513
	24	10-53 to 10-61	A513
2	25	11-08 to 11-16	A515
	26	11-17 to 11-25	A515
	27	11-26 to 11-34	A515
	28	11-35 to 11-43	A515
	29	11-44 to 11-52	A515
	30	11-53 to 11-61	A515
2	31	12-08 to 12-16	A516
	32	12-17 to 12-25	A516
	33	12-26 to 12-34	A516
	34	12-35 to 12-43	A516
	35	12-44 to 12-52	A516
	36	12-53 to 12-61	A516

SECTION C

AN/TTC-39D DESCRIPTION

1. Introduction. Like the AN/TTC-39A(V)4, the AN/TTC-39D is a product improvement of the AN/TTC-39A(V)1. The AN/TTC-39D, with a few exceptions, is identical in design (hardware and software) to the AN/TTC-39A(V)4 (see Section C). Where differences exist between the two versions they are noted and explained.

2. System Improvements in the AN/TTC-39D

a. The AN/TTC-39D is employed by the Army at EAC.

b. The AN/TTC-39D is equipped similar to the AN/TTC-39A(V)4, except as follows.

(1) The switch software includes the NATO digital interface capability.

(2) The HGF-85 was upgraded to the HGF-87 for data calls using the TA-1035 or TA-1042A (DNVT). The HGX-83 was modified to the HGX-83A for the bulk transfer function only.

c. The switch has been upgraded with the MSE packet switch (PS) capability. (See paragraph 3b(1)(e), Section D and CJCSM 6231.03.)

3. Functional Description. The AN/TTC-39D is a transportable, automatic switching system housed in a modified S-280B/G shelter. The switch is designed to interface with the same systems and switches as the AN/TTC-39A(V)4 (Section B), except as follows. Table II-28 is a listing of AN/TTC-39D terminal allocations.

a. NATO digital.

b. AN/TRC-191 (RAU).

4. Technical Description. The AN/TTC-39D is identical to the AN/TTC-39A(V)4 (Section B) except for the following major equipment items.

a. ALTG. The AN/TTC-39D's ALTG provides the same interface capabilities as the AN/TTC-39A(V)4.

Table II-28. AN/TTC-39D Termination Allocations

Description	Quantity
External local subscribers-directly connected (60 DLTU terminations on ALTG)	64
External local (loop MUX/DEMUX) subscribers on DTG group terminations	176
Total external local subscribers	240
Loop MUX/DEMUX test terminations or DTG group terminations	5
DTG group terminations	467
Total external terminations	712
TSB, NSB, or DSB (only 28 are addressable	30
LKG (32 plain text and 32 cipher text)	64
Digital receivers	20
Scanner test	6
RSU/DTA (only 7 used, AN/TTC-39D only) (reserved in AN/TTC-39A(V)4)	12
DSVT (shelter)	1
CSP, signaling channel, and 2 voice ports	3
Monitor and test terminations	3
CBU, terminals assigned for six 5-port bridges	30
DSDI (CSCE interface)	1
VDTC--provision for operating with remoted local	1
VDT	61
Spare	3
Spare--connected to LDI terminal	12
No connection	
Total internal terminations	248
Total TDMX terminals (15 TDMM, 64 local)	960

b. CPG. The AN/TTC-39D also includes two additional VDT controllers for interfacing with the RSSD.

c. COMSEC Equipment. COMSEC equipment is located in the HGF-87 and trunk encryption module (TEM) assembly racks. The equipment complement for the HGF-87 rack is the same as the AN/TTC-39A(V)4 (HGF-85) except for the availability of two modified AKDCs (HGX-83A). (See Table II-9.)

d. DLTUs. The composition of DLTUs, in the delivered configuration, is shown in Table II-29. (See Table II-10 for the terminal types associated with each DLTU.) The NATO analog interface is provided through either the NATO interface unit (NIU, CV-3478), which is interfaced through the MFLTU (Terminal Type 39); the NATO analog interface (NAI, CV-4002), which is interfaced through DPLMAs (Terminal Type 87); or the NATO interface LTU (NILTU), which is normally interfaced through the CV-4180 LTU (Terminal Type 87). Table II-30 lists the switch's terminal equipment types.

e. Fiber Optic Accommodation. The switch has been wired to accommodate a future DTG interface to the FOTS. When the interface is operational, 12 FOMs will be added. The FOMs will be mounted inside the shelter and behind the optical SEP. Each fiber optic cable assembly (FOCA) connects to a fiber optic bulkhead connector (FOBC) protruding through the SEP. The AN/TTC-39D has been supplied with dummy FOMs. Six cables from FOMs to TDSGM1 and six cables from FOMs to TDSGM2 are physically in place and can be connected to a group modem output of the TDSGM patch panel when the FOMs are available.

f. Packet Switch. The PS capability includes two AN/TYC-20 packet switches and one AN/TYC-19 gateway. The PS provides access for six 64 kbps trunks, five 16 kbps trunks, two X.25 dial-up interfaces, eight X.25 dedicated hosts, and three IEEE 802.3 LAN interfaces for user access.

Table II-29. AN/TTC-39D Local External Subscribers

Description	Cards	Number of Terminations
4WLTU	14	56
2WLTU	5	20
EMLTU	2	8 1/
MFLTU	2	4
TCLTU	6	12
DLPMA	35	140

Table II-30. AN/TTC-39D Terminal Equipment Types

Terminal Type (TT)	Name	Quantity
Signaling Equipment And Pooled Equipment		
106	Digital NATO Signaling Buffer	
107	Routing Signaling Buffer	
108	Routing Signaling Channel	
109	NATO Signaling Buffer (DNTSB)	2 1/
110	DIBTS Buffer (DSB)	8 1/
113	Digital Receiver	20
114	570-Hz Test Card	1
117	Digital Trunk Signaling Buffer	20 1/
118	Digital Signaling Channel	1
119	Loop Group Signaling Channel	5
120	Conference Bridge	6
121	CSP	1
122	RCSP	4
123	Loop Key Generator (KG-82)	32
Other Equipment		
125	TDMM	16
127	Digital Signal Generator (DSG)	2
128	Nine-Channel Mux/Demux (NCMD)	72
129	TTY Controller	1
131	Local VDT Controller (LVDTC)	1
132	Mag Tape Unit Controller	1
133	Switching Controller A	1
134	Switching Controller B	1
135	COMSEC Controller A	1
136	COMSEC Controller B	1
137	Signaling Buffer Controller A	1
138	Signaling Buffer Controller B	1
139	PPI	1
140	DTG	30
141	Switch Mux/Demux (SMD)	15
142	Loop Mux/Demux (LMD)	5
143	Remote VDT Controller (RVDTC)	1

1/ As delivered

5. External Connections to the AN/TTC-39D. Same as the AN/TTC-39A(V)4 (see paragraph 8, Section B).

6. Card Locations. See paragraph 9, Section B and Tables II-14 to II-27.

SECTION D

MSE SWITCHING DESCRIPTION

1. General. This section is divided into two subsections: Subsection 1 is a technical and functional description of the MSE CSs, and Subsection 2 is a summary of MSE switch features.

SUBSECTION 1

MSE CIRCUIT SWITCHES

2. Introduction. The MSE system employs three types of switching assemblages: the node center switch (NCS), AN/TTC-47(V); the large extension node switch (LENS), AN/TTC-46(V); and the small extension node switch (SENS), AN/TTC-48(V). At EAC the LENS and SENS are employed in conjunction with the AN/TTC-39D. Notation is made where differences exist between the design and employment of MSE switches at EAC and ECB. In addition, this subsection describes the switches that are part of the contingency communications package (CCP).

3. NCS AN/TTC-47 Description

a. Functional Description. The NCS is used primarily for automatic tandem switching. It also provides 24 local subscribers service for signal command and control. Figure II-1 is a functional block diagram of the NCS. The NCS provides the principal network interface for the RAU (local and remote), LENS, and SENS. The NCS interoperates with the following equipment:

(1) AN/TTC-39 series.

(2) AN/TYC-39 series.

(3) NATO Analog Interface (STANAG 5040).

(4) NATO Digital Interface (STANAGs 4206-4212, 4214).

(5) AN/TTC-42.

(6) SB-3865.

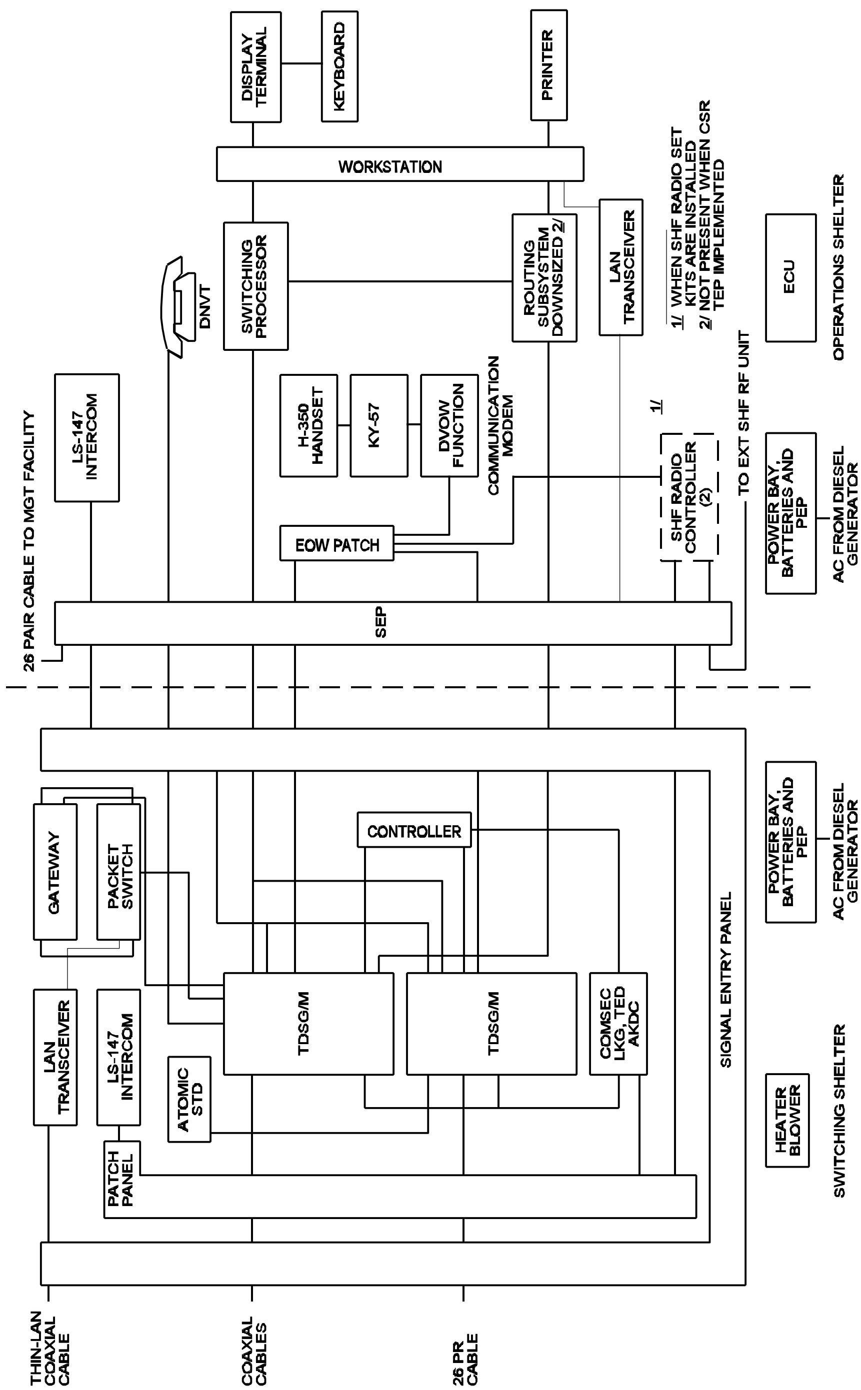


Figure II-1. AN/TTC-47C(V)1 Functional Block Diagram

b. Technical Description. The NCS is fielded in two assemblages: switching group/shelter, ON-306/TTC-47(V); and the operations group/shelter, OL-413/TTC-47(V). Table II-31 lists the major equipment in the MSE NCS objective configuration, AN/TTC-47C(V)1.

Table II-31. AN/TTC-47C(V)1 Equipment

Operations Group Assemblage	Switching Group Assemblage
Communication Modem, MD-1270	COMSEC Group (1) Dual LKGs, KG-112 (8) (2) AKDC, KGX-93A (3) TUNA, HGF-96 (4) TED, KG-194A (15)
RSSD 1/	Timing Group
(1) Modular Power Supply, PP-8277 (2) Routing Unit, CP-1997	Time Division Switching Group Modified
Workstation c/o: (1) Computer, AN/UYK-86(V)3 (2) Floppy Drive (3) Display & Keyboard (4) CSP Headset Control (5) Printer	Packet Switch Set c/o: (1) Packet Switch, AN/TYC-20 (2) Packet Gateway, AN/TYC-19
Switching Processor	Timing Group
LAN Transceiver	LAN Transceiver (2)
SHF Radio Control Module Mounting	--

1/ Not present when CSR TEP is implemented.

(1) Switching Group Shelter. The shelter provides the external interface and line switching functions and is populated with the following major equipment:

(a) TDSGM. The TDSGM, using the 16-kbps channel rate, provides external terminations for digital trunks and loops and DTGs. The DTG interface can be assigned in various modularities of 8 or 9 channels, up to a maximum of 144, from the workstation display terminal and keyboard under software control. The TDSGM contains the equipment necessary to interface with digital loops, trunks, and groups; combine and decombine individual channels; and perform switching between individual terminations. Equipment includes a time-division switching matrix, group and supergroup multiplexers and demultiplexers, line interfaces, modems, buffers, timing control, the EOW interface, and BITE. The NCS employs 2 TDSGM modules to provide the following 648 digital terminations:

1. 31 packet switch terminations.

2. 8 TSBs.

3. 10 DSBs.

4. 16 DTGs.

5. 20 digital receivers.

6. 24 digital loops.

7. 4 CBUs (20 ports).

8. 8 STANAG 5040 analog interfaces.

9. 14 STANAG 4206-4212, 4214 digital interfaces.

10. 512 digital matrix terminations.

(b) Timing Group. The MSE system uses a voice digitization rate of 16 kbps and performs the switching function on these channels in a bit-interleaved format. This requires all switches to operate with bit synchronization to maintain bit count integrity (BCI) for support of the COMSEC equipment.

1. Bit synchronization is achieved by employing highly accurate atomic timing standards at each NCS/LENS. RAU, SENS, RMC, and subscriber sets acquire timing from the incoming bit streams provided by the NCS/LENS. The NCS/LENS employs an MTG, which derives its accuracy from the atomic standard.

2. The Timing Group consists of an atomic standard, a master timing group (MTG), and timing circuits. The atomic standard is a militarized rubidium beam frequency and time module. The module provides frequency accuracy within $\pm 2.0 \times 10^{-11}$ over a temperature range of -25C to +60C. The module uses a rubidium beam tube resonator to stabilize the output of an ultrastable quartz oscillator to

provide the output signals from the unit. Accuracy and stability of this rubidium standard are determined by the rubidium atom's atomic resonance. The interface in the switch is via the rubidium standard interface card, which provides signal buffering and frequency synthesis of the rubidium standard output to a compatible frequency for phase-locking the MTG.

3. The MTG employs redundant crystal oscillators for reliability. These oscillators exhibit a long-term aging rate of 1.0×10^{-9} parts per day and require annual recalibration by unit-level maintenance personnel.

(c) Controller Group. The Controller Group provides the interface between the switching processor and the switch devices. This group consists of a COMSEC controller, signaling buffer controller (SBC), and a switching controller.

1. The COMSEC controller processes and controls command and status information for the interface between the switching processor and the COMSEC equipment.

2. The SBC processes and controls the data transfer between the switching processor and the TSB/DSB devices.

3. The switching controller contains a central controller and six separate device controllers. The central controller provides the common interface between the switching processor and the device controllers through which all data, status, and command signals are routed. The individual device controllers provide separate interfaces between the central controller and the devices located in the TDSGM as follows:

a. The scanner controller provides control functions for digital scanners.

b. The receiver controller provides control functions for digital receivers.

c. The matrix controller is a bidirectional device controller that sends commands from the central controller to the TDMX and returns status from the TDMX to the central controller.

d. The sender/special devices controller enables the CPU central controller to transmit configuration and control data to the TDSGM.

e. The Fault Controller provides the control function and collection point for all device BITE error and status reports returned to the switching processor for evaluation.

f. The test generator controller provides an online diagnostic function for all switching controllers and the central controller. All switching controllers are tested together with the switching controller.

(d) COMSEC Group. The switching shelter is equipped with 15 TEDs and 1 TUNA (HGF-96), housing 8 dual-LKGs and 1 modified AKDC (KGX-93A). The LKG provides cryptographic support for a variety of terminal equipment. Under switch control or manual operation, rack-mounted LKGs accomplish synchronization, resynchronization, and key transfers necessary to operate and process end-to-end encrypted traffic and to encrypt/decrypt traffic between encrypted (KY-68) and unencrypted (i.e. TA-1042) terminations. The TEDs are full-duplex, synchronous devices used to provide DTG bulk encryption and decryption. The AKDC unit interfaces with TEDs and LKGs and provides automatic key-generation distribution and storage for the NCS.

(e) Packet Switch (PS) Set. The PS capability of the NCS includes one AN/TYC-20 packet switch and one AN/TYC-19 gateway. The PS provides access for five 64-kbps PS trunks, one 16-kbps X.25 PS dial-up interface, two IEEE 802.3 10-Mbps LAN ports, one 64-kbps gateway trunk, and one 16-kbps X.25 gateway dial-up port. If the dial-up gateway port is not used, an additional 64-kbps gateway trunk is available.

(2) Operations Group Shelter. This shelter provides central processing and operator interface functions and is populated with the following major equipment:

(a) Switching Processor. This processor serves as the functional interface between the OPG and the RSSD and the TDSG Controller Group to enable the performance of all call processing and switch control functions. These include such features as conference calls, compressed dialing, call forwarding, call transfer, DAS, commercial network access, and automatic line hunting. Database organization within the processor allows for online integrated BITE monitoring of the CPG through the VDU at the supervisory position.

(b) Control/Alarm Panel (CAP). The CAP is equipped with indicators, alarms, and switches that enable the operator to monitor and control various operations. The CAP provides a summary fault-alarm system that presents both audible and visual alarms when a major system fault is detected. The CAP also provides for manual selection on the call-processing function and allows the EUB function to be initiated in the event of an NCS processor failure.

(c) Super High Frequency (SHF) Radio Set Control Module. When installed, this module contains controls and indicators used to operate and monitor the SHF radio link. The module operates with DTG and orderwire equipment and the externally mast-mounted radio module.

(d) Transceiver. This transceiver interfaces with a transceiver in the Switching Shelter to provide the workstation to the PS set for configuration and troubleshooting.

(e) Workstation. The workstation consists of a UNIX-based computer, AN/UYK-86(V)3, floppy disk, display and keyboard, headset control for the call service position (CSP) function, and printer. The workstation serves as the primary local operator/machine interface to NCS switching processors. It combines the functions of the VDU, MTT, and CSP found in the earlier models. The printer is used for maintaining a hard copy output of various switch operations.

(f) DVOW. Six DVOW channels are used in the NCS to provide voice communications between shelters. The operator can select either a private channel or any combination of multiparty conversations. All DVOW traffic is encrypted using a KY-57. A communications modem, MD-1270, provides the orderwire capabilities.

(g) DVOW Patch Panel. This patch panel has three rows of jacks. In each row there are 3 jacks in each group, with a total of 10 groups in the top row and 6 groups in the bottom row. In the top row, the first eight groups are labeled GM/DVOW 1 through 8. The remaining two are labeled SHF 1 and SHF 2. The bottom row is arranged so that each jack in this row is exactly below the corresponding jack in the top row. These six groups of jacks in the bottom row are labeled DVOW CHAN 1 through 6. Lines from the first eight groups of jacks in the top row go to each of eight different DTGs in the switching shelter. Lines from the SHF 1 and SHF 2 group of jacks go to the SHF 1 and SHF 2 units in the switching shelter.

1. Each jack in the bottom row lies directly below the corresponding jack in the top row, and each of these vertical pair of jacks is through connected. A patch cord inserted into the top jack (GM/DVOW) interrupts the through connection to the bottom jack and connects that patch cord to the line going out to a DTG in the switching shelter. A patch cord inserted into the bottom jack (DVOW CHAN) interrupts the through connection to the top jack and connects that patch cord to the line going to the OCU. GM/DVOW jacks 7 and 8 are connected to the remaining two of eight DTGs in the switching shelter. To use the orderwire over these DTGs, one of the six DVOW CHAN group of jacks 1 through 6 must be patched to GM/DVOW jacks 7 or 8. Table II-32 shows the connections between GM/DVOW jacks on the OCU patch panel with the DTG/MDTG located in the switching.

Table II-32. Patch Panel GM/DVOW Jacks and Related Switching Shelter DTG/MDTGs

GM/DVOW Number	DTG/MDTG Number	DVOW CHAN
1	1	1
2	5	2
3	9	3
4	25	4
5	26	5
6	27	6
7	28	N/A
8	16	N/A

2. When using an orderwire over the SHF radio, the DTG switch in the switching-shelter patch panel must be set to SHF and patched to one of the two SHF units. On the OCU patch panel, the CLK jack in the OCU channel going to the DTG must be patched to the CLK jack on the

selected unit SHF unit to use the OCU clock rate for SHF transmission.

c. Switching Shelter Patch Panel. The patch panel is located along the curbside wall. It enables the operator to perform the following functions: loop-around for MDTGs and DTGs; loop-around for digital loops; baseband loop-around for SHF 1 and 2 radios (if equipped), and MDTGs 25, 26, 27, and 28; select timing of either internal or recovered MDTGs; and access manual test and monitoring points for up to three TDSGM terminations.

(1) The NCS accommodates 16 DTGs, 15 of which are encrypted by TEDs. Typically four of the encrypted DTGs are used for internodal trunking; six encrypted DTGs are used for extension switches; and two DTGs, one encrypted (remote site) and one unencrypted (local), are used as RAU interfaces. The remaining DTGs can be used for additional LENS, SENS, RAUs, and SCC interfaces and to satisfy other interface requirements, such as EAC and NATO. Following is an explanation of the basis of the standard DTG/MDTG database that is loaded during initialization.

(a) DTGs 1, 5, and 16 can be multiplexed into an MDTG or via a GM using the low-speed DTG switch.

(b) DTG 16 does not have a GM.

(c) DTG 9 (local RAU) does not have a TED.

(d) DTG 5 (SCC) is equipped with a TED but must be bypassed because the SCC is not equipped with a TED.

(e) NCS DTGs use a standard conditioned diphase signaling format. The GM cards are electronically strapped for diphase or dipulse by the NCS software. The dipulse setting allows the switch to interface with Army Tactical Communications System (ATACS) assemblages.

(f) NCS DTGs are assigned at standard group and channel rates. The channel rate is always 16 kbps. The standard database tape assigns NCS DTGs at 1,024 kbps; LENS at 512 kbps; and SENS, RAUs, and SCCs at 256 kbps. RMCs are assigned a data rate of 288 kbps. DTGs may be installed at group rates of 72 to 2,304 kbps.

(g) Figure II-2 depicts the application of the standard NCS database.

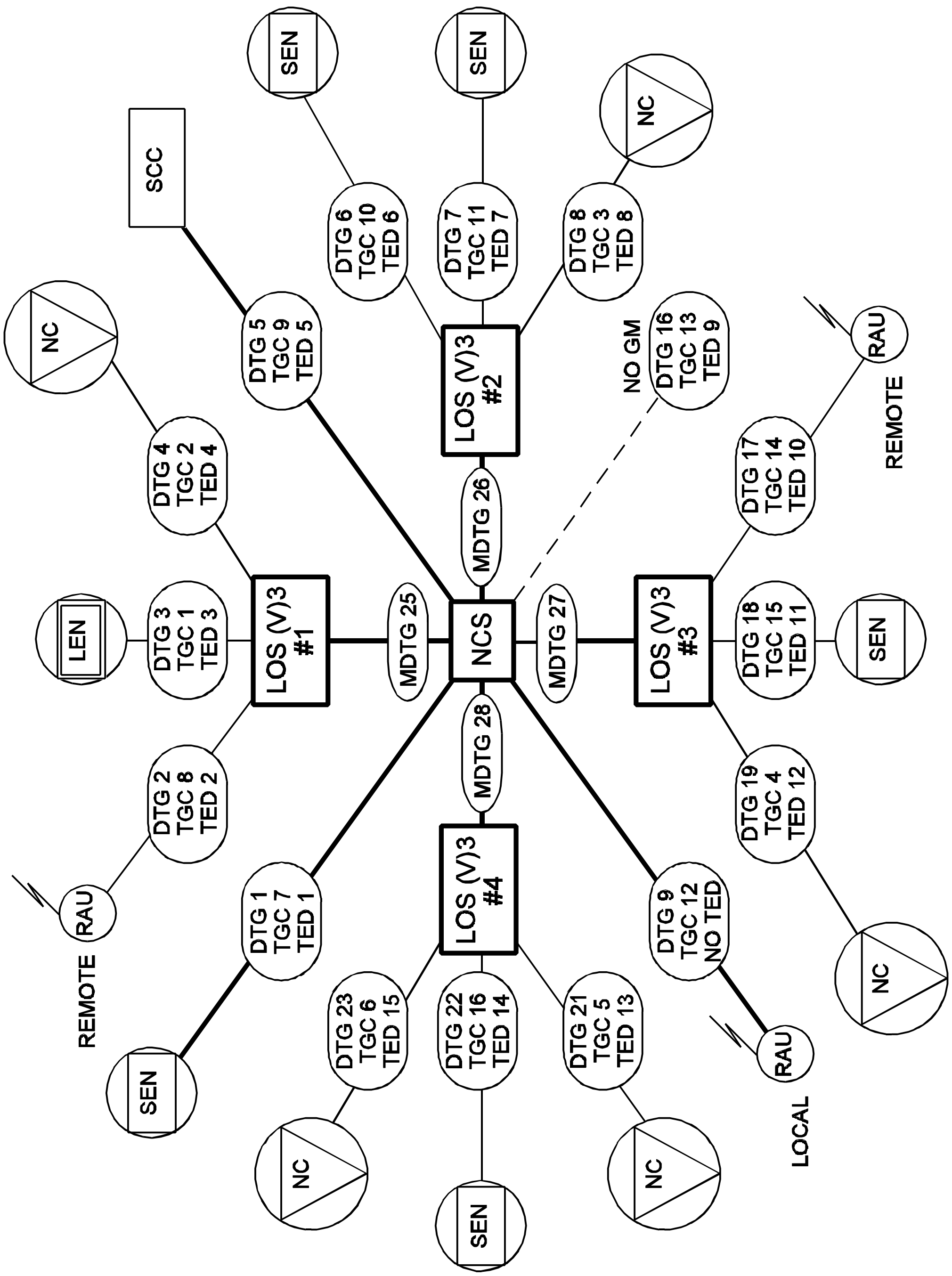


Figure II-2. NCS Standardized Data Base

(2) Use of Patch Panel. Most signaling and data lines entering the switching shelter pass through the patch panel. The panel contains the following equipment:

(a) MDTG and DTG Jacks

1. At the top of the patch panel there are jacks for four MDTGs (CABLE NO. 1 through CABLE NO. 4) and four DTG cables (CABLE NO. 5 through CABLE NO. 8). Cable numbers 1 through 4 handle MDTGs 25, 26, 27, and 28, respectively; cable numbers 5 through 8 handle DTGs 1, 5, 9, and 16 and, except for DTG 9, have provision for TED encryption. For each MDTG and DTG there are four jacks arranged in a two-over-two grouping. The jacks interrupt the MDTG or DTG receive and transmit lines between the GM and the connector at the SEP. The GM receives data from the field over the left pair of jacks while it transmits data to the field over the right pair. However, for the GM to receive over these lines, a looping plug must be inserted into the left vertical pair of jacks for receiving and the right pair for transmitting. The row of jacks labeled FIELD provides access to the lines going to the SEP, and the row of jacks labeled GM provides access to the lines going to the GMs in the switching matrix. The location of the GM in the TDSG card rack and the reference designation of the SEP jack for each MDTG/DTG are listed in Table II-33.

Table II-33. MDTG/DTG GM Locations and SEP Jack Reference Designations

MDTG/DTG	GM Rack Location 1/	SEP Jack
1	TDSG1 A502	A8A5
5	TDSG1 A508	A8A6
9	TDSG1 A514	A8A7
16	TDSG2 A502	A8A8
25	TDSG2 A302	A8A1
26	TDSG2 A307	A8A2
27	TDSG2 A312	A8A3
28	TDSG2 A317	A8A4

1/ Rack Number: Row Number-Card Slot number.

2. Each MDTG has multiplexed on it a number of DTGs. Each MDTG used in the NCS and the DTGs that are multiplexed are listed in Table II-34. DTGs 1, 5, and 16 can be switched out of the shelter instead of being multiplexed onto their MDTGs. Subparagraph (f), below, describes how these DTGs are selected to become directly connected DTGs. The MDTGs normally connect to LOS(V)3 shelters for transmission to remote subscribers. However, DTGs normally connect to local shelters, SENS, RAUs, SCCs, and DNI. DTG 9 cannot be multiplexed onto an MDTG, and, because it has no provision for encryption, it can never be connected to an LOS radio assemblage. DTG 9 is normally connected to the local RAU.

Table II-34. MDTG and Its Multiplexed DTGs

MDTG NO.	DTGs Multiplexed onto MDTGs
25	1[1/], 2, 3, 4
26	5[1/], 6, 7, 8
27	16[1/], 17, 18, 19
28	21, 22, 23

1/ Low-speed DTG switches permit these DTGs to bypass the MDTG.

(b) Loop Jacks. Below the MDTG/DTG jacks are jacks for the three field cables used in the NCS configuration. Each cable has 12 pairs of transmit and receive lines, plus 2 spares. In the switching shelter there are 12 pairs of transmit and receive lines going to each cable from the switching matrix diphase loop modems, through the patch panel, and to the SEP. At the patch panel each transmit and receive line passes through a pair of jacks that have a normal through connection. The two spare lines in the field cable are connected separately to each jack in the spare pair. This spare pair of jacks does not have a normal through connection. The jacks in the receive and transmit lines have their connections interrupted when a patch cord is inserted into one of the jacks. A patch cord inserted into the jack on the FIELD side interrupts the through connection and connects that patch cord to the line going out to the SEP. A patch cord inserted into the jack on the NETWORK side interrupts the through connection and that patch cord to the line going to the switching matrix diphase loop modem. Loop cable 3 has been designated as the NATO group and only 8 of 12 lines are used in this application. The location of the diphase modems in the TDSG card rack and the reference designation of the SEP jack for each loop cable are listed in Table II-35.

Table II-35. Loop Cable Diphase Modem Location and SEP Jack Reference Designations

Loop Cable Number	Diphase Modem Rack Location 1/	SEP Jack
1	TDSG1 A526, 28, 30	A8J1
2	TDSG1 A533, 35, 37	A8J2
3	TDSG2 A526, 28, 30	A8J3

1/ Rack Number: Row Number-Card Slot Number.

(c) Monitor/Test Jacks. These jacks are provided for accessing, testing, and monitoring three TDMX terminals. The jacks are arranged in three vertical groups labeled TD1, TD2, and TD3. The top row of jacks is labeled SWITCH TEST. These jacks are on lines going to three different switch multiplexer input lines that tie into three separate TDMX terminals. These jacks have through connections with the corresponding middle row of jacks. The middle row of jacks is labeled SWITCH OUTPUT. These jacks are on lines that go to three switch DEMUX output lines corresponding to the multiplexers connected to the jacks in the top row. The last row of jacks is labeled MONITOR, and each jack is hardwired to the jack above it in the middle row. These jacks permit the patch cord inserted into the SWITCH TEST jack monitoring of the TDMX DEMUX output line. A plug interrupts the through connection to the SWITCH OUTPUT jack and connects that patch cord to the line going to the TDMX terminal. This connection permits a signal to (1) be inserted into a TDMX terminal through the patch cord; and (2) use the software, for example, to connect the inserted signal to any other TDMX terminal. A patch cord inserted into the SWITCH OUTPUT jack interrupts the through connection to the SWITCH TEST and connects that patch cord to the line going to the TDMX DEMUX output. These jacks are not used by the shelter operators and are not used at operator and intermediate levels of maintenance.

(d) Intercom and DNVT Jacks. A single, vertical pair of jacks is used for the intercom. One jack is connected to one intercom line, and the other jack is connected to the other intercom line. These jacks provide a means of connecting another intercom in parallel with the existing intercoms so that a patched-in intercom can communicate with each of the existing intercoms. The DNVT jacks consist of a vertical pair that is in the receive line and another vertical pair that is in the transmit line. Each vertical pair of the DNVT jacks has a normal through connection. A patch cord inserted into the top jack interrupts the through to the bottom jack and connects that patch cord to the line going to the SEP. A patch cord inserted into the bottom jack interrupts the through connection to the top jack and connects that patch cord to the line to the modem in the switching matrix.

(e) Timing Source Rotary Switch. This switch selects the reference for the MTG from one of three sources: the timing standard reference oscillator (installed in the shelter (switch position labeled MA)), or the frequency being used on one of two MDTGs (MDTGs 25 or 26) connected to either another NCS or a LENS. When MDTGs 25 or 26 are being used as the timing source, they cannot be used as an SHF link, since timing cannot be recovered over an SHF link. Normally the switch is set in the MA position so that the timing standard reference oscillator is used as the frequency reference source.

(f) Low-Speed DTG Switches. These switches permit the three local DTGs (1, 5, and 16) to bypass their associated MDTGs and be directly transmitted out of the switching shelter. With the switches set at the bottom position (MUX), DTG 1 is multiplexed onto MDTG 25, DTG 5 is multiplexed onto MDTG 26, and DTG 16 is multiplexed onto MDTG 27. With the switches set to the top position (NGM or GM), DTGs 1, 5, and 16 are directly connected to the SEP.

(g) SHF 1 and SHF 2 Jacks. Separate transmit, receive, and clock lines from the SHF 1 and SHF 2 equipment installed in the operations shelter are connected to groups of jacks. These lines must be patched into the jacks associated with one of the four DTG selector switches on the patch panel that allow for the transmission and reception of that DTG line over the SHF equipment, as described in subparagraph (i) below.

(h) TED Bypass Jacks. These jacks permit bypassing the TED equipment on DTGs 1 and 5. Each of the two DTGs has a pair of through-connected jacks in their receive, transmit, and clock lines (labeled MODEM SIDE) going from the modem to the TED. The two DTGs also have a pair of through-connected jacks in their receive, transmit, and clock lines (labeled SWITCH SIDE) going from the TED to the switch. With no patching of the TED BYPASS jacks, a signal on the DTG line between the modem and the TED (MODEM SIDE) is ciphered text either going into the TED to be deciphered or leaving the TED after being ciphered. The signal on the DTG line between the TED and the switch (SWITCH SIDE) is in plain text. By patching the top row of the MODEM SIDE jacks to the bottom row of the SWITCH SIDE, the TED is bypassed. The line with the bypassed TED goes out as a low-speed DTG or is multiplexed onto the MDTG, depending on the setting of the LOW SPEED DTG switches.

(i) MDTG 25, 26, 27, and 28 Switches. These switches permit MDTGs 25, 26, 27, and 28 to operate in one of three positions: GM, SHF, and LP BK. Also associated with each switch is a set of transmit, receive, and clock jacks that are used to patch the lines in that DTG to either SHF 1 or SHF 2. In the GM position, the switch permits the MDTG line in which it is installed to go to the SEP through the GM. In the SHF position, the DTG line goes to the SHF unit it is patched to instead of going through the GM. In the LP BK position, the transmit line going to the GM is connected to the receive line so that the transmitted signal is looped back to the transmitting source for test purposes.

4. LENS AN/TTC-46(V) Description

a. Functional Description. The LENS is primarily used as a network access switch for local service to wire subscribers. It functions similarly to the NCS but is populated to emphasize digital loop-termination capability. Figure II-3 is a functional block diagram of the LENS. The LENS can serve up to 164 wire subscribers who access the switch by connecting a terminal device (DNVT or DSVT) to a junction box (J-1077) or to an RMC. The LENS is interconnected with two NCSs, each link composed of a 32 channel DTG. A maximum of 84 subscribers can access the LENS through the 7 J-1077s provided. Up to 80 subscribers can access the LENS through 10 RMCs. The 10 RMCs are subdivided by connecting them piggy back by coax cable to create 5 DTGs. The LENS interoperates with the following:

(1) AN/TTC-39 series.

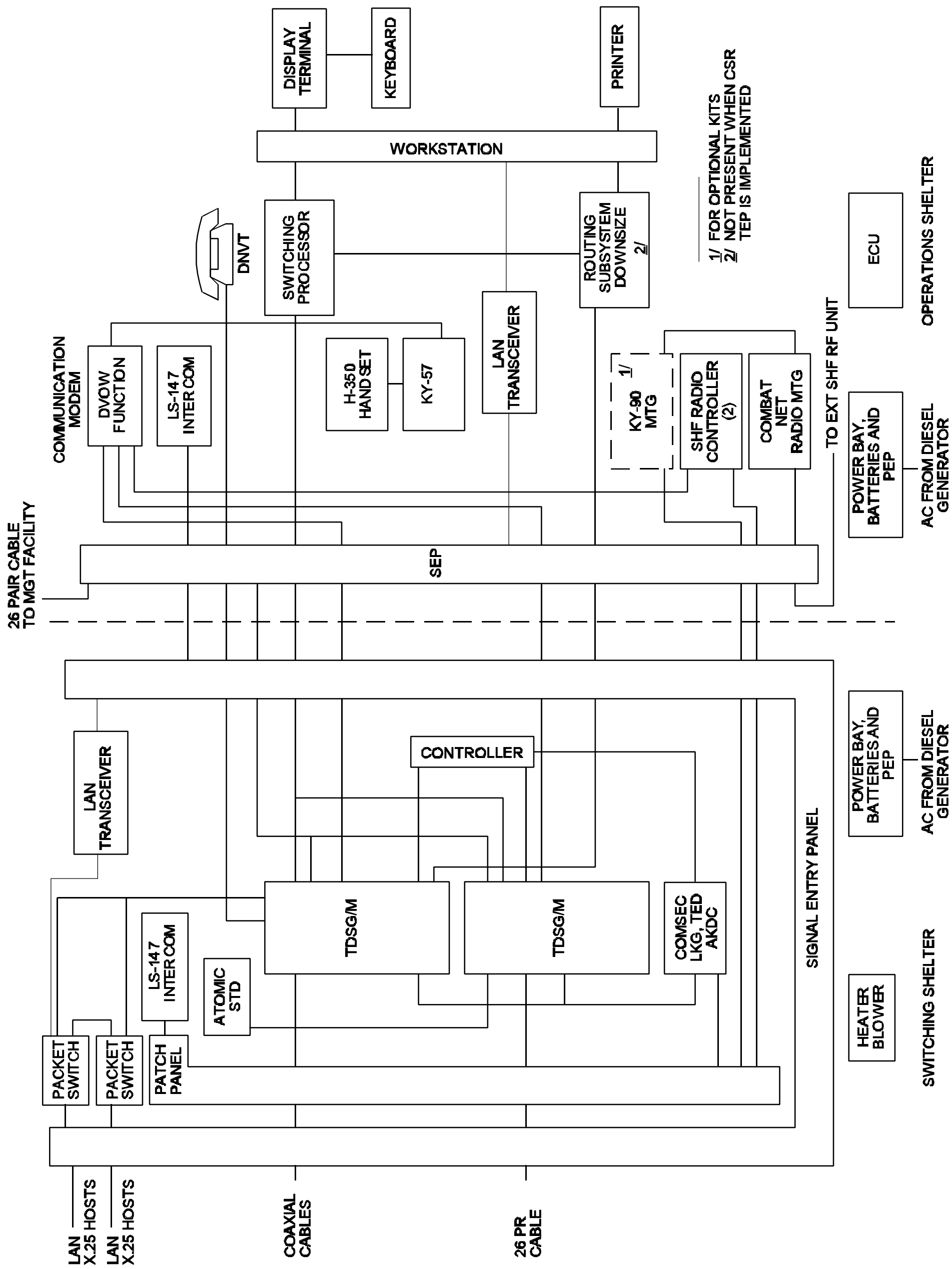


Figure II-3. AN/TTC-46C(V)1 Functional Block Diagram

(2) AN/TYC-39 series.

(3) AN/TTC-42.

(4) MSE series.

(5) SB-3865.

(6) Commercial networks.

b. Technical Description. Like the NCS, the LENS is fielded in two assemblages: switching group shelter, ON-306/TTC-46(V); and operations group shelter, OL-413/TTC-46(V). Table II-36 lists the major equipment in the objective model, AN/TTC-46C(V)1.

Table II-36. AN/TTC-46C(V)1 Equipment

Operations Group	Switching Group
Communication Modem, MD-1270	COMSEC Group: (1) Dual LKG, KG-112 (8) (2) AKDC, KGX-93A (3) TUNA, HGF-96 (4) TED, KG-194A (3)
RSSD c/o : 1/ (1) Modular Power Supply, PP-8277 (2) Routing Unit, CP-1997	Packet Switch, AN/TYC-20 (2)
Workstation c/o : (1) Computer, AN/UYK-86(V)3 (2) Floppy Drive (3) Display and Keyboard (4) CSP Headset Control (5) Printer	Timing Group
Switching Processor	TDSG Modified
LAN Transceiver	LAN Transceiver (4)
SHF Radio, AN/GRC-224 (2)	Signal Data Converter, CV-4206
Combat Net Radio and SDNRIU Mounts	--

1/ Not present when CSR TEP is implemented.

(1) Switching Group Shelter. The switching shelter provides the external interfaces and line switching

functions and is populated with the same major equipment as the NCS.

(a) TDSGM. The TDSGM is similar to that which is used in the NCS except for the quantities of terminations and common equipment. The LENS employs two TDSGM modules to provide the following 648 digital terminations:

1. 9 digital packet switch

2. 4 TSBs.

3. 4 DSBs terminations.

4. 8 DTGs.

5. 20 digital receivers.

6. 164 digital loops.

7. 2 each 4-wire SF and 2 each 2-wire dc, analog, commercial access trunks.

8. 4 CBUs (20 ports).

9. 256 digital matrix terminations.

(b) Timing Group. This group is the same as NCS.

(c) Controller Group. This group is the same as NCS.

(d) COMSEC Group. The same COMSEC equipment is used in the NCS, except that only three KG-194A TEDs are required.

(e) PS Set. The LENS PS equipment consists of two AN/TYC-20 packet switches. The PS provides access for two 64-kbps PS trunks, one 16-kbps PS trunk, seven X.25 dedicated host ports, and four IEEE 802.3 10-Mbps LAN ports.

(2) Operations Group Shelter

(a) The Central Processor Group is the same as used in the NCS.

(b) The Operator Equipment Group includes the same equipment as used in the NCS. In addition, it provides two radio control units (RCUs) for the SHF radios and space and power for inclusion of a combat net radio (CNR) and a secure digital net radio interface unit, KY-90. The SHF radio set (AN/GRC-224) includes an RCU, a 9-meter mast assembly, and an RF module and antenna subassembly. The radio operates in the 14-15 GHz range and is used when cable can't be used to connect the LENS to the LOS assemblage. The control unit, located within the shelter, operates at 256, 512, 1,024, and 4,096 kbps. (See Chapter XVIII, CJCSM 6231.04 for a detailed description of the AN/GRC-224.)

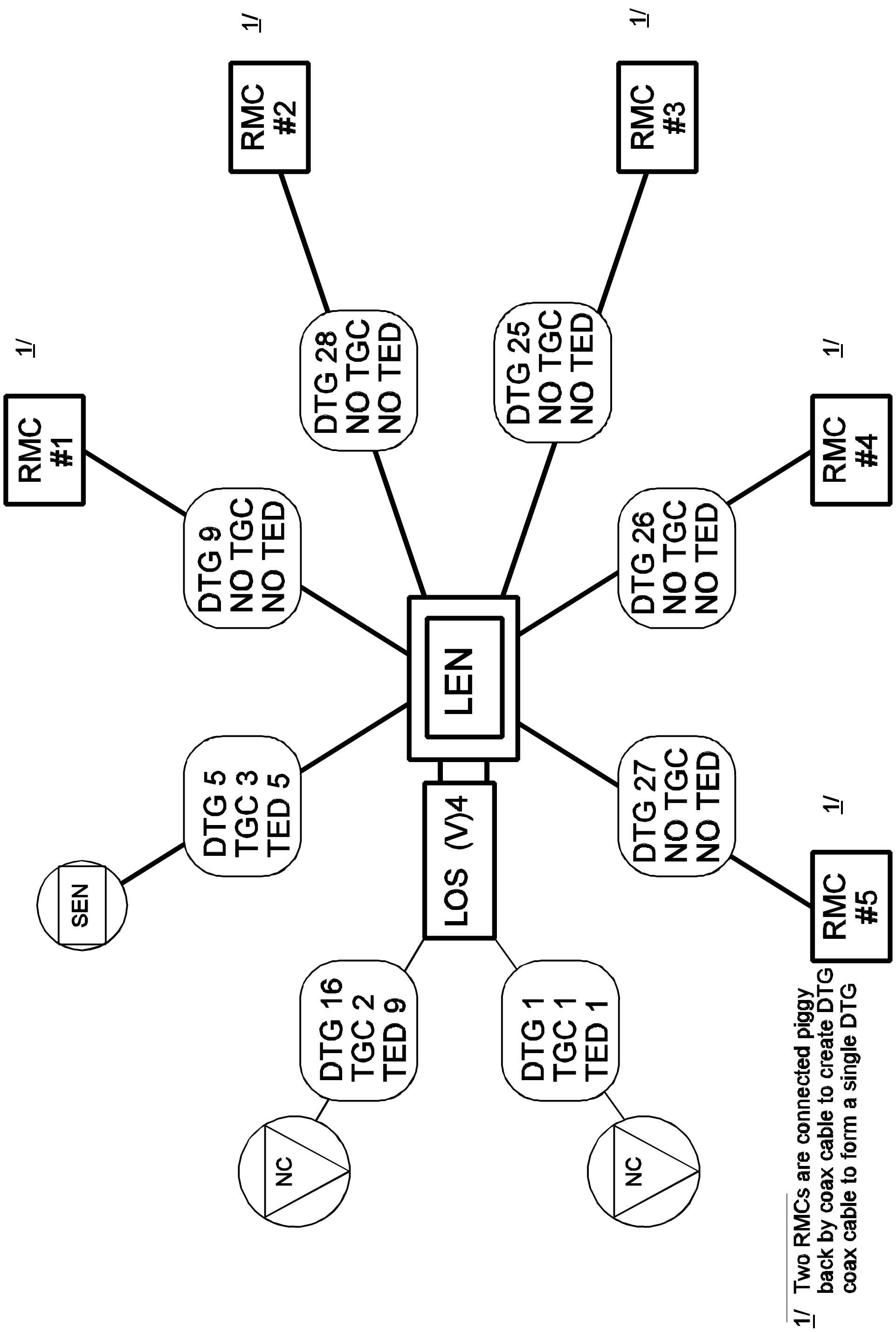
(3) Switching Group Patch Panel. The patch panel is located along the curbside shelter wall and enables the operator to perform the following patching, monitoring, and testing options: loop-around for DTGs; loop around for digital loops; baseband loop around for DTGs 1 and 16; timing of either internal or external DTGs; manual test and monitoring points for up to three TDMX terminations; and a CNR interface patch.

(a) The LENS accommodates eight DTGs, three of which are encrypted by TEDs (DTGs 1, 5, and 16). As shown in Figure II-4, the standard database for the LENS, the three encrypted DTGs provide dual-NCS access via a LOS(V)4 and a single, local SENS or RAU connection.

(b) The design and layout of the patch panel is similar to that in the NCS.

1. DTG Jacks. There are jacks for eight DTGS (1, 5, 9 ,16, 25, 26, 27, and 28), and the design and arrangement of jacks is identical to that which is in the NCS. The lines in DTGs 25, 26, 27, and 28 normally connect to RMCs, but the lines in DTGs 1, 5, and 16 normally connect to NCSs and a SENS. Table II-37 lists DTG GM locations, SEP jack reference designations, and associated OCU channels.

2. Loop Jacks. Loop jacks in the LENS are identical to NCS. Table II-38 shows the location of loop-cable diphase modem and SEP jack reference designations.



1/ Two RMCs are connected piggy back by coax cable to create DTG coax cable to form a single DTG

Figure II-4. Large Extension Node Standardized Data Base

Table II-37. DTG GM Locations, SEP Jack Reference Designations, and DVOW Channels

DTG	DVOW Cabinet	GM Rack Location [1/]	SEP Jack
1	1	TDSG1 A502	A8A5
5	2	TDSG1 A508	A8A6
9	--	TDSG1 A514	A8A7
16	3	TDSG1 A502	A8A8
25	--	TDSG2 A302	A8A1
26	--	TDSG2 A307	A8A2
27	--	TDSG2 A312	A8A3
28	--	TDSG2 A317	A8A4

1/ Rack Number-Row Number-Card Slot Number.

Table II-38. Loop-Cable Diphase Modem Location and SEP Jack Reference Designation

Loop Cable Number	Diphase Modem Rack Location [1/]	SEP Jack
1	TDSG1, A526, 28,30	A8J1
2	TDSG1, A533, 35, 37	A8J2
3	TDSG1, A402, O4, 06	A8J3
4	TDSG1, A409, 11, 13	A8J4
5	TDSG2 A526, 28, 30	A8J5
6	TDSG2 A533, 35, 37	A8J6
7	TDSG2, A402, 04, 06	A8J7
8	TDSG2 A409, 11, 13	A8J8

1/ Rack Number-Row Number-Card Slot Number.

3. Monitor/Test Jacks. These jacks are identical to NCS.

4. Timing Source Rotary Switch. As in the NCS, the switch selects the reference frequency for the MTG from one of three sources. DTGs 1 and 16 cannot use an SHF radio link because timing control cannot be recovered.

5. DNVT and NRI Jacks. Each vertical pair of DNVT and NRI jacks has a normal through connection. A patch cord inserted into the top jack interrupts the through connection to the bottom jack and connects that patch cord to the line going to the SEP. A patch cord inserted into the bottom jack interrupts the through connection to the top jack and connects that patch cord to the line going to the modem in the switching matrix.

6. Intercom Jacks. There are jacks to accommodate two intercoms. These jacks provide a means of connecting another intercom in parallel with the existing intercoms so that a patched-in intercom can communicate with each of the existing intercoms.

7. DTG 1 and 16 Switches. These switches are identical in operation to the MDTG switches in the NCS.

(4) LENS Configuration. At EAC, the LENS configuration, AN/TTC-46C(V)1, is 100 percent identical to its counterpart at ECB; however, no use is made of the inherent dual-SHF and CNRI capabilities. It normally interconnects with the AN/TTC-39D. The KY-68 (DSVT), TA-954 (DNVT), or TA-1042 (DNVT) subscriber sets are used with the LENS. The TA-1042, a new version of the DNVT, is equipped with a digital data port and operates in the auto dial/answer mode at 16 or 32 kbps.

5. SENS AN/TTC-48(V) Description

a. Functional Description. The SENS is an attended mobile communications system that provides CPs with automatic, local, secure switching and wire subscriber access. It also includes provisions to interconnect with a CNR and can interoperate with commercial networks. (See Figure II-5.)

(1) There are two configurations of the SENS. The (V)1 provides 26 digital loops and 11 DIBTS trunks while the (V)2 provides 41 loops and 13 DIBTS trunks. At ECB the SENS normally supports battalions and brigades. At EAC the SENS normally supports a major subordinate command (see subparagraph 5b(2)). Both versions provide two dc-closure

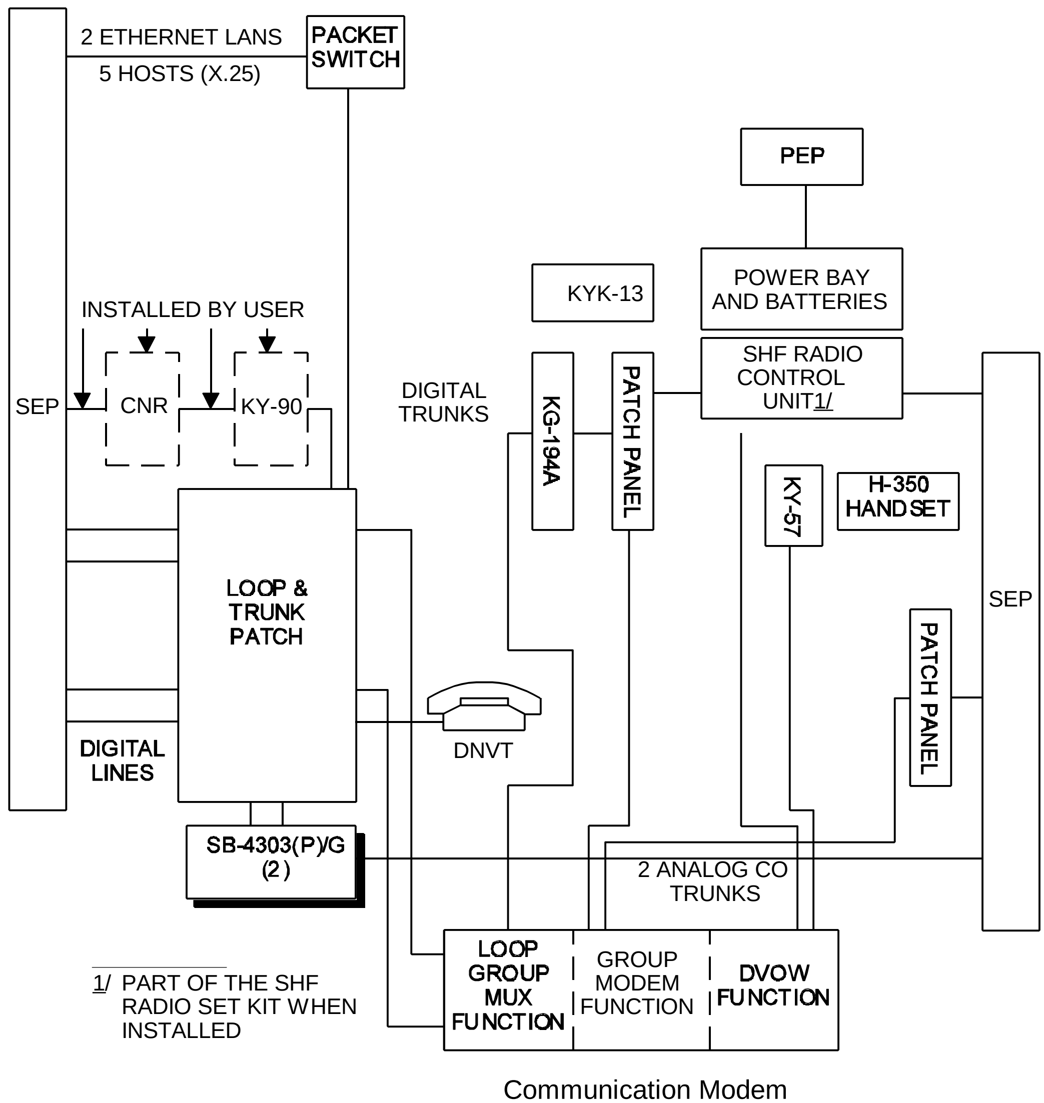


Figure II-5. AN/TTC-48C(V)1 and C(V)2 Functional Block Diagram commercial office interfaces and mountings for the KY-90 and a CNR.

(2) The SENS provides three transmission options for trunk interconnection: CX-11230/G cable; LOS(V)1; and GMF TACSAT terminals.

b. Technical Description. The principal equipment in the objective model, AN/TTC-48C(V)1 and C(V)2, is shown in Table II-39.

Table II-39. SENS Equipment Configuration

Equipment Item	Quantity
Switchboard, SB-4303	2
TED, KG-194A	1
Packet Switch, AN/TYC-20	1
Signal Data Converter, CV-4206	1
ThinLan Interface Port	2
SHF Radio Mount	1
KY-90 Mount	1
Combat Net Radio Mount	1

(1) Below is a discussion of the principal equipment items within the SENS:

(a) Communication Modem. The communication modem combines the GM, LGM, and DVOW functions into a single unit.

(b) SHF Radio Set, AN/GRC-224(P). Provision is available to mount one SHF radio to connect the SENS to its LOS assemblage. The radio operates at 256 kbps.

(c) COMSEC Equipment

1. TED. The KG-194A provides encryption to the NCS or LENS.

2. KY-57. The KY-57 is used in conjunction with the communication modem for encryption of DVOW traffic.

(d) CNR Mount. This mount is a bracket that can accomodate a user supplied AN/VRC-12 or AN/VRC-90(V).

(e) Secure Digital NRI Unit. When installed, the KY-90 provides a secure communications interface between the SENS CNR and remote CNRs. This interface provides a CNR with a manual (operator assistance) access to the MSE switching system.

(f) Packet Switch. Each SENS contains a PS configured to support two IEEE 802.3 LANs, one 16-kbps PS trunk, and five conditioned diphase X.25 host interfaces. The hosts interface with the PS through an SDC, but the LANs use transceivers.

(g) SDC. The SDC, CV-4206/TTC, converts RS-423A data into conditioned diphase and vice versa. It enables X.25 compatible hosts to use standard MSE equipment to interface with the MPN.

(h) ThinLan Transceivers. Two transceivers provide a 10-Mbps medium access LAN interface for coaxial cable to the PS.

(2) The AN/TTC-48A(V)2 is normally employed at EAC. The EAC SENS interconnects with the AN/TTC-47, AN/TTC-39A(V)1, AN/TTC-39A(V)4, or AN/TTC-39D. It supports 41 local subscribers, 13 DIBTS trunks to the parent CS, and 2 DCO trunks. The SB-4303 switchboard is set for the 16 or 32 kbps voice digitization rate of the parent CS. At EAC the SENS is not equipped with either the CNR interface or SHF capabilities. The subscriber sets used with the EAC SENS are the KY-68, TA-954, and the TA-1042A/U.

6. Contingency Communications Package (CCP). The CCP is a repackaged version of MSE assemblages and equipment assigned to XVIII Airborne Corps and selected light forces signal units. The CCP enables airborne, airmobile, and light force units to establish an initial contingency communications. The CCP is capable of being airlifted in two sorties. The CCP includes two types of switches, as discussed below.

a. Force Entry Switch (FES). The FES, nomenclatured AN/TTC-50, Communications Central, is a CCP assemblage that emulates both NCS and LENS functions in a single shelter.

It also provides the radio access unit (RAU) capability. It can be employed as either a contingency communications parent switch (CCPS) or a contingency communications extension switch (CCES). The CCPS can be situated at a CP or airfield. The CCES, which can be situated to support a task force headquarters, provides local wire and mobile subscriber access, as well as access to the CCPS. The CCES utilizes a dismounted LOS (V)1 to link to the CCPS.

(1) Interfaces. The FES is capable of interfacing with the following equipment:

(a) MSE.

(b) AN/TTC-39 series.

(c) AN/TYC-39 series.

(d) AN/TTC-42.

(e) SB-3865.

(f) DSN.

(g) Commercial central offices.

(h) NATO analog and digital.

(i) Combat net radio.

(2) Terminations. In the CCPS application, the FES provides support for up to 117 subscribers using 2 versions of the dismountable LTU: (a) 3 digital, CV-4180(V)3; and (b) 1 analog, CV-4180(V)4 and 12 subscribers using a J-1077. Each of the 3 digital LTUs supports up to 35 subscribers; a single analog LTU supports 8 commercial office and 8 DSN circuits. In the CCES application, one analog and one digital LTU is provided.

(a) The FES can provide eight TED-encrypted and two unencrypted DTGs and one MDTG (supergroup).

(b) The FES has an integral RAU capability that can support up to four simultaneous MSRT calls.

(3) Major Equipment. The FES is populated with the major equipment shown in Table II-40.

Table II-40. AN/TTC-50 Equipment Complement

Equipment	Quantity
Packet Switch, AN/TYC-20	1
Workstation: AN/UYK-86(V)3 c/o: Display Keyboard Printer Floppy disk drive	1
Group Logic Unit, C-11865	1
Radio Set, RT-1539	4
Antenna Multicoupler, CU-11865	1
ThinLAN Transceivers	3
COMSEC Device, KY-57	1
COMSEC Group	
Dual LKGs, KG-112	8
TEDs, KG-194A	4
AKDC, KGX-93A	1
TUNA, HGF-96	1

(4) Packet Switch. The FES support two LANs, four internodal trunks, and one dial-up circuit.

(5) Radio Set, RT-1539. The four radios provide the RAU capability.

(6) Group Logic Unit (GLU). The GLU controls the RAU.

(7) Antenna Multicoupler. This unit mates the RAU to the antenna.

b. Dismounted Extension Switch (DES). The DES, nomenclatured AN/TTC-51, Switching Set, Communications, is a dismounted SENS that can be employed to quickly establish support for small, remote CPs.

(1) The DES's external interfaces include the CNR interface, digital loop interface, commercial office interface, and digital trunk interface. The DES connects to the AN/TTC-50 (FES) or MSE parent nodes using LOS radio links or coaxial cables.

(2) The DES is packaged in transit cases and can be cabled directly to the FES or employed as a stand-alone system connected to a dismounted LOS (V)1 radio, AN/TRC-198(V)2 (see Chapter XVIII, CJCSM 6231.04).

(3) The DES provides 16 local subscribers and 10 internodal digital encrypted DIBTS trunks. With 3 stacked switchboards, up to 52 digital loops can be supported.

(4) The DES consists of the equipment listed in Table II-41.

Table II-41. AN/TTC-51 Equipment List

Equipment Item	Quantity
Communication Modem, MD-1270	1
TED, KG-194A	1
COMSEC Device, KY-57	1
Electronic Transfer Device, KYK-13	1
Switchboard, SB-4303	1
SDC, CV-4215 (Optional)	1

SUBSECTION 2

MSE SWITCHING FEATURES

7. Introduction. Because MSE switches were derived from the AN/TTC-39 series technology, they incorporate many of the same features. In the following discussion only those features unique to MSE are described.

a. System Features

(1) Flood-Search Routing. The MSE system uses a nondeterministic flood-search routing technique to locate called subscribers and set up the circuit connections for the call. Using this technique, calls are automatically routed over optimum routes on a call-by-call basis without the need for switch routing tables.

(a) A call begins when the calling subscriber places the telephone handset off-hook and dials digits. If the call is a local, wire-line, NCS/LENS subscriber, the switch collects the dialed digits. If the calling subscriber is mobile, the digits are first collected by the MSRT, transmitted to the RAU, and then transmitted to the NCS. When the calling subscriber is a SENS subscriber, the digits are collected by the SB-4303, and, if the call is not local or one of the subscribers is a DSVT, the call is forwarded to the NCS or LENS. Successful digit validation and translation results in formulation of a search message. The NCS or LENS sends the search message to all other connected NCSs or LENSs via flood-search routing.

(b) Each switch receiving a search message examines its subscriber affiliation table for the called directory number. If the called party is not affiliated at that switch, the search message is forwarded to all other connected NCSs, and the path is marked (but not reserved) for possible routing. An exception is the LENS, which does not forward search messages from an NCS (to prevent tandem traffic through the LENS). The terminating switch, where the called party is affiliated, sends a return message back over the marked routing path. The originating switch then broadcasts end-of-routing messages to all connected nodes so that switches not involved in the marked path can then clear their routing registers of that call attempt.

(c) Restrictions are placed on the broadcast of search messages to ensure network-wide traffic regulation and to provide for call precedence during route selection.

A precedence threshold level is periodically determined for each interswitch link, and search messages are transmitted only if the precedence level is equal to or higher than the current threshold level for that link. In addition, search messages are sent to connected switches in a most-idle-or-preemptable-trunks order to automatically select the route that tends to minimize network congestion. A search message is sent over a link only in which trunks are currently available.

(2) Interswitch Signaling. The MSE system uses integrated CCS, in conjunction with the flood-search routing technique, to locate a subscriber and to supervise the call once circuit connections have been made.

(a) CCS is used to transfer all internodal and NCS-to-LENS signaling messages. CCS messages sent to and received from the switches for call placement contain a full 13-digit called subscriber number in the form 9YX+XXX+LNX+XXXX (where Y=0 or 1, and X=0 through 9). The originating switch inserts the 6-digit nationality identifier (NI) and area code or zero-fills if none is dialed. Flood-search messages and call-connection messages use separate overhead channels to avoid congestion.

(b) DIBTS is used to transfer all SENS to NCS/LENS signaling messages. The SENS forwards the dialed digits to the NCS for nonlocal calls and calls requiring parent COMSEC switch processing, using the DIBTS signaling message formats. All subsequent call supervision is also performed in-band.

(3) Subscriber Telephone Numbers. The MSE system uses a fixed-directory, deducible subscriber number, based on STANAG 5046. This deducible number enables system users to determine subscriber directory numbers without knowing a subscriber's location or network connectivity. The MSE system accepts 7-, 10-, and 13-digit subscriber numbers. Directory numbers for intra-area (within a single corps MSE network) subscribers are based on the 7-digit format (LNX+XXXX). Directory numbers for interarea subscribers are preceded by the appropriate area code MYX. NATO directory numbers are preceded by the international access code 9YX+WXX. Table II-42 lists the dialing formats used by MSE subscribers.

Table II-42. MSE Subscriber-Dialed Digit Sequences

Digit Sequence	Destination
R+LNX+XXXX	Direct MSRT-MSRT call
8R+PC+LNX+XXXX	Subscriber affiliation
8C+PC+LNX+XXXX	Subscriber disaffiliation
(P)+0	Call-service attendant
(P)+LNX+XXXX	Intra-area subscriber
(P)+MYX+LNX+XXXX	Interarea subscriber or EAC
(P)+9YX+WXX+XXXXXXX	NATO subscriber
(P)+NXC	Compressed dialing
(P)+C+(number)	Progressive conference call
(P)+1C+(number)	Security required call
2C+(number)	Call forwarding
(P)+4C+(number)	End-to-end encrypted call
(P)+5C+(number)	Commercial call
(P)+6C+NX	Preprogrammed conference
(P)+6R+TGC+LNXXXXX	Force dial trunk group cluster
(P)+MYX+88XXXXX	Packet-switched dial-up port access
(P)+MYX+89XXXXX	Packet-switched gateway dial-up port access

Legend:
(P) - optional precedence level code
PC - subscriber's 3-digit personal affiliation code
(Number) - Any valid attendant or subscriber directory number sequence will be permitted
C - "C" key on telephone keypad
L - any digit 1 through 7
M - any digit 2 through 8
N - any digit 2 through 9
R - "R" key on telephone keypad
X - any digit 0 through 9
Y - digit 0 or 1
W - indicates any digit 0 through 8
TGC - three digit TGC number 001-127

b. Subscriber Services

(1) Multilevel Precedence and Preemption. Same as AN/TTC-39 series.

(2) Voice Conferencing. Up to 4, 5-party conferences or various combinations of up to 1, 14-party conference may be accommodated at each NCS and LENS. Conference bridges within a particular NCS and LENS may be connected together as required to provide for conferences with more than 5 conferees. Each NCS or LENS provides up to 20 preprogrammed conferences, each of which may contain up to to 14 members.

(3) Call Security. Call security is the same as for other CBCSs.

(4) Commercial Network Access. Authorized subscribers can initiate calls to commercial networks. All incoming commercial access calls are intercepted and forwarded by the LENS or SENS operator.

(5) Compressed Dialing. Compressed dialing is the same as for the AN/TTC-39 series.

(6) DAS. The NCS and LENS DAS termination capacity (60 subscribers) is the same as the AN/TTC-39 series. At the SENS, up to 10 subscribers may be classmarked for DAS. DAS can be assigned as a paired operation where subscriber "A" can only call subscriber "B" and vice versa, or as a one-way operation where subscriber "A" can only call subscriber "B," but "B" can call any MSE subscriber except subscriber A.

(7) Zone Restriction. Zone restriction is identical to the AN/TTC-39 series with these exceptions: the Start and End codes (defining the restrictive areas) consist of either a 3-digit area code, a 4-digit unit code, or a 6-digit NATO area code in the form NYX, LNXX, or 9YXWXX, respectively.

(8) TLC. TLC functions are similar to those of the AN/TTC-39 series. Table II-43 depicts how the NCS or LENS uses the TLC classmarks.

(9) TGC Traffic Limitations. Same as the AN/TTC-39 series.

(10) <u>MSRT Access Restrictions</u>. Each RAU has eight radios. Whenever a RAU has fewer than three idle radios, the marker signal, which the RAU transmits continuously, is modified to indicate the presaturation state. As part of the affiliation process, each MSRT is assigned to one of two priority classes based on the precedence classmark in the subscriber's assigned classmark profile. FO, F, and I subscribers are designated as priority; P and R subscribers are designated as nonpriority. When the RAU is in the presaturation state, only priority subscribers are permitted to place calls. The priority status of the subscriber is stored by the MSRT at the time of affiliation. When the RAU marker indicates the presaturation state, a nonpriority MSRT returns a busy tone when the subscriber goes off-hook. The RAU can be set to one of three presaturation modes: automatic, forced, or inhibited.

Table II-43. Application of Traffic Load Control

	Traffic Load Control				
Subscriber Classmark	No Restrictions	Trunk Access		Switch Access	
	1	2	3	4	5
1. Most Essential	No Restrictions	Trunk Access	Trunk Access	Calls Allowed	Calls Allowed
2. More Essential	No Restrictions	No Trunk Access	Trunk Access	Calls Allowed	Calls Allowed
3. Essential	No Restrictions	No Trunk Access	No Trunk Access	Calls Allowed	Calls Allowed
4. Less Essential	No Restrictions	No Trunk Access	No Trunk Access	No Calls Allowed	Calls Allowed
5. Least Essential	No Restrictions	No Trunk Access	No Trunk Access	No Calls Allowed	No Calls Allowed

NOTE: Shaded area represents restricted access.

(a) In the automatic presaturation mode, the MSRT precedence levels are used to prohibit routine MSRT users from the RAU when two or fewer radio channels are available for network access. The restriction is only temporary. As soon as more than two radio channels are available, all MSRTs are allowed access.

(b) In the forced presaturation mode, all routine MSRT subscribers are inhibited from accessing the RAU.

(c) In the inhibited presaturation mode, all MSRT subscribers have RAU access.

(11) <u>EUB</u>. EUB is an important classmark. In loop circuits EUB is part of a subscriber's profile; in a SEN or RAU trunk group, it is a transmission group classmark. The EUB capability, provided in all NCSs and LENSs, reduces the effects of routing or switching failures on service to important subscribers.

(a) When switch operators determine the nature of a processor failure (based on the time limits established by the SOP), they set up the EOW to ring the service attendant at the switch that has been predesignated to service essential users. The switch supervisors and call service attendant then coordinate, verbally, because the EUB must be initiated manually. The NCS or LENS that accepts the EUB group of subscribers or trunks provides service as if these circuits were locally connected. The accepting switch reports by EOW to the SCC the circumstances causing the failure and the time EUB was initiated. Once in effect, the bypass set-up does not allow for disaffiliation or reaffiliation, a situation that stays in effect until the switch failure is corrected.

(b) Normally the essential user plan at a particular switch is used to distribute essential users among all the connected switches. The signal operating instructions (SOI) establish the order in which groups are to be bypassed. Tables II-44 and II-45 show the normal TGC assignments at an NCS and the priorities for bypassing TGCs in the case of EUB. Normally, the DNVT and TTY located in the management facility associated with the switch are part of the first essential user group to be bypassed. The SCC is kept updated on the progress of the bypass operation.

Table II-44. NCS TGC Assignment Chart

Usage	TGC	DTG	Port
INTERNODAL LINKS	TGC # 1	DTG #3	LENS PORT
	TGC # 2	DTG #4	NCS PORT
	TGC # 3	DTG #8	NCS PORT
	TGC # 4	DTG #19	NCS PORT
	TGC # 5	DTG #21	NCS PORT
	TGC # 6	DTG #23	NCS PORT
TGCs USED FOR AFFILIATED DIRECTORY NUMBERS CONNECTED TO: SENs RAUs SCCs	TGC # 7	DTG #1	LOCAL SEN PORT
	TGC # 8	DTG #2	REMOTE RAU PORT
	TGC # 9	DTG #5	LOCAL SCC PORT
	TGC # 10	DTG #6	REMOTE SEN PORT
	TGC # 11	DTG #7	REMOTE SEN PORT
	TGC # 12	DTG #9	LOCAL RAU PORT
	TGC # 13	DTG #16	LOCAL PORT (NO GM)
	TGC # 14	DTG #17	REMOTE RAU PORT
	TGC # 15	DTG #18	REMOTE SEN PORT
	TGC # 16	DTG #22	REMOTE SEN PORT
TGCs USED FOR: DUPLICATION OF CONNECTED SWITCHES SUBSCRIBER DATA BASE; BYPASS OF ESSENTIAL TGCs (SENs/RAUs/SCCs); BYPASS OF LOCAL ESSENTIAL USERS (FIRST FREE, FIRST USED)	TGC # 17		
	TGC # 18		
	TGC # 19		
	TGC # 20		
	TGC # 21		
	TGC # 22		
	TGC # 23		
	TGC # 24		
	TGC # 25		
	TGC # 26		
	TGC # 27		
	TGC # 28		
	TGC # 29		
	TGC # 30		
	TGC # 31		
AFFILIATED LOCAL USERS DIRECTLY CONNECTED TO THE SWITCH	TGC # 32		
	TGC # 33		
	TGC # 34		
	TGC # 35		
ABSENT SUBSCRIBERS	TGC # 36		
TGCs USED TO STORE PREAFFILIATION TABLES (PALs)	TGC # 37		
	TGC # 38		
	TGC # 39		
	TGC # 40		

Table II-45. NCS Priorities for Bypassing TGCs

Trunk Group Cluster	Priority	DTG Assignment
TGC # 7	2	Local SEN port
TGC # 8	3	Remote RAU port
TGC # 9	1	Local SCC port
TGC # 10	2	Remote SEN port
TGC # 11	2	Remote SEN port
TGC # 12	3	Local RAU port
TGC # 13	No GM	Local port
TGC # 14	3	Remote RAU port
TGC # 15	2	Remote SEN port
TGC # 16	2	Remote SEN port
TGC # 32	4	Affiliated local users
TGC # 33	4	Affiliated local users
TGC # 34	4	Affiliated local users
TGC # 35	4	Affiliated local users

(c) Once the switch operator informs the SCC that the failed processor has been repaired, the SCC issues instructions to reestablish service. The essential users affected by the bypass action must be passed back to the originating switch. This operation is coordinated using the EOW. The originating switch reports successful reacquisition as each group is reestablished.

(12) Line-Hunting Groups. Each NCS and LENS can accommodate up to 32 line-hunting groups, and each SENS up to 3.

(13) Absent Subscriber Mode. This feature allows subscribers to notify the NCS or LENS to which they are affiliated so that they will not be available to place or receive calls for an indefinite period of time. The subscriber initiates this feature by keying 8C, followed by the subscriber's 3-digit personal code and 7-digit directory

number. When calling an absent subscriber, the caller receives a recorded "not assigned" or "out-of-service" announcement.

(14) Call Forwarding. Authorized subscribers can have incoming calls forwarded to designated telephones in the MSE system. Up to 40 simultaneous call-forwarding calls can be accommodated per a NCS/LENS and 30 per a SENS.

c. Service Management. The following features are available to control subscriber assignments and operate network resources efficiently.

(1) Subscriber Profiles. The profile level defines the level of service authorized to each MSE subscriber. Each profile defines the type of service and classmarks (precedence, call restrictions, call forwarding) automatically assigned when the subscriber affiliates.

(2) Affiliation. Affiliation is the process by which subscribers enter and identify their location in the network. This allows the host NCS or LENS to determine the subscriber's profile. The subscriber initiates the affiliation process by keying 8R, followed by the 3-digit personal code and 7-digit directory number. When successful affiliation occurs, a subscriber receives dial tone. Three repeated unsuccessful affiliation attempts result in the receiving subscriber error tone, being added to the blacklist, and remaining in the unaffiliated state. If a subscriber is placed on the blacklist due to failed affiliation attempts, a call must be placed to the operator on a working telephone. The operator can then remove the subscriber from the blacklist. (See subparagraph (4) below for information on the blacklist.) Lists of subscribers may also be affiliated or preaffiliated by the switch operator, using the Assign Affiliation Lists (AAL) command.

(3) Preaffiliation List (PAL). The PAL is the key information source for the flood search routing process executed by the RSSD. The PAL is generated from inputs supplied by the user prior to fielding for inputting into the NCS, LENS, and SCC databases. A global database is maintained to facilitate the construction of global PALs. See Appendix J.

(a) The PAL identifies subscribers (individuals and units) likely to be connected to a corps-sized MSE network. There can be up to 999 PALs, each containing a maximum of 200 subscribers to cover a notional Army corps structure.

(b) Each sublist is developed corresponding to an Army unit, a command structure or echelon, or a community of interest. Each NCS and LENS in the same network (i.e., corps) will receive an identical PAL disk. The SCC will distribute to each NCS and LENS a hard copy of the activation list that specifies which units, by PAL sublist number, the switches are to activate.

(c) Each PAL consists of a deducible directory number (LNX+XXXX) and a 3-digit profile number. Each profile lists 17 classmarks that are assigned to each subscriber to define the level of service authorized. (See Table II-46.)

(4) Blacklist. Each NCS or LENS has a blacklist table that lists the directory number of those subscribers unable to affiliate. Unsuccessful affiliation may be due to a mismatch between the personal code stored in the network and the dialed personal code. This blacklist table contains the number of previous unsuccessful attempts to affiliate. Whenever a subscriber fails three successive attempts, the subscriber is blacklisted and any further affiliation attempts by that subscriber are not to be processed, even if the dialed personal code matches the stored personal code.

(5) Duplication. The NCS and LENS EUB function provides limited operation under degraded conditions. A feature, called duplication, enables extension of service to subscribers when extensive failure or damage (to the extent the entire switch is inoperative) has taken place. Duplication is the storing of subscriber directory and profile numbers from the database of an NCS or LENS in the databases of other NCSs or LENSs in the same network. Duplication ensures that the necessary subscriber information received from an adjacent NCS or LENS can be accessed when required to allow a subscriber from the failed switch to affiliate elsewhere in the network. If the SCC receives a message indicating that an NCS or LENS has failed or been destroyed, the network manager can order the activation of duplication lists. This order is issued to the selected switch by an SCC operational message. When the node manager of the selected switch receives this message, the appropriate man-machine interface command must be entered at the selected switch to activate the duplication lists for the failed switch (ALD command). Only one switch performs an ALD command, even if the failed switch was

duplicated to one or more switches in the network. Once the ALD command is done, a message is transmitted to other switches in the network that have duplication from the failed switch.

Table II-46. MSE Profile Classmarks

Profile Entry Classmark	Valid
Profile Number	1-255
Terminal Type	3 = DSVT, 13 = DNVT, 15 = DTA, or 16 = LG-1
Traffic Load Control	1-5
Security Level	N = Nonsecure R = Security Required, P = Security Preferred, or E = End-to-End.
Maximum Precedence	FO, F, I, P, or R
Terminal Characteristics	V = Voice, M = Multimode, or D = Data
MS Compatible	Yes or No
NRI	Yes or No
Progressive Conference	Yes or No
Call Forwarding	Yes or No
Commercial Network Access	Yes or No
Essential User	Yes or No
Compressed Dial	0-5
Zone Restriction	1-8
Direct Access	Yes or No
Rekey	1-25
Net ID A	2
NET ID B	27

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SECTION E

UNIT LEVEL CIRCUIT SWITCH DESCRIPTION

SUBSECTION 1

AN/TTC-42

1. General. The AN/TTC-42 is a shelterized, automatic telephone central office. It is capable of 16 or 32 kbps operation using deterministic routing. It provides automatic switching and subscriber service to the TRI-TAC family of 4-wire analog and digital telephone instruments, including DSVTs, DNVTs, and analog telephone terminals. It also provides switching service for 4-wire trunks, both single-channel and TDM groups. The AN/TTC-42 is sized to provide switching for 280 channels used for loops and trunks. The AN/TTC-42 provides end-to-end secure call services for subscribers equipped with DSVTs. The AN/TTC-42 also furnishes nonsecure call services for analog telephones and DNVT-equipped subscribers. Call services provided include loop-to-loop, loop-to-trunk, trunk-to-loop, and trunk-to-trunk connections. The AN/TTC-42 also performs automatic and semiautomatic switching for selected analog loops and trunks. Each AN/TTC-42 has a COMSEC capability for secure communication through an interface that is compatible with a TED, KG-94/KG-194. The AN/TTC-42 provides both end-office and tandem switching functions, as well as extension of services automatically to digital subscribers located at subordinate SB-3865 switchboards. The AN/TTC-42 also acts as a COMSEC Parent Switch to the SB-3865.

2. Architecture

a. Equipment Complement. The AN/TTC-42 consists of the major components listed in Table II-47. These units are housed in a modified electrical equipment shelter, S-280 B/G. The equipment electronics are functionally divided into eight subsystems, discussed in subparagraphs 2c through j below.

b. Block Diagram. A simplified functional block diagram is shown in Figure II-6. Overall systems control is provided by two SCPUs. During normal operation, one SCPU is in the online mode and the other is in standby mode. All calls are routed using the deterministic method. The system includes an MCPU that continuously monitors system performance using diagnostic test routines.

Table II-47. AN/TTC-42 Major Components

Unit Number	Nomenclature	Common Name	Description/ Function
1	Shelter, Electrical Equipment Type S-280B/G, Modified	Shelter	Houses units 2 through 8. Protects crew and equipment from environment.
2	RED Switch Cabinet Assembly	RED Switch Cabinet	Houses and protects switching, patching, and signaling components.
3	BLACK Switch Cabinet Assembly	BLACK Switch Cabinet	Houses and protects termination, patching, and signaling components.
4	COMSEC Cabinet Assembly	COMSEC Cabinet	Houses and protects COMSEC equipment.
5	Maintainer-Supervisor Position	Maintainer-Supervisor Position	Provides system control station for maintenance and supervisory personnel and man-machine interfaces. A dot matrix printer is available to obtain hard copy printouts of data and messages displayed on the VDU.
6	Call Service Unit, C-11954/TTC-42(V)	CSU	Provides facilities for call service operator assistance.
7	Voice Orderwire Control Unit, C-11955/TTC-42(V)	Voice Orderwire Control Unit (VOCU)	Provides Maintainer-Supervisor with control facilities for EOW circuits.
8	Power Distribution Cabinet Assembly	Power Distribution Cabinet	Houses and protects internal power units and power control circuits.
9	Fault Assistance Module Kit, AN/TTC-42	Fault Assist Module (FAM)	Houses and protects CCAs, electronic modules, and magnetic tape used in troubleshooting the system.

c. <u>Termination Subsystem</u>. The termination subsystem

Table II-47. (Cont'd)

provides terminating and signaling functions to and from all systems that use the following: external cable connection and protection circuits; single-channel digital and analog loop or trunk supervision and signaling circuits; and multichannel digital trunk supervision and signaling circuits. Interface and patching are also provided for digital and analog EOW circuits. The termination subsystem converts inbound subscriber signals to digital bit streams compatible with the system logic. These signals are applied to the matrix subsystem and EOW circuitry, either directly or by the COMSEC subsystem.

(1) All terminations to the AN/TTC-42 are made at the SEP. This panel serves as the tie point for all signals entering or leaving the shelter and also provides lightning and EMP protection.

(2) Single-channel terminations connect from the SEP to the single-channel patch and monitor panel in the single-channel termination group. This panel provides a normal through connection for each of eight WM-130 (CX-4566) cables. In addition, two WM-130 cables provide 24 spare circuits. These spare circuits do not have normal through connections, but can be patched-in to replace any single-channel termination on which an external fault has occurred.

(3) Analog and digital loops and trunks from the single-channel patch and monitor panel are connected to 2-wire and 4-wire ALTUs (2W ALTUs and 4W ALTUs), AIUs, and DLTUs. The 2W ALTUs, 4W ALTUs, and AIUs digitize incoming analog signals, and the outputs of all termination units are applied to the MUX portion of the MUX/DEMUX in the matrix

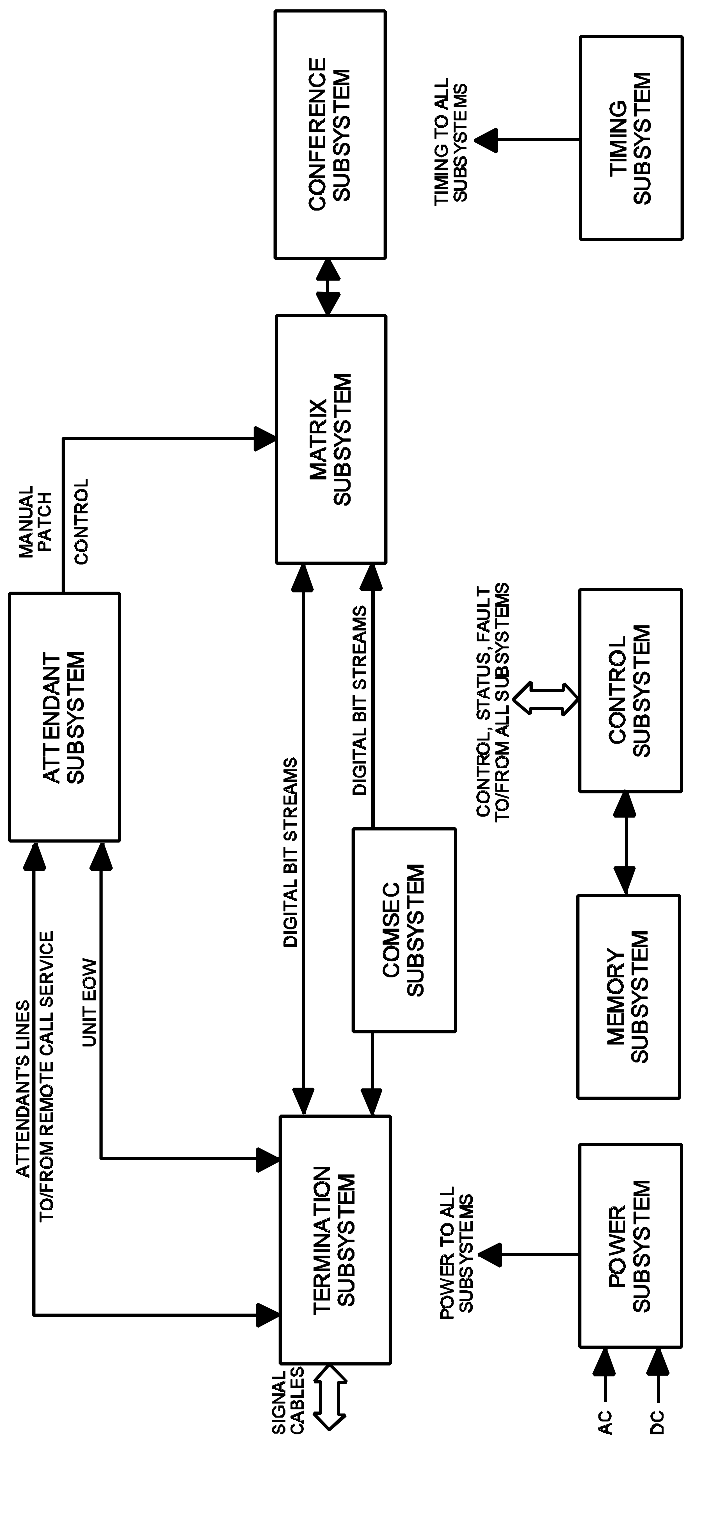

Figure II-6. AN/TTC-42 Functional Block Diagram subsystem. Outgoing signals from the DEMUX portion of the MUX/DEMUX are converted to subscriber signal formats. These signals are then connected to the single-channel patch and monitor panel and to the SEP.

(4) TDM group terminations at the SEP are connected to BLACK and RED group modems in the multichannel group. The modems convert TDM group signals to system signal format. BLACK trunk groups from the BLACK group modems are connected to a Black Electronic Patch. RED trunk groups from the RED group modems are connected directly to a framing circuit. Under program control, a RED Electronic Patch, together with a BLACK Electronic Patch, allows an operator to select one TED to be inserted into one of the designated BLACK trunk group paths. The framing circuit processes group signals, which are then applied to the time space matrices in the matrix subsystem. Outgoing signals from the time space matrix are applied through the FRC to either the RED modem or (through the RED Electronic Patch, TED, and BLACK Electronic Patch) to the BLACK modem as required. The modems convert the signals to the proper format and apply them to the signal lines through the SEP.

(5) The analog signaling group interfaces with the 4W ALTUs, AIUs, or both to provide incoming, SF scanning of supervisory signals and reception of tone signals, and outgoing signaling with supervisory and DTMF signals. Incoming signals are scanned by an SF scanner, and tones are received by a DTMF/SF receiver. Outgoing supervision and signaling is accomplished by a DTMF/SF sender.

(6) The digital signaling group interfaces with DLTUs and group modems through the time space matrices. Digital scanner and receivers scan and receive supervisory and signaling codes for incoming signals; DIBTS or TSBs provide the signals for outgoing signaling. An in-band trunk sender is used to send in-band digital code analog tone synthesizer trunk messages supplied by the control subsystem. An auxiliary test receiver is used for verifying the correct operation of the DCATS and for loop-back testing of various switch circuits.

(7) The EOW group is on each side of the RED-BLACK boundary. BLACK EOW consists of an AVOW patch, a DVOW patch, and a VOCU, which can be used in-shelter or remotely. RED EOW facilities consist of a CVDOW patch, a combined voice and data orderwire unit, and a data orderwire combiner (DOC). The DOC interfaces with the MUX/DEMUX in the matrix

subsystem; and the AVOW and DVOW circuits interface with the VOCU via the black patch panel.

d. Matrix Subsystem. The matrix subsystem is an electronic switching device which, under program control, provides the interconnection between terminations. There are two separate matrices, the switching and patching matrix and the scanner/receiver matrix. This subsystem permits any switch termination to be connected to any other switch termination over an independent signal flow path.

(1) The matrix subsystem uses TDM techniques, whereby incoming and outgoing connections to the matrix are sequentially switched to permit timesharing by all subscribers. This scheme provides a nonblocking matrix; that is, all call requests can be served simultaneously. Because these time-switching operations occur in microseconds, the matrix connections appear to be continuous to subscribers. Normally, calls are switched through the matrix under control of the online SCPU in the control subsystem. However, if the control subsystem fails, calls can be manually connected through the matrix. This occurs using the Control Panel in the Maintainer/Supervisor Position.

(2) Data is routed through the matrix subsystem in serial, digital bit streams. These bit streams are organized into highways, each consisting of 36 channels. The matrix subsystem is designed to handle up to 16 highways: highways 1 to 10 are used for call traffic; highways 0 and 15 are used for testing; and highways 11 to 14 are spares reserved for future expansion.

e. Attendant Subsystem. The attendant subsystem provides the operator-machine interface and includes a CSU and a Maintainer/Supervisor Position.

(1) The CSU provides call-service assistance, including directory assistance and special call-service assistance. The CSU may be used in either the in-shelter or remote positions. An interface is provided between the attendant subsystem and the CSU console when the latter is used in a remote position outside the shelter. The CSU contains a keyboard, switch and adjustment controls, a headset interface, and indicators required for attendant operation. In addition, the CSU provides the functions required for call-service assistance to switch subscribers. This service assistance includes (a) call-completion assistance; (b) directory and routing information; (c)

outside network call completion; and (d) busy and no-answer verification. It also establishes conference calls and verbal precedence or preemption requests.

(2) Two basic units are used to perform the call-service function: the remote CSU and the call-service interface. The CSU, a portable module, contains the controls and indicators necessary for the attendant to perform the call-service function. As a detachable module, it may be removed from the interior of the shelter and positioned up to 30 meters away. The call-service interface consists of the electronics necessary to interface the CSU, in its local or remote position, with the switch control processor and the switch matrix through the MUX/DEMUX.

(3) The Maintainer/Supervisor Position provides switch-related supervisory tasks, such as accomplishing database assignments and changes, reconfiguring switch functions, implementing COMSEC communications, and maintaining the system.

(4) The AN/TTC-42 is capable of providing a sole-user patch when full-time data links or other continuous duty lines are required. The patch is made electronically by means of the attendant's keypads.

f. Timing Subsystem. The timing subsystem provides timing signals and distributes them throughout the system to coordinate synchronous digital operations. It can function as a master timing device or it can be slaved by timing signals derived from external sources. The timing subsystem generates, synchronizes, divides, and distributes the timing signals required by each AN/TTC-42 subsystem. Because these timing signals are critical to system operation, two identical timing channels are provided. During operation, one timing channel is online and the other is in the standby mode. The timing subsystem design permits the control subsystem to switch all or part of either timing channel if a failure occurs. The timing subsystem can be operated in either of two operating modes, MASTER mode or SLAVE mode. In the MASTER mode, timing is derived directly from the timing subsystem's MASTER VCXO. In the SLAVE mode, the frequency and phase of the MASTER VCXO is controlled by external timing sources. These external timing sources are supplied to the timing subsystem by TDM Modem No. 1 or Modem No. 7. Operating mode and timing source selection are controlled by the maintainer or supervisor using the switches on the timing control panel in the Maintainer/Supervisor Position.

g. <u>Conference Subsystem</u>. The conference subsystem provides the AN/TTC-42 with a five-party, full-duplex conference bridge capability. The bridge functions for any combination of analog or digital conferees at either a 32 or 16 kbps CVSD conversion rate. Circuitry is contained on two conference bridge CCAs, A and B. They are housed in the Red Switch Cabinet in card nest slots 2A7A23 and 2A7A25, respectively.

(1) The conference subsystem performs the following functions:

(a) Provides voice bridging among all five conferees.

(b) Provides side-tone suppression to every party.

(c) For nonsecure conferences, generates the NSW tone and distributes it to all parties.

(d) Detects the C tone from the conference originator.

(e) Provides D/A and A/D conversions for every party.

(f) Provides automatic gain control within the pairs of CVSD conversions.

(g) Provides suppression of the 2,600 Hz signal for every party.

(h) Provides the I/O interface with the control subsystem.

(i) Suppresses power line noise.

(2) An 8-bit bidirectional I/O interface to the conference bridge allows the SCPU to command CVSD conversion rates for each party and also enables the NSW tone. Operational conversion rates may be monitored and verified by the SCPU software. The NSW tone is either On or Off, depending on the stage of the control bit command.

(3) Also contained in the status word is the digit C detect signal. Once an analog conference master is assigned to the bridge, the SCPU reads the status at a scanning interval (14.5 ms) and monitors the least

significant bit. The presence of a logic 1 for 2 scans will cause the SCPU to take further action by connecting a receiver (analog) to the conference master input. The receiver verifies the digit C presence from the master before any subsequent digit acceptance. The digital receiver verifies the digital digit C in the same manner as above, when the digital scanners report the presence of digit C.

(4) The input and output of the bridge are single-channel appearances from the DEMUX and to the MUX, respectively. In the 32-kbps switch, these channels are either 2 bits wide for the 32-kbps subscriber or 1 bit wide for the 16-kbps subscriber. The I/O interface is composed of buffers for the tri-state data bus and also includes selector MUXes for CVSD conversion rate-clock selection.

(5) Addition and subtraction functions are performed in the analog domain. All incoming subscriber signals are summed along with the output of an NSW tone generator to provide one common bridge summation point. Each subscriber's input signal is then subtracted from this bridge summation signal to provide an output signal to each party. This subtraction process prevents subscribers from hearing their own signals fed back to them from the bridge. A 2,600-Hz passive notch filter is provided for each output signal to prevent the release of all analog trunks when any analog conferee leaves the conference.

(6) The analog digit C detection on the conference master input signal is accomplished with dual-tone decoders and integral phase-locked loops. These devices are tuned for 941 Hz or 1,477 Hz. Each detector's outputs are combined in an AND function. When each frequency is within the acceptable bandwidth at the minimum level, the AND output becomes active as the status word's digit C detect bit.

(7) NSW tone is injected into the bridge summation point when the SCPU commands the NSW tone to On. The tone is generated with a dual-monolithic timer circuit, one timer interrupting the other. The NSW signal is a 1,050-Hz tone at -14 dBm, which is enabled every 6 seconds for 50 ms.

(8) AN/TTC-42 analog and digital subscribers classmarked for conference privilege, and the attendant, can originate conference calls. To establish a conference call, the originator (conference master), after receiving dial tone, dials precedence (optional), plus C, and then the

called number of the first conferee. The C digit indicates to the processor that the conference bridge is required. The processor seizes the bridge or attempts to preempt it at the dialed precedence level if precedence has been dialed. If the bridge cannot be seized, the busy tone is returned. If the bridge can be seized, the called conferee is rung. Upon answering, the called conferee is connected to the bridge's conferee port. The originator is then connected to the master port of the bridge. The two parties can now converse using the conference bridge. If one of them is the attendant or a nonsecure subscriber, the NSW tone is added.

(9) By depressing the C key, the originator may add conferees. This causes the originator to receive dial tone. The originator can now dial the called number of another conferee. If the called conferee is busy (in which case busy tone is returned to the originator), if the called subscriber does not answer, the originator may depress C. This releases the outgoing connection and returns the originator to the conference bridge. By depressing C again, the originator receives dial tone and may call another conferee. The originator may call up to four conferees. If the originator attempts to call a fifth conferee, he receives a 2-second error tone and is returned to the conference bridge. When the originator goes on-hook, all conferees are released and the conference bridge is returned to idle.

h. COMSEC Subsystem. The COMSEC subsystem interfaces with the termination subsystem to process secure calls and maintain TRANSEC. The COMSEC module is entered once for every cycle of call processing. Upon entry, the module determines (a) if a request is being processed by the AKDC or (b) if a current request exists in the COMSEC request queue. If neither case exists, exit from the module is immediate.

(1) If the AKDC is processing a request, then the COMSEC module obtains the current status of the request from the AKDC. A status request causes the module to transfer to the privilege state, where the request is verified.

(2) When the status has been input from the AKDC, the COMSEC module determines that the AKDC request has been completed. If so, the COMSEC module is informed and a new request, if available, is sent to the AKDC. If the status indicates that the AKDC has not completed the request, the COMSEC module checks if the time-out set for the task has expired. Providing the time-out has not expired, the COMSEC

module exits; otherwise, maintenance personnel are informed of the COMSEC failure.

(3) If the AKDC is not processing a request, and if a COMSEC request is entered in the COMSEC request queue, the module formats the request for the AKDC and attempts to send the command to the AKDC. At this point a privilege mode interrupt condition occurs and the COMSEC module performs a verification procedure. When the output to the AKDC has been performed, a time-out is set (the value of the time-out being dependent on the particular AKDC command), and the module then exits.

(4) Privilege State. To prohibit the operating program from creating illegitimate memory alterations or executing incorrect code, a two-state-processor hardware architecture exists. These two states, the privilege state and the applications state, are independent of switch processor modes. They are active in all modes. When the processor is in the applications state, it executes program code as currently resident in the operating page.

(a) Upon interrogating its mode status, which is contained in a hardware register external to the CPU, the SCPU determines whether the program is in the privilege or applications state. If this hardware register does not indicate the privilege state, the software checks the validity of the calling program.

(b) The processor knows in advance if a program in the applications state can enter the privilege state by its calling address and path. If validity is confirmed, the program enters the privilege state and conducts the appropriate sequences. If the request to enter the privilege state is not valid, the SCPU transmits an indicator to the security statistics file, located in the MCPU. The MCPU maintains a record of illegal attempts to enter the privilege state and returns an error condition to the applications program. Operation continues in the privilege state until an instruction is received, indicating a return of the program to the applications state. Upon encountering this instruction, the program resets the privilege state register to the applications state; executes a CPU instruction to reenable processor interrupts; finishes privilege state processing; and returns to the applications state.

(5) COMSEC Subsystem. The COMSEC subsystem consists of three groups: loop encryption group, trunk

encryption group, and TEMPEST group. Except for interface circuits, all of the equipment in these groups are housed in the COMSEC cabinet.

(a) Loop Encryption Group. The loop encryption group consists of two HGF-93 TUNAs and four LKG interfaces (LKGIs). Each TUNA contains one KGX-93 AKDC, which controls eight KG-82 LKGs. Two LKGI CCAs are used with each TUNA. Each LKGI controls four LKGs. The loop encryption group components are housed in the Red Switch Cabinet in card slots 2A8A3, 2A8A4, 2A8A23, and 2A8A24. The HGF-93 and KG-82 are CCI. The KGX-93 unit is CONFIDENTIAL crypto equipment.

(b) Trunk Encryption Group. The trunk encryption group consists of a mission selectable number (up to six) of KG-94 TEDs. These units are CCIs.

(c) TEMPEST Group. The TEMPEST group provides the RED/BLACK, BLACK/RED isolation for the signal paths within the AN/TTC-42. This group consists of 2 digital filter 'A' CCAs, 1 digital filter 'B' CCA, and 14 analog filters, which are located on the back of the blank panel in location 4A6.

i. Control Subsystem. The control subsystem is capable of detecting a switching action requirement, interpreting the requirement, and connecting the switching and COMSEC equipment necessary to satisfy the requirement. The control subsystem provides maintenance and diagnostic functions, which include error and status monitoring and fault isolation. In addition, the control subsystem consists of two identical processor systems, each independently capable of performing control subsystem functions. These functions include (a) redundant IOCs that support the processors, and monitor and control logic to initiate a switchover if a processor fails; and (b) an interface to the attendant subsystem to exchange control and status information and manually generated commands.

(1) The control subsystem consists of two SCPUs (SCPU-A and SCPU-B), supported by I/O controllers (IOC-A and IOC-B) dedicated to each processor. The control subsystem also consists of a stack modifier, an arbiter that contains the switchover control logic, and the interface to the manual patch control panel in the attendant subsystem. SCPUs contain two data links called IPLs. One connects to the MCPU, and the second directly connects SCPUs to each other and to the controls and indicators on the processor

control and timing control panels in the attendant subsystem. In addition, RED/BLACK isolation filters permit the processor data and address bus in the RED area to interface with IOCs in the BLACK area.

(2) Each SCPU interfaces with the MCPU, its dedicated IOCs, and the arbiter. IOCs interface with each subsystem to exchange control and status information. This information establishes the AN/TTC-42 configuration and verifies that the commands were correctly decoded and executed. SCPUs can scan the switch's devices for errors. In addition, the keyboard and display I/O CCAs receive alarms from several subsystem components, and activate the alarm and status panel indicators.

(3) To prevent a total switch failure because of a hardware failure, and to assist maintainers in fault isolation procedures, the I/O group is organized in four sections within RED and BLACK areas. The four IOC-A CCAs and the four IOC-B CCAs each have two interface buses with the subsystem devices, that is, each bus handles one of the subsystem components in the RED area and the BLACK area. Either the A system or the B system is designated as online, with the other in standby. A processor failure, which could affect other components on the bus, impacts a relatively small portion of the switch. Each RED IOC also contains an input port to interface with the manual patch control panel to manually select highways and channels. This allows single channel terminations to be connected to TDM groups.

(4) In a normally functioning AN/TTC-42, an SCPU is designated as online; the other SCPU is designated as standby. The online SCPU is in full control of switch operation. The standby SCPU function checks the operating condition of the online SCPU and updates its own database in response to messages received from the online SCPU, MCPU, or both, through the IPL. Thus, the standby SCPU is always ready to take over switch control in response to the arbiter, without losing established calls.

(5) When the arbiter receives a manual enable, both processors are disconnected from their associated IOC units and stopped. The manual patch control interface exchanges data with previously enabled IOC units, using separate interface ports on the IOC units. The attendant can select either IOC group by activating the enable switch on the manual patch control panel to either the A or B position. Once in manual mode, the operator can connect any single channel termination or channel derived from a TDM group to

any other single-channel termination or channel derived from a TDM group via the manual patch control panel. This panel sets up a simplex connection via thumbwheel switches, identifying the input and output highway and channel number. When the connect pushbutton is pressed, the control logic sequentially loads the connection information into the time space matrix. The control logic simulates I/O command and automatically interrogates the matrix to verify the connection. If a valid comparison between matrix contents and thumbwheel switches is not made, the ERROR LED on the manual patch control panel is activated.

j. Memory Subsystem. The memory subsystem stores information for control subsystem and attendant subsystem use. This subsystem provides ROM for storage of bootstrap and recovery initialization programs and provides RAM for operating programs. The memory subsystem also provides all of the required memory addressing, read/write control, and memory refresh facilities associated with memory storage.

(1) The memory subsystem consists of two functional blocks: a memory control function and a memory storage function. The memory control function provides the logic required to operate the memory storage and interface with the processor.

(2) The memory storage function provides 2,000 bytes of PROM and 1 megabyte of dynamic RAM. It also interfaces with the memory control function.

k. Power Subsystem. The power subsystem controls and distributes all ac and dc power required to operate all other subsystems. The power subsystem accepts external primary ac, external emergency dc, or internal emergency battery dc power at the following levels: three-phase primary ac power at 120/208 volts; 50, 60, or 400 Hz; and external and internal emergency dc power at +24 volts, 120 amperes maximum. In the event of an external power failure, the power subsystem can be operated from an internal storage battery. The storage battery provides the power necessary to operate the system electronics for up to 1/2 hour. The power subsystem distributes ac and dc power to all AN/TTC-42 subsystems. It also provides ac/dc and dc/ac conversions to produce the voltage levels required by the subsystems.

3. Characteristics and Limitations. Table II-48 lists AN/TTC-42 operating characteristics and limitations. Table II-49 lists analog line types and typical interfaces.

Table II-48. AN/TTC-42 Characteristics and Limitations

Item	Characteristic/Limitation
1. Single-Channel Digital Lines	
Quantity	96 channels maximum; 4 spare channels (4-wire) also provided.
Type of Modulation	Conditioned diphase
Bit Rate	16 or 32 kbps (all channels)
2. Single-Channel Analog Lines	Up to 96 digital channels can be used for analog traffic. Six of these channels can be used for commercial subscribers. The remaining channels can be used for 4-wire analog subscribers only.
3. Multichannel Digital TDM Groups	
Quantity	7 groups maximum; 6 of these groups can contain a maximum of 18 channels each. 1 group can contain a maximum of 72 channels.
Type of Modulation	Unbalanced conditioned diphase.
Bit Rate	Diphase: 144 to 2,304 kbps at channel bit rate of 32 kbps; or 72 to 1,152 kbps at channel bit rate of 16 kbps.
4. Engineering AVOW	One AVOW circuit is provided in each 26-pair WM-130 cable, 7 maximum at one time. One AVOW can be provided by each TDM group modem circuit.
5. Engineering DVOW	One DVOW circuit can be provided in each TDM group, 4 maximum at one time.
6. Attendant's OW	Two voice OW circuits are provided for the attendant (VOCU operator), one analog and one digital.
7. Maximum Line Lengths	
Single-Channel Loops	0 to 4.0 km (0 to 2.5 miles)
TDM	
(1) 576 kbps	0 to 3.2 km (0 to 2.0 miles)
(2) 288 kbps	0 to 4.0 km (0 to 2.5 miles)
LSCDM (Optional)	0 to 10.0 km (0 to 6.25 miles) using LSPRs. The Marines use fiber-optic cable for long cable runs.

Table II-49. Analog Line Types and Typical Interface Equipment

Line Type	Equipment	Mode of Operation
I	AN/TTC-38 AN/TTC-30	Two-wire DTMF Confirmation Trunk
II	SB-3614	Four-wire DTMF 3-digit Tone-Burst PABX Trunk
III	CV-1919 SB-3082	Four-wire DTMF Converter Trunk
IV	Commercial Dial Central Offices	Two-wire Dial Pulse, dc Supervised Trunk
V	TA-341 TA-720 TA-838	Four-wire ac Supervised Local Battery
VI	DSN	Four-wire, SF, ac Supervised DSN Trunk
VII	Commercial DCO	Two-wire DTMF, dc supervised trunk

4. Highway-Channel and Termination Number Assignments. The AN/TTC-42 uses a group of highway and channel numbers to identify each of the connected single-channel loops and the individual channels within multichannel TDM trunk groups. These highway and channel numbers also provide a method of identifying input and output signal paths through the switching matrix. The highways are numbered 0 through 15, and each highway contains 36 channels numbered 0 through 35. Highways 1 through 10 are used to identify single-channel and multichannel TDM group terminations. Highways 0 and 15 are used to identify signaling codes and digitized tones. Highways 11 through 14 are not used at the present time. To provide a more user-friendly numbering scheme, each highway-channel subscriber assignment also has a corresponding 4-digit termination number assigned to it. These numbering schemes are described in the following subparagraphs.

a. Multichannel TDM Group Assignments. Up to seven multichannel TDM groups can be connected to the AN/TTC-42's SEP, using dual-coaxial cables, Type CX-11230( )/G. Six of these TDM groups can contain a maximum of 18 channels and the seventh TDM group can contain a maximum of 72 channels.

Each TDM group channel is assigned a 4-digit termination number in the form 1AXX, where: A = TDM group number and XX = channel number (0-17 for groups 1-6 or 0-71 for group 7). Table II-50 shows the termination numbers, highway-channel assignments, and SEP receptacles associated with each TDM (MUX) group.

Table II-50. TDM Group Highway and Channel Assignments

MUX Group	SEP Receptacle	Termination Numbers	Highway Number	Channel Numbers
1 - Red or 1 - Black	J12	1100 through 1117	1	0 through 17
2 - Red or 2 - Black	J13	1200 through 1217	2	0 through 17
3 - Red or 3 - Black	J14	1300 through 1317	3	0 through 17
4 - Red or 4 - Black	J15	1400 through 1417	4	0 through 17
5 - Red or 5 - Black	J16	1500 through 1517	5	0 through 17
6 - Red or 6 - Black	J17	1600 through 1617	6	0 through 17
7 - Red or 7 - Black	J18	1700 through 1771	7 through 10	0 through 17 for each highway (72 channels total)

b. <u>Single-Channel LTU Configurations</u>. Single-channel lines connected to SEP receptacles J1 through J8 (cables 1 through 8) can be used for 4-wire digital, 4-wire analog, or DSN interface channel traffic. Six of the terminations connected to receptacle J1 (cable 1) can also be used for 2-wire analog traffic. LTU CCAs are installed in the Black Switch Cabinet. Each DLTU CCA contains four LTUs and can terminate four subscribers. Each 4W ALTU CCA and AIU CCA contain only two LTUs, and each 2W ALTU CCA contains only one LTU. Each 4W ALTU or AIU CCA can terminate two subscribers, and each 2W ALTU CCA can terminate only one 2W trunk. Table II-51 lists allowable DLTU, 4W ALTU, and AIU CCA locations. Table II-52 lists allowable locations for 2W ALTU CCAs. Table II-53 lists allowable 4W digital, 4W ALTU, AIU, and 2W ALTU traffic configurations that can be connected to SEP receptacle J1 (cable 1). AIUs and 4W ALTUs are selected and assigned in the same manner.

Table II-51. Highway Channel Assignments and Locations for DLTU, 4W ALTU, and AIU CCAs

Cable Number	Terminal Number	Highway Channel	LTC Number	LTU Number	CCA Location (Nest Slot)	4W ALTU or AIU Number	CCA Location (Nest Slot)
1	0001	3-18	001	1	3A12A6	1	3A12A6
	0002	3-19	002				
	0003	3-20	003			2	3A12A8
	0004	3-21	004				
	0005	3-22	005		3A12A10	3	3A12A10
	0006	3-23	006				
	0007	3-24	007			4	3A12A12
	0008	3-25	008				
	0009	3-26	009	3	3A12A13	5	3A12A13
	0010	3-27	010				
	0011	3-28	011			6	3A12A14
	0012	3-29	012				
2	0013	3-30	013	4	3A12A15	7	3A12A15
	0014	3-31	014				
	0015	3-32	015			8	3A12A16
	0016	3-33	016				
	0017	4-18	017	5	3A12A17	9	3A12A17
	0018	4-19	018				
	0019	4-20	019			10	3A12A18
	0020	4-21	020				
	0021	4-22	021	6	3A12A19	11	3A12A19
	0022	4-23	022				
	0023	4-24	023			12	3A12A20
	0024	4-25	024				
3	0025	4-26	025	7	3A13A1	13	3A13A1
	0026	4-27	026				
	0027	4-28	027			14	3A13A2
	0028	4-29	028				
	0029	4-30	029	8	3A13A3	15	3A13A3
	0030	4-31	030				
	0031	4-32	031			16	3A13A4
	0032	4-33	032				
	0033	5-18	033	9	3A13A5	17	3A13A5
	0034	5-19	034				
	0035	5-20	035			18	3A13A6
	0036	5-21	036				

Table II-51. (Cont'd)

Cable Number	Terminal Number	Highway Channel	LTC Number	LTU Number	CCA Location (Nest Slot)	4W ALTU or AIU Number	CCA Location (Nest Slot)
4	0037	5-22	037	10	3A13A7	19	3A13A7
	0038	5-23	038				
	0039	5-24	039			20	3A13A8
	0040	5-25	040				
	0041	5-26	041	11	3A13A9	21	3A13A9
	0042	5-27	042				
	0043	5-28	043			22	3A13A19
	0044	5-29	044				
	0045	5-30	045	12	3A13A11	23	3A13A11
	0046	5-31	046				
	0047	5-32	047			24	3A13A12
	0048	5-33	048				
5	0049	6-22	049	13	3A13A15	25	3A13A15
	0050	6-23	050				
	0051	6-24	051			26	3A13A16
	0052	6-25	052				
	0053	6-26	053	14	3A13A17	27	3A13A17
	0054	6-27	054				
	0055	6-28	055			28	3A13A18
	0056	6-29	056				
	0057	6-30	057	15	3A13A19	29	3A13A19
	0048	6-31	058				
	0059	6-32	059			30	3A13A20
	0060	6-23	060				
6	0061	7-18	061	16	3A14A1	31	3A14A1
	0062	7-19	062				
	0063	7-20	063			32	3A14A2
	0064	7-21	064				
	0065	7-22	065	17	3A14A3	33	3A14A3
	0066	7-23	066				
	0067	7-24	067			34	3A14A4
	0068	7-25	068				
	0069	7-26	069	18	3A14A5	35	3A14A5
	0070	7-27	070				
	0071	7-28	071			36	3A14A6
	0072	7-29	072				

Table II-51. (Cont'd)

Cable Number	Terminal Number	Highway Channel	LTC Number	LTU Number	CCA Location (Nest Slot)	4W ALTU or AIU Number	CCA Location (Nest Slot)
7	0073	7-30	073	19	3A14A7	37	3A14A7
	0074	7-31	074				
	0075	7-32	075			38	3A14A8
	0076	7-33	076				
	0077	8-18	077	20	3A14A9	39	3A14A9
	0078	8-19	078				
	0079	8-20	079			40	3A14A10
	0080	8-21	080				
	0081	8-22	081	21	3A14A11	41	3A14A11
	0082	8-23	082				
	0083	8-24	083			42	3A14A12
	0084	8-25	084				
8	0085	8-26	085	22	3A14A13	43	3A14A13
	0086	8-27	086				
	0087	8-28	087			44	3A14A14
	0088	8-29	088				
	0089	8-30	089	23	3A14A15	45	3A14A15
	0090	8-31	090				
	0091	8-32	091			46	3A14A16
	0092	8-33	092				
	0093	7-34	093	24	3A14A17	47	3A14A17
	0094	7-35	094				
	0095	8-34	095			48	3A14A18
	0096	8-35	096				
	0097	6-18	097	25	3A13A14	No ALTC	None
	0098	6-19	098			No ALTC	None
	0099	6-20	099			No ALTC	None
	0100	6-21	100			No ALTC	None

Table II-52. Highway-Channel Assignments and Locations for 2W ALTU CCAs

WM-130 Cable Number 1 Wire Pair	Terminal Number	Highway Channel	LTC Number	2W ALTU Number	CCA Location (Nest Slot)
1	0001	3-18	001	1	3A12A6
3	0002	3-19	002	2	3A12A7
5	0003	3-20	003	3	3A12A8
7	0004	3-21	004	4	3A12A9
9	0005	3-22	005	5	3A12A10
11	0006	3-23	006	6	3A12A11

5. Operational Planning

a. System Application

(1) Deployment. The AN/TTC-42 operates in joint service circuit-switching networks. Deployment may occur in any of the three configurations shown in Figure II-7.

(2) Stand-Alone Switch. Stand-alone switches use single-channel terminations as loop circuits to form a local, self-contained CS network. A typical application could be as part of a shipboard network, where only limited intraship switching is required. Stand-alone switches can be converted to access other applications by using the multichannel trunk connections to a higher-level switch, such as the AN/TTC-39 series.

(3) Access Switch. Access switch applications allow other switches and local subscribers to gain entry into larger networks. Such connections usually occur using multichannel trunks to tactical or strategic CSs.

(4) Tandem or Nodal Switch. Tandem or nodal switch applications provide traffic between switches, using their multichannel trunk lines.

Table II-53. Analog and Digital Line Termination Unit Configuration

			Allowable Configurations						
Termination Number	Highway Channel	CCA Nest/ Slot No.	1	2	3	4	5	6	7
001 002 003 004	3-18 3-19 3-20 3-21	A12/A6	DLTU 1-1 1-2 1-3 1-4	4W-ALTU 1-1 1-2	4W-ALTU 1-1	4W-ALTU 1-1	2W-ALTU 1	2W-ALTU 1	2W-ALTU 1
002	3-19	A12/A7	NA	NA	NA	NA	2W-ALTU 2	2W ALTU 2	2W ALTU 2
003 004	3-20 3-21	A12/A8	NA	DLTU 1-3 1-4	4W-ALTU 2-1 4W-ALTU 2-2	2W-ALTU 3	DLTU 1-3	4W ALTU 2-1 1-4	2W-ALTU 3 2-2
004	3-21	A12/A9	NA	NA	NA	2W-ALTU 4	NA	NA	2W-ALTU 4

			Allowable Configurations				
Termination Number	Highway Channel	CCA Nest/ Slot Number	8	9	10	11	12
0005 0006 0007 0008	3-22 3-23 3-24 3-25	A12/A10	DLTU 2-1 2-2 2-3 2-4	4W-ALTU 3-1 3-2	4W-ALTU 3-1 3-2	2W-ALTU 5	2W-ALTU 5
0006	3-23	A12/A11	NA	NA	NA	2W ALTU 6	2W-ALTU 6
0007 0008	3-24 3-25	A12/A12	NA	DLTU 2-3 2-4	4W-ALTU 4-1 4-2	DLTU 2-3 2-4	4W-ALTU 4-1 4-2

Table II- 53. (Cont'd)

			Allowable Configurations			
Termination Number	Highway Channel	CCA Nest/ Slot Number	13	14	15	16
0009 0010 0011 0012	3-26 3-27 3-28 3-29	A12/A13	DLTU 3-1 3-2 3-3 3-4	4W ALTU 5-1 5-2	4W-ALTU 5-1 5-2	--
0011 0012	3-28 3-29	A12/A14	NA	DLTU 3-3 3-4	4W-ALTU 6-1 6-2	--

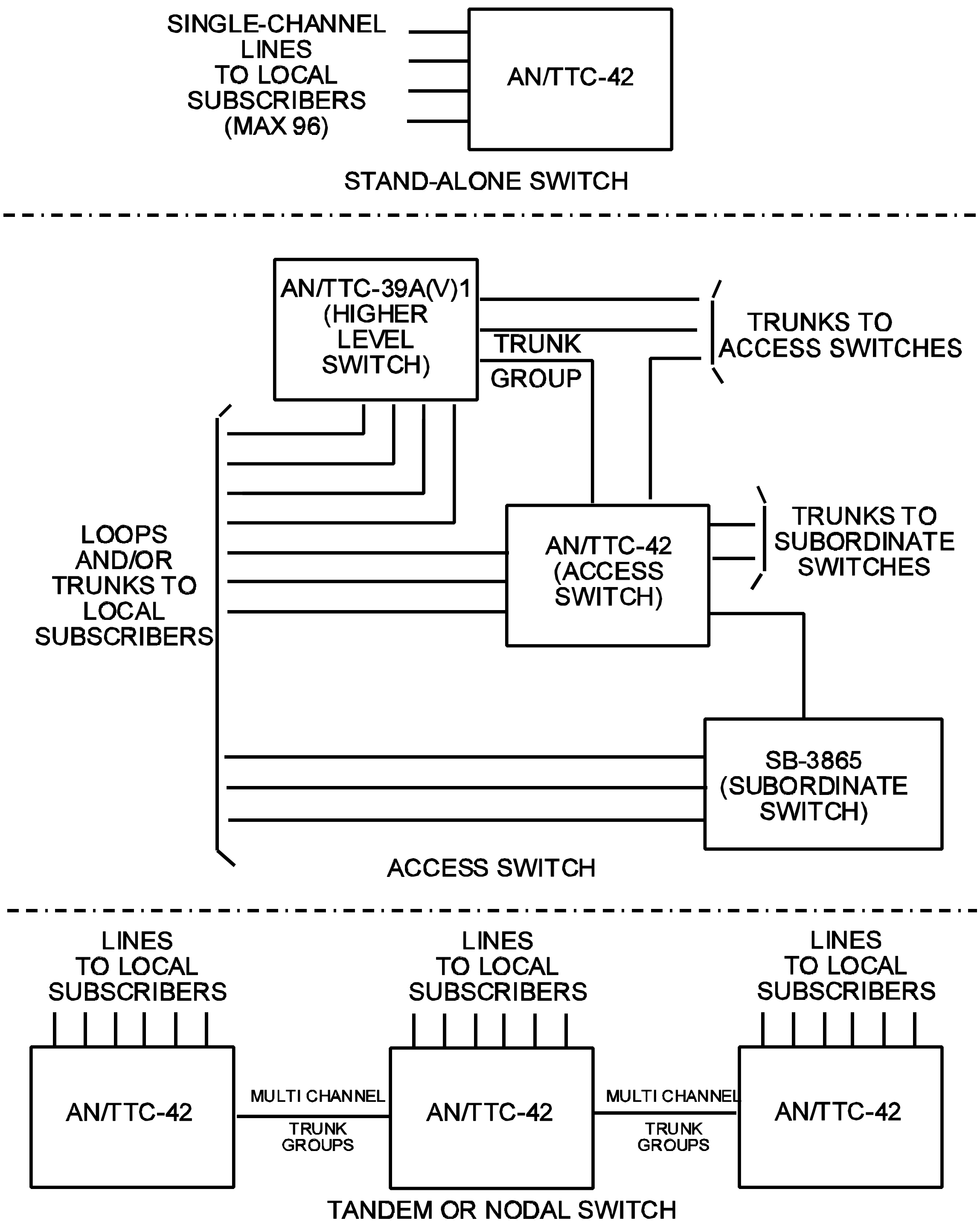

Figure II-7. AN/TTC-42 Typical Deployments

b. AN/TTC-42 Routing. The AN/TTC-42 can perform in any of the following nine network routing operations:

(1) Originating Switch. Routing is determined by subscriber dialed address or a requirement for test or rekeying actions with an adjacent office.

(2) Terminating Switch. Routing is determined by (a) a received in-band or common-channel trunk signaling message, (b) analog trunks, or (c) local-loop dialing if the call is to be completed locally.

(3) In-Band/Out-of-Band (IB/OOB) Switch. Routing is determined by received in-band trunk-signaling, loop-loop dialed address, or received common-channel signaling. The switch can assume the role of an originating switch or a terminating switch.

(4) Middle Switch. Routing is determined by the received in-band or common-channel trunk-signaling message. The switch performs tandem switching only.

(5) Spill-Forward Switch. Routing is determined in the same way as a middle switch except the trunk group used is classmarked for spill-forward control. This action causes the switch to assume control of call routing. If COMSEC action is required, the role becomes Acting Originator.

(6) Remote Switch. Routing is determined by the received inband or common-channel trunk-signaling message, which requires call completion in an analog network. The switch acts as a terminating switch to digital networks. The call generally progresses in a spill-forward mode to the analog network (commercial interface excluded).

(7) Nearest Switch. Routing is determined by a received, analog trunk call request and requires call completion through common-channel or in-band trunk networks. The switch assumes the role of an originating switch for the digital network (commercial interface excluded).

(8) Call-Transfer Switch. Any switch receiving a call request for a local subscriber address marked for call transfer assumes the role of a call-transfer switch. Routing is determined by the transfer number with the antishuttle restriction lifted. Multiple call transfers are not possible. Only one call-transfer switch may be involved in any call setup.

(9) Commercial Interface Switch. Routing is determined by the received common-channel or in-band trunk-signaling message or by local or long-loop subscriber dialing.

c. EOW. The EOW allows local technicians to communicate with technicians at remote terminals to coordinate maintenance actions. Each of the seven AN/TTC-42 TDM trunk lines can provide a combined voice and data orderwire (CVDOW) circuit or an AVOW circuit. In addition, each of the 10 single-channel cables furnishes an AVOW. The AN/TTC-42 VOCU can terminate a maximum of 11 EOW circuits (4 digital and 7 analog). Each EOW circuit is terminated at, and operated from, the VOCU whether inside or outside the shelter.

d. Traffic Metering. The AN/TTC-42 has a traffic metering capability less sophisticated than that found in the AN/TTC-39 series. The switch's traffic metering capability is as follows. Reports are available to the switch supervisor by a man-machine interface.

(1) Total number of calls offered to the switch in four categories: network to network, subscriber to network, network to subscriber, and subscriber to subscriber.

(2) Number of Routine precedence calls offered per trunk group and number of non-Routine (Priority through Flash Override) calls offered per trunk group.

(3) Total number of calls blocked and total number of calls offered per trunk group.

(4) Number of Routine calls preempted per trunk group and number of non-Routine calls preempted per trunk group.

6. Network and Switch Configuration Planning. Two planning methods exist for the AN/TTC-42. The first method, manual planning, is described in the following subparagraphs. The second method, automated planning, is available in the systems planning, engineering, and evaluation device (SPEED) switch network automated planner module (SNAP). (See CJCSM 6231.07 for details on network planning.)

a. Network Planning. To create a switch configuration plan that the AN/TTC-42 operator or maintainer can use, the system planner-engineer must first prepare a network plan. Chapter V provides network planning sheets for the

AN/TTC-42. Completion of these sheets establishes the network plan.

b. Switch Configuration Planning. Once the planner-engineer develops a network plan, a switch configuration plan is then prepared. Chapter V provides AN/TTC-42 switch configuration planning sheets. Completion of these sheets establishes the switch configuration plan.

SUBSECTION 2

SB-3865: OVERVIEW, FEATURES, AND OPERATIONAL PLANNING

7. Introduction

a. The SB-3865()(P)/TTC is a team-transportable telephone switchboard that provides automatic switching service and subscriber service functions (to include but not limited to loop and trunk hunting, precedence, and preemption) to the TRI-TAC family of 4-wire, digital telephone instruments (DSVTs and DNVTs); and to 4-wire digital trunks, including both single channels and time division multiplex (TDM) groups. The SB-3865 provides automatic switching for 4-wire analog loops and trunks at a 16 or 32 kbps switch rate using deterministic routing. The SB-3865 provides switching among 64 channels. It is possible to stack two SB-3865s (two-unit configuration) and three SB-3865s (three-unit configuration) to provide up to 90-line switching capacities. The SB-3865 is a member of the TRI-TAC ULCS family.

b. End-user COMSEC services are possible via a COMSEC parent switch such as the AN/TTC-42 or AN/TTC-39 series. The SB-3865 may be used with a type SB-3614 automatic analog telephone switchboard in a hybrid stack. This arrangement allows up to 59 additional analog telephones. The total number of switches in the stack, including the SB-3614, cannot be greater than four.

8. Architecture. The SB-3865 consists of a switch module (Unit 1) and power supply assembly (Unit 2). A simplified functional block diagram is shown in Figure II-8. The switchboard is functionally allocated to seven subsystems described in paragraphs 9 through 15 below. The processing functions of the SB-3865 are controlled by a single microprocessor. Stored operating programs for the processor provide real-time control over all switching and COMSEC equipment needed to process secure and nonsecure calls

through the system. Additional maintenance and diagnostic programs enable circuit testing and fault detection throughout the system. The programs are executed on a time-share basis, using the stored database as needed. The keypad interface on the switch control panel allows the operator to set up and change the switching services in accordance with network needs.

9. Termination Subsystem

a. The termination subsystem provides the connecting interface between the SB-3865 and external switch and subscriber terminations. This subsystem provides:

(1) Digital and analog loop and trunk signaling and supervisory functions.

(2) Impedance-matching circuits for the transmission lines.

(3) Analog-to-digital (A/D) and digital-to-analog (D/A) conversion circuits needed to match the input-output (I/O) signals.

(4) I/O circuit protection from the effects of overloads, lightning, and electromagnetic pulse (EMP) radiation.

(5) Interface with external COMSEC equipments to include the KY-90.

(6) Analog orderwire terminations.

(7) Interconnection to and from the control subsystem.

b. Each switch has ports for 30 single-channel lines and 3 TDM groups. The number of single-channel and TDM groups can be increased to 60 or 90 single-channel lines and 6 or 9 TDM groups by electrically interconnecting (stacking) 2 or 3 switches. All line and trunk connections are 4-wire and provide full duplex operation. The single-channel lines use hole-in-head binding post connectors for field wire such as type WF-16( )/U. The TDM groups use twin coaxial connectors for type CX-11230( )/G special purpose cable. Each switch can handle a mix of single-channel and multiplexed groups and provides sole-user and switched service. The switch is capable of terminating three trunk groups, one of which can be secured using the KG-94 or KG-194A.

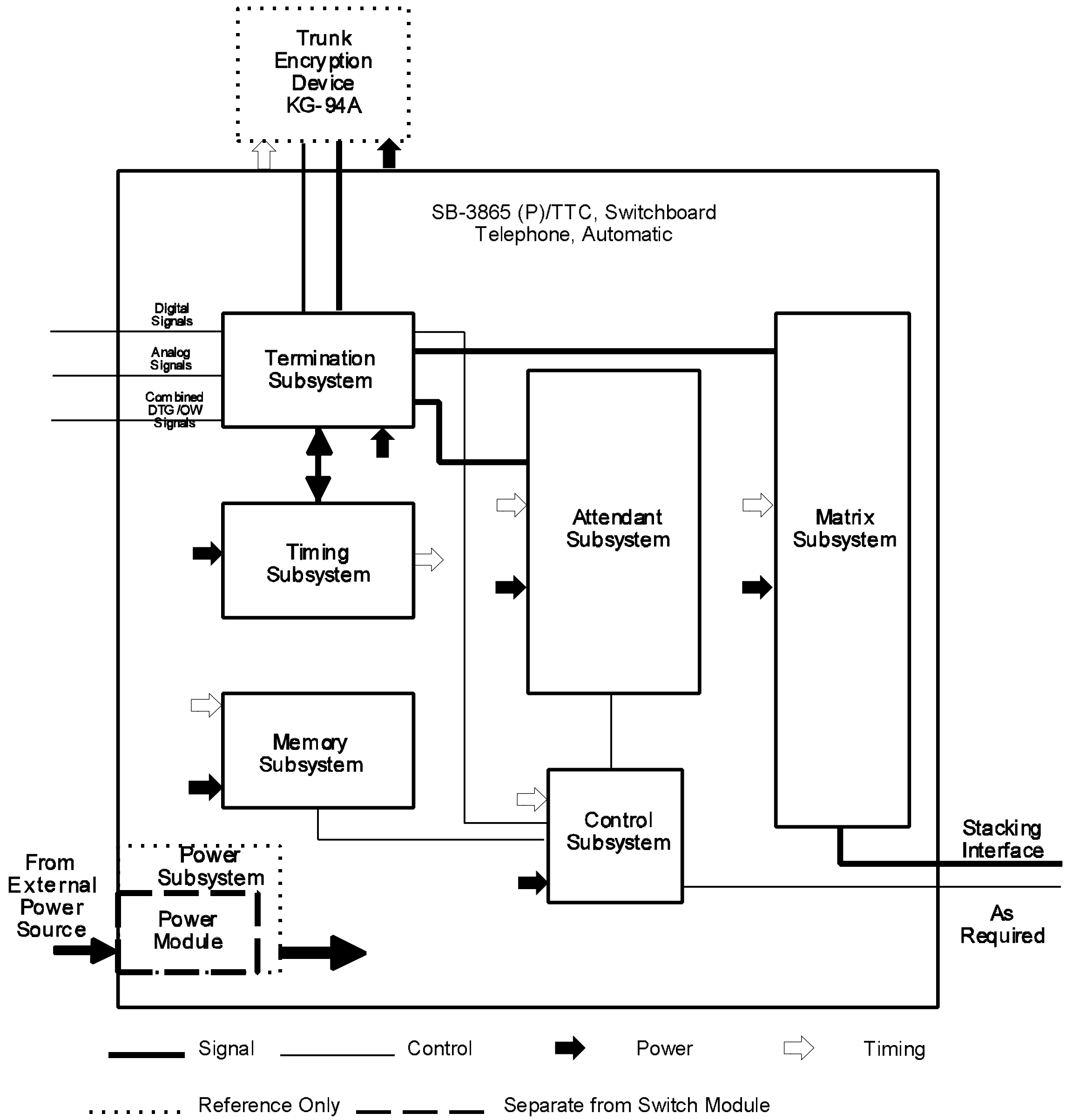

Figure II-8. SB-3865 Functional Block Diagram

c. The termination subsystem includes the following functions and facilities:

(1) Connectors. The termination subsystem provides for physical termination of the signal wires and cables.

(2) Line Termination Units. Both 32- or 16-kbps digital and 4-wire analog lines are terminated.

(3) Multiplex Group Terminations. These terminals provide multiplexing and demultiplexing of digital single channels to and from TDM group signals.

(4) TED Interface Termination. Modem numbers 1, 4, and 7 can be equipped with an external KG-194A. Cables required to interconnect the COMSEC to the switch are provided on the front cover of the switch.

(5) EOW Facilities. These facilities terminate voice orderwires and terminate one AVOW for attendant access.

(6) Nonswitched Circuit Service. Facilities for direct interconnection of circuits not requiring switched service are provided.

10. Matrix Subsystem. The matrix subsystem is an electronic switching device which, under program control, provides the interconnection between terminations. There are two separate matrixes, the switching and patching matrix and the scanner/receiver matrix. This subsystem permits any switch termination to be connected to any other switch termination over an independent signal flow path.

a. The matrix subsystem utilizes time division multiplexing (TDM) techniques, whereby input and output connections to the matrix are sequentially switched to permit time sharing by all subscribers. This scheme provides a nonblocking matrix; i.e., all call requests can be served simultaneously. Because these time switching operations are performed in microseconds, the matrix connections appear to be continuous to the subscribers. Normally, calls are switched through the matrix under the control of the microprocessor in the control subsystem. However, if the control subsystem fails, calls can be manually connected through the matrix. This is accomplished using the MANUAL PATCH CONTROL panel located inside the switch module.

b. Data are routed through the matrix subsystem in serial digital bit streams. These bit streams are organized into highways, each consisting of 36 channels. The matrix subsystem is designed to handle up to three voice highways per switch unit.

11. Attendant Subsystem. The attendant subsystem provides the man-machine interface for call service assistance and switchboard-related supervisory tasks and a Maintainer and Supervisor Position.

a. Both functions are combined at one physical location, and only one attendant can tend the switch at any time. The supervisor can access both the call service and the supervisory functions. Access to the supervisory functions can be locked out to the call service attendant by use of a security password. The SB-3865 is designed for both attended and unattended operation. When the SB-3865 is in the unstaffed call service mode, all local call service entries from the keypad are ignored. Incoming calls to the call service position are rerouted to a subscriber terminal or attendant at another switch designated to provide service assistance.

b. When operating in a stacked configuration, one SB-3865 module is designated as the online switch-board of the stack; i.e., its processor is the only processor that can be used to accomplish the call processing functions for the entire stack. Supervisory functions are accomplished at the controller group of the online switch module in the stack. The call service functions may be performed on the online switch module or on any standby switch module.

c. The SB-3865 provides all facilities and functions required to set up and extend calls between loops and trunks. Calls to the call service position are only nonsecure. Secure call assistance is possible only through a separate subscriber terminal (KY-68) collocated with the call service attendant. The call service function is provided through the combined actions of a call service facility and a call service module.

d. The call service facility allows the switch operator to initiate and terminate calls, to service incoming requests, and to provide switch services to subscribers not classmarked for such services. Controls and indicators are provided to effect those functions. An audible alarm is provided to draw the attendant's attention to the call service facility for events such as incoming calls and alarm conditions. The call service facility also provides for connection to the engineering orderwire termination.

e. The maintenance/supervisor (M/S) group consists of the equipment needed to interact with the control subsystem programs and to effect changes in the database. The M/S position is provided with facilities for performing manually initiated supervisory and maintenance services, for setting up and reconfiguring equipment and circuits, for receiving alarms and descriptive displays, and for localizing and diagnosing faulty equipments, modules, and circuits.

f. The M/S group includes the following:

(1) A Bulk Storage Unit (BSU).

(2) A Visual Display Unit (VDU).

(3) A manual patch control.

(4) Stacking control.

(5) EOW facilities.

(6) A timing control facility.

(7) A processor and system control facility.

(8) An alarm and status panel.

(9) An M/S control facility.

12. Timing Subsystem. The function of the timing subsystem is to provide and regulate the timing signals of all subsystems. The network synchronization scheme is based on a master/slave scheme where one or more switches are slaved to a master timing source. The timing of the slave switches is derived from the data transitions from the master timing source or another slave station which in turn is slaved to the master timing source. The SB-3865 is capable of operating as a master or slave station.

a. The bit rate for all synchronous transmission, originated or retransmitted by the SB-3865, is controlled by a timing unit (TU). Incoming synchronous bits whose rate is not controlled by the TU of the SB-3865 are accepted at the received bit rate by buffer devices. The outputs of these devices are at rates controlled by the TU. The TU is an element of the timing subsystem and its main component is a voltage controlled crystal oscillator (VCXO) whose operating frequency is capable of being altered and controlled from an external source.

b. When the TU is operating as a slave source, it receives an incoming digital bit stream from a specified termination and applies the necessary control signals to the oscillator so that the oscillator output frequency is locked to the frequency of the incoming bit stream. The SB-3865 is able to slave its TU to the timing recovered from an incoming single channel trunk connected to binding posts 25 or 29 or from any TDM group termination. The timing source selection is controlled by the supervisor using the Timing rotary selection switch on the Switch Module front panel. In a stacked configuration, one of the switches is set up as the controlling unit and the remaining units are synchronized to the controlling unit.

13. Control Subsystem. The control subsystem provides the facilities for detecting a switching action requirement, interpreting the requirement, and connecting the switching equipment necessary to satisfy the requirement. The control subsystem provides maintenance and diagnostic functions that include error and status monitoring and fault isolation.

a. The control programs that operate in the control subsystem are responsive to, and provide for the control of, the SB-3865 subsystems. In response to requests from the subsystems and associated hardware, the programs perform or control the hardware that performs the following functions:

(1) Call processing.

(2) All call service features.

(3) Routing and alternate routing.

(4) All required administrative operations.

(5) Diagnostic operations.

(6) General system "housekeeping" and related needs.

(7) System start-up and recovery operations.

(8) Man-machine features.

b. When two or three SB-3865s are stacked, it is possible to designate the processor in any of the SB-3865s as the online processor. In a two-unit stack, the other processor is automatically designated as standby. In a three-unit stack, one of the other processors is automatically designated as standby. In a three-unit stack, both of the other processors can be designated as standby. Which one will take over is determined by its place in the stack. The online processor is capable of controlling the entire stack. Failure of the online processor activates a major alarm. When a processor fails it is marked out-of-service. Following failure of an online processor, the standby processor is capable of assuming full online status. In a three-unit stack, if the standby processor fails to assume online status within 100 ms, the processor on the third unit is capable of assuming full online status. The operator-maintainer can restart any processor in the stack without reloading the program or database.

14. Memory Subsystem. This subsystem provides all of the facilities and functions required to store information for use by the control subsystem and the attendant subsystem. It provides read-only memory (ROM) and random access memory (RAM) for storage of bootstrap (and recovery initialization) programs and operating programs, respectively. The memory subsystem provides all of the required memory addressing, read/write control, and memory refresh facilities associated with memory storage.

15. Power Subsystem. The power subsystem controls and distributes all ac and dc power required for switch operation. The power subsystem accepts external primary ac, external emergency dc, or internal emergency battery dc power at the following levels: single phase primary ac power at 120/240 volts, 50, 60, or 400 Hz (not at the same time), 12.5 amps max., and external or internal emergency dc power at + 24 volts, 14.6 amps. In the event of an external power failure, the power subsystem can be operated from an internal storage battery. The storage battery provides the power necessary to operate the system electronics for up to 3 hours. The subsystem distributes dc power to all SB-3865 subsystems. It also provides ac/dc and dc/dc conversions to produce the voltage levels required by the various modules.

16. Characteristics and Limitations. Table II-54 lists the operating characteristics, capabilities, and limitations. Table II-55 lists and describes the analog line types and typical interface equipment.

Table II-54. SB-3865 Characteristics and Limitations (per Switch Module)

Item	Characteristics/Limitations
Single-Channel Digital Lines	
a. Quantity	30 channels maximum
b. Type Modulation	Conditioned diphase
c. Bit Rate	16 or 32 kbps
Single-Channel Analog Lines	Up to 8 channels can be used for 4-wire analog terminations only
Multichannel Digital TDM Groups	
a. Quantity	3 groups maximum. Each group can contain 18 channels maximum.
b. Type Modulation	Unbalanced conditioned diphase
c. Bit Rate	Diphase: 144 to 576 kbps at 32 kbps channel rate; or 72 to 288 kbps at 16 kbps channel rate.
Engineering Analog Voice Orderwire	One AVOW can be provided by each TDM group modem circuit.
Attendant's Orderwire	One analog voice circuit is provided for the attendant
Maximum Line Lengths	
a. Single Channel Loops	0 to 4 km
b. TDM, 576 kbps	0 to 3.2 km
c. TDM, 288 kbps	0 to 4 km

Table II-55. SB-3865 Analog Line Types and Interfaces

Line Type	Interface Equipment	Mode of Operation
I	AN/TTC-38 AN/TTC-30	Four-wire DTMF Confirmation Trunk
II	SB-3614/A	Four-wire DTMF, 3-digit, tone burst PABX trunk
III	CV-1919 SB-3082	Four-wire DTMF converter trunk
V	TA-341 TA-720 TA-838	Four-wire, ac supervised, local battery
VI	DSN	Four-wire, SF, ac supervised trunk

17. Line Termination Unit Selection. The SB-3865 can be configured to operate with a variety of Line Termination Unit Configurations. The single channel lines connected to binding posts BP1 through BP30 can be used for 4-wire digital traffic. In addition, eight of the terminations BP1 thru BP6, BP9, and BP10) can also be used for 4-wire analog or DSN traffic. The type of termination available is determined by the type LTU CCA installed in the corresponding slot in the Switch Module. Each DLTU CCA contains four line termination circuits (LTUs) and, therefore, can terminate four subscribers or digital in-band trunks. Each 4-wire analog LTU (4W ALTU) CCA and DSN Interface Unit (AIU) CCA contain two LTUs and can terminate two subscribers or analog trunks.

18. Operational Planning

a. System Applications. The SB-3865 can operate in most joint service telephone switching systems. Deployment is possible in the configurations shown in Figure II-9.

(1) Tandem Switching. Tandem switching applications provide lateral routing capability between switches in subnetworks and also other subnetworks. DSVT calls cannot be tandemed between CPSs via the SB-3865. This capability allows routing to alternate parents, permits direct throughput between subordinate switches and allows for nodal subnetwork expansion by the addition of access

switches. Connection to other switches is accomplished via either TDM groups or single-channel trunks using in-band signaling.

(2) Stand-Alone Switching. When the SB-3865 is deployed as a stand-alone switch, its single-channel loop circuits are used to form a local, self-contained telephone network. In this application, the multichannel TDM groups can only be used with RLGMs, RMCs, or Group Modems. The switch is required to operate in the "Emergency Mode" instead of the "Normal A" or "Normal B" Mode because a COMSEC parent switch is not included as part of the network. In either arrangement, both the calling and called parties must be equipped with DSVTs to process secure calls. All other connections will result in nonsecure (plain text) call processing.

(3) Hybrid Stacking. The SB-3865 may be used with a type SB-3614 automatic analog telephone switch-board to create a hybrid stack. This arrangement allows up to 59 additional analog telephones to be added to a system. The hybrid connection is made via the SB-3865 4-wire analog terminations used as single-channel analog trunks. For routing purposes, both switches are assigned the same identification number (NNXX). Calls are completed directly to or from the assigned SB-3614 subscribers (GXX) as though they were local calls. The total number of switches in a stack, including the SB-3614, cannot exceed four. The hybrid stacked deployment differs from the normal deployment of the SB-3614. Normally the SB-3614 will be assigned its own identification number and routing will be made on receipt of the switch code. In a hybrid stack, the SB-3614 and SB-3865 share the same switch code.

b. Routing. In the SB-3865, call routing is automatically controlled. Path selection is based upon processor analysis of dialed numbers and routing tables stored as part of the database. Routing options include local switch routing assignments, interswitch routing, and hybrid stack routing. For individual calls, the selected route is determined by such factors as COMSEC requirements, type of call (analog or digital), switch operating mode (normal or emergency), and selected restrictions stored in the database. Routing requirements and restrictions are determined and implemented during network planning and

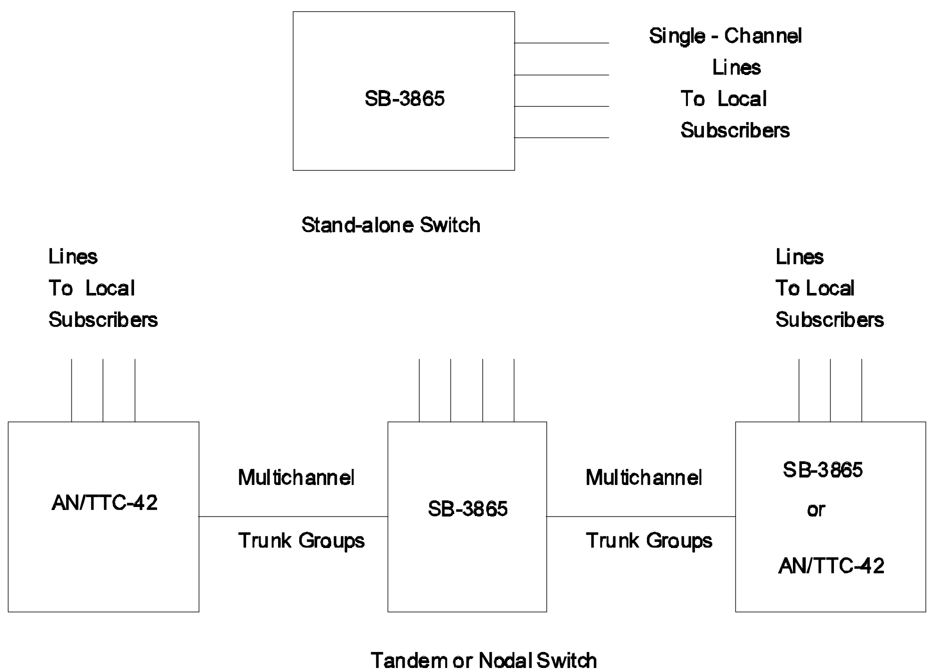

Figure II-9. SB-3865 Typical Deployments installation phases. The SB-3865 processes analog and digital calls from loop or trunk lines as listed below:

(1) Analog Lines. The SB-3865 accepts and provides analog signals for 4-wire analog loops and trunks. All analog connections are nonsecure, single-channel only and can interface with 4-wire DTMF loops or trunks as follows:

(a) Ac supervised, local battery loops; e.g., TA-341, TA-720, or TA-838.

(b) Confirmation trunks; e.g., AN/TTC-38.

(c) Three-digit tone burst PABX; e.g., SB-3614.

(d) Four-wire converter trunks.

(2) DSN Interface. Access to the DSN system can be accomplished by any digital subscriber. In addition, the configuration kits include a DSN interface CCA, which may be substituted for any 4-wire analog line termination unit CCA, thereby allowing direct access to DSN lines from the local switch, when it is in the Type III, Emergency Mode.

(3) Digital Lines. The SB-3865 accepts and provides secure and nonsecure digital signals for 4-wire loops and trunks as listed below. The SB-3865 also provides for loop and trunk service via the TDM transmission groups.

(a) Loops as provided by type TA-954 (nonsecure) or type KY-68 (secure) voice terminals.

(b) In-band signaling trunks as provided by other SB-3865s, AN/TTC-42, or a AN/TTC-39 series CS.

c. Network Planning. See Chapter V, Section B, for information on preparing a network plan for the SB-3865.

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SECTION F

COMPACT DIGITAL SWITCH, AN/TTC-39E, AND SWITCH MULTIPLEXER UNIT

1. Introduction

a. Compact Digital Switch (CDS). The CDS is a small, lightweight stand-alone circuit switch, which is designed for rapid deployment. It can be employed in a transit case configuration or installed in a shelter. The CDS is a state-of-the-art version of the AN/TTC-39A(V)4. The CDS is a part of the AN/TTC-39E(V)1 used by the 112th Signal Battalion in support of the SOF, the AN/TSQ-188, Special Operations Command Light Initial Communications Module (SOCLICM) used by the JCSE, and the AN/TSQ-201 used by USAFE. The CDS is a fully digital trunk switch that uses a 64 kbps switching matrix.

b. AN/TTC-39E. The AN/TTC-39E combines switching, multiplexing, COMSEC, and peripheral assemblies to provide full AN/TTC-39A(V)4 functionality. The major components of the AN/TTC-39E are:

(1) Rack mountable switching unit.

(2) Rack mountable call service position console.

(3) Rack mountable LTU or circuit card nest.

(4) Transit case LTU.

(5) KG-82, HGF-93, KGX-93 (or equivalent) COMSEC.

(6) Rubidium standard.

c. Switch Multiplexer Unit (SMU). The SMU repackages the CDS, a loop nest, and an atomic standard frequency reference into a single unit. The SMU can be used in a transit case configuration or installed in various shelter or rack mounted configurations.

2. CDS. The CDS supports only group level interfaces, either standard TRI-TAC DTG groups or commercial standard T1 or E1 groups (the T1/E1 card is still being developed).

a. The DTG interface is a standard TRI-TAC format from 4 1/2 to 144 channels. If the CDS is to operate at a 32 kbps sampling rate, then the DTGs can operate at either a 32 or 16 kbps channel rate. If configured for a 16 kbps sampling rate, the DTGs can operate only at the 16 kbps channel rate.

b. The T1 interface (T1CEPT card) is a US commercial standard interface used within North America and the DSN. ATT Publication 83501 defines the commercial standard and DCA Circular 310-175-13 defines the DSN standard. A T1 group consists of 24, 64 kbps mu (μ)-law PCM traffic channels and a 8 kbps framing channel for a group rate of 1.544 Mbps. The T1 group format consists of an 8-bit sample for each of the 24 traffic channels (24 x 8 = 192), plus a single framing bit for a 193 bit frame. The T1 interface supports fractional interfaces for tolling purposes by assigning only the number of traffic channels required. The remaining channels can be left unassigned or used as loops. The group rate remains as 1.544 Mbps. The T1 interface uses alternate mark inversion (AMI) modulation. Since a consecutive series of zeroes would result in a constant signal level and would be subject to receiver drift, one of two types of "Ones Density" modes (B8ZS or B7) are used to ensure an adequate number of ones or "marks" is maintained.

c. The E1 interface (T1CEPT card) is a European commercial standard interface used throughout the world (except North America and Japan) and DSN in Europe. ITU (formerly CCITT) Recommendations G.703 and G.732 define the commercial standard and DCA Circular 310-175-13 defines the DSN standard. An E1 group consists of 30, 64 kbps a-law PCM traffic channels, a 64 kbps framing channel, and a 64 kbps signaling channel for a group rate of 2.048 Mbps. The E1 group format consists of a 256 bit frame with an 8-bit sample for each of the 32 channels (32 x 8) = 256). The E1 interface supports fractional interfaces for tolling purposes by assigning only the number of traffic channels required. The remaining channels can be left unassigned or used as loops. The group rate is 2.048 Mbps. The E1 interface uses HDB3 modulation. Since this modulation scheme ensures an adequate number of transitions to preclude receiver drift, the Ones Density mode used for T1 operation is not required. The physical interface is 4-wire, twisted pair cable.

d. Table II-56 shows the configuration by CDS version.

Table II-56. CDS Configurations

Capability	Version		
	TTC-39E(V)1	TSQ-188	TSQ-201
TACTS	1	1	1
TACLS	1	1	1
COMSEC Controller	0	1	1
RSBC	1	1	0
DTG	6	1	1
T1CEPT	0	1	6
DVOW	1	1	0
PIC2	1	1	--
Rubidium Standard	1	1	1
AKDC	2	2	2
<u>Signals Row Nest</u>	1	1	0
DLPMA	25	8	12
2WLTU	10	10	4
4WLTU	5	4	4
EMLTU	0	2	2
MFLTU	0	6	2
NILTU	0	2	10
TCLTU	5	4	2
CV-4180 (LTU)	2	2	4
CSP	2	2	2
TED	5	12	--
AN/TYC-20	1	0	0
AN/TYC-19	1	0	0

3. <u>SMU</u>

a. The SMU is employed in the AN/TSC-143 Tri-Band Satellite Terminal and the Common Air Defense Communications Interface (CADCI), which is used in Patriot Fire Control Shelters and the Kuwait Air Defense (KAD) Fire Control Shelters. SMUs are also employed on the Navy’s USS BLUE

RIDGE and USS MOUNT WHITNEY command ships and at DISA STEP sites.

b. The SMU provides both group level and subscriber access. The group interfaces are the same as provided in the CDS. Subscriber access is provided by an internal loop nest supporting up to 60 subscribers or by means of a standard DTG to an external multiplexer, LTU, or single row nest.

c. Table II-57 shows the SMU configurations in the AN/TSC-143 and two versions of CADCI. CADCI 1 contains card set 01-2753100-2; CADCI 2 contains card set 01-2753100-3.

Table II-57. SMU Configurations

	Version		
Capability	TSC-143	CADCI 1	CADCI 2
TACTS	1	1	1
TALCS	1	1	1
COMSEC Controller	1	0	0
RSBC	2	0	0
DCBU	0	2	2
DTG	3	2	4
PIC	1	1	1
Rubidium Standard	1	1	1
Internal Row Nest	1	1	1
DLMPA	8	1	5
2WLTU	3 1/	2	2
4WLTU	0	3	1
EMLTU	6 1/	0	0
MFLTU	6 1/	0	0
NILTU	6 1/	1	1
TCLTU	6 1/	0	0
Downsized CSP	1	1	1
TED	3	1	1

1/ Provided in the Variable Card Set.

4. General Information Common to CDS and SMU

a. Table II-58 lists the cards common to the CDS and SMU. Both the CDS and SMU can support TRI-TAC COMSEC equipment to provide bulk encryption and per-call security for both DSVTs and approved loops. If equipped with TRI-TAC COMSEC equipment, both can act as a COMSEC parent switch for the SB-3865 or AN/TTC-48(V).

Table II-58. CDS and SMU Card Types

Circuit Card	Function
TERM	Terminal board for CDS, incorporated into SMU backplane
MEM	Litton memory--1 Megaword (32/word bit memory)
CPU	Litton-CPU-VSLI version of 1-3050
I/O CON	Litton Input/Output controller
I/O CTLR	Switch I/O controller
PIC	Operator interface though VDT or PC and TTY
MATRIX	64 kbps switch matrix-maximum of 2,048 terminations
TACTS	Tactical Trunk Signaling (TSB and DSB)
TACLS	Tactical Loop Signaling-Digital receivers and DSG
COMSEC	COMSEC controller for AKDC and LKGs
DCBU	Digital Conference Bridge-20 ports with AN/TTC-39A(V)4 software
RBSC2	Flood Search Signaling Buffers
SIB	System Interface Bus-interconnects two switches for redundant operation or extends matrix bus to expansion chassis
DVOW	DVOW for up to 48 DTGs
MTG	Synthesizes required frequencies-can be slaved to a rubidium standard, DTG, or T1/E1 groups
DTG	TRI-TAC/MSE standard: DTGs from 4 ½ to 144 channels, each card supports two groups
T1CEPT	Commercial standard T1 or E1 groups- each card supports two groups
Loop Nest	SMU Only
GPMDM	TRI-TAC card to interface to DTG in SMU switch nest
TGMOW	TRI-TAC card to interface to DTG in SMU switch nest

Table II-58. (Cont'd)

Circuit Card	Function
TIMTG	LTU card to provide required timing to SMU loop nest
41MUX	SMU/SRN card to multiplex/demultiplex up to four 16 channel groups into a single DTG to interface to the CDS/SMU
MXDMX	LTU card to multiplex/demultiplex up to 36 channels
20Hz Gen	Generates 20 Hz ring to analog telephones
DLTU	Digital Line Cards-terminates either digital or analog loops or trunks

b. Table II-59 lists the maximum capabilities of both switches.

Table II-59. CDS and SMU Capabilities

Maximum Capability	CDS	SMU
Total Channels	744	744
Single Channel Interfaces	0	61 1/
Maximum Number of Multiplexed Channels	744	683 2/
Group Interface Card Slots (DTG) 3/	6	4 4/
DTGs	12	8 4/
TED	12	6
LKG	12	32
TSB	32	30
DSB	30	30
Digital Receivers	30	20
Digital Conference Bridges	20	20
CSP	20	2
DVOW (1 card supports 48 DVOW channels)	1	0

Table II-59. (Cont'd)

1/ There are 15 slots for DLTUs in the SMU, depending on the card type, up to 60 single-channel terminations are available.
2/ The CDS and SMU switch matrix supports up to 2,048 terminations but is limited to 744 when using the AN/TTC-39A(V)4 software. In the SMU, 61 terminations are dedicated for single channel terminations and the remaining 683 are available for groups.
3/ The DTG and T1/E1 cards are slot compatible, each card supports two groups. The maximum number of DTGs, T1s, and E1s cannot exceed the numbers shown and **are not additive.**
4/ The SMU uses one DTG for the internal loop nest, leaving the remaining DTG on that card and up to 3 additional group interface slots for DTGs or T1/E1 groups for external use.

c. Table II-60 shows the maximum capability of the CDS and SMU in either configuration.

Table II-60. Redundant or Expanded CDS/SMU Configuration

Configuration	DTGs	Single Channels
CDS	12	0
Redundant CDS	24	0
SMU	8 (7 external)	60
Redundant SMU	12 (10 external)	120
SMU with Expansion Chassis	12 (10 external 1/)	120

1/ Assumes both loop nests are used.

d. The CDS and SMU have a limited control capability, including DVOW (**CDS only**), a rubidium atomic standard frequency standard, a DTG repeater mode, and channel reassignments.

e. Figures II-10 and II-11 are block diagrams of the CDS and SMU respectively.

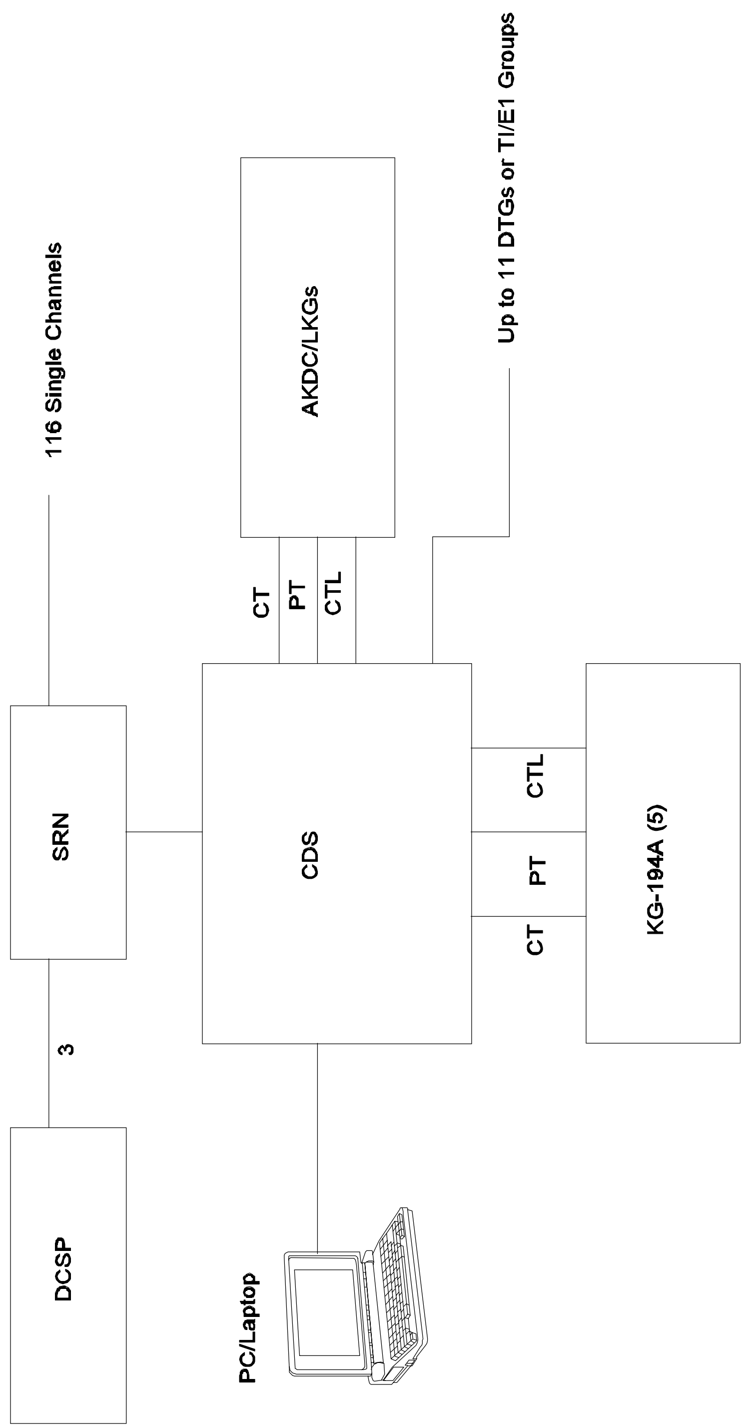

Figure II-10. Block Diagram of CDS in an AN/TTC-39E

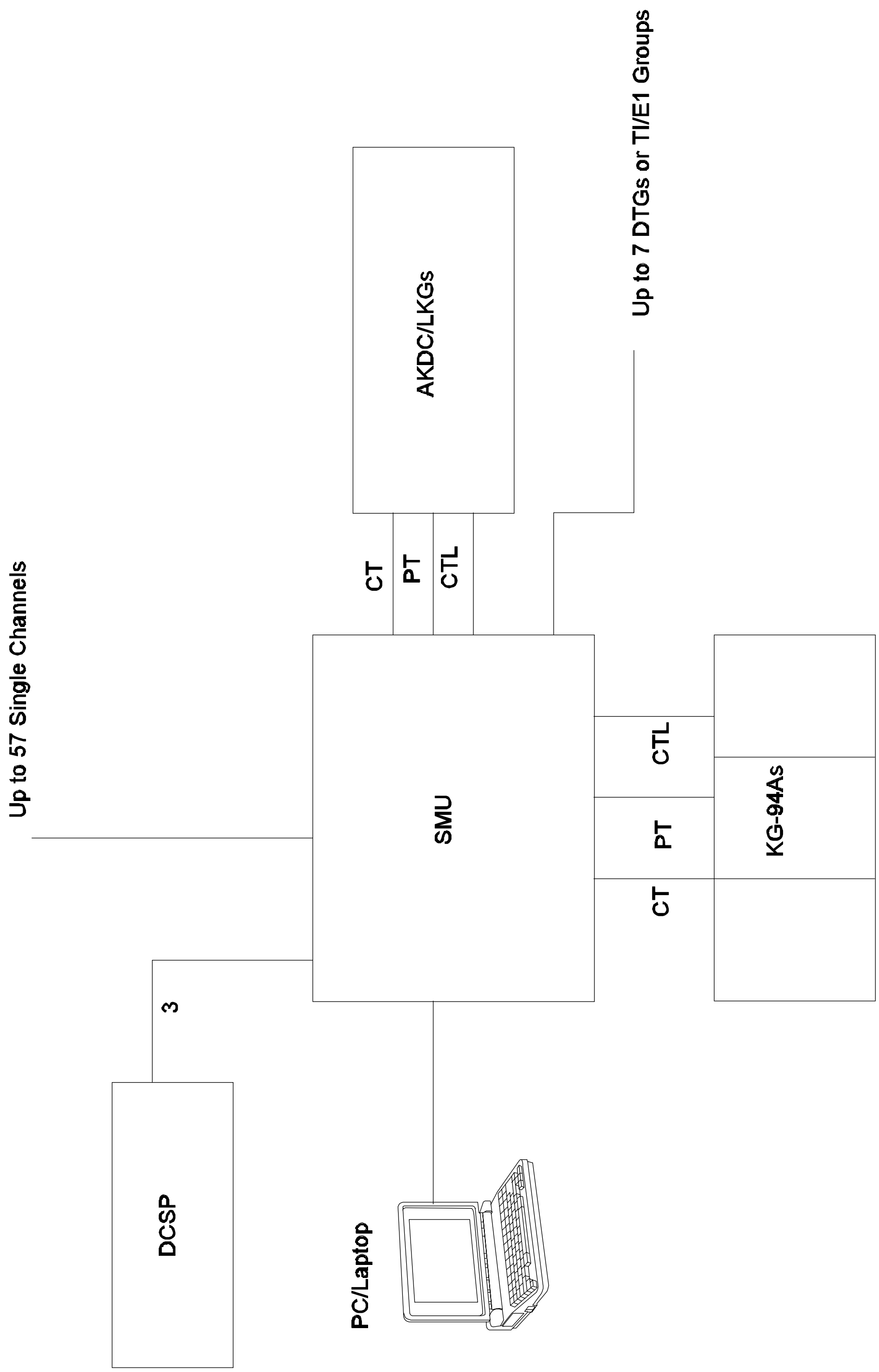

Figure II-11. Block Diagram of SMU in an AN/TSC-143

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SECTION G

NAVAL CIRCUIT SWITCHES

1. Introduction. This section provides information of the MITEL SX-50, a digital private branch exchange (DPBX) employed in the Navy's Fleet Mobile Operations Center (FMOC), and Navy shipboard switching systems.

2. MITEL SX-50

a. General Characteristic

(1) Timing. The DPBX uses a microprocessor driven by a 8 MHz crystal oscillator with a 0.5 microsecond cycle time. It uses time division switching and PCM. The master clock for PCM operates at 16.384 MHz.

(2) Switch Capacity. The switching matrix (DX) provides time division switching for up to 48 line and trunk channels or for 1.5 links, with a link having 32 channels. A shared link is provided for the attendant console and DTMF receivers. A digital signal processor provides 8 channels of dual tone generators, 18 conference circuits, and 1 tone detector circuit. The system provides 10 peripheral circuit cards for lines and trunks. A line card can accommodate either 8 or 16 telephone lines depending on the type. A trunk card can accommodate either eight or four trunks depending on the type. The line capacity is 160 terminations (no trunks) and up to 80 trunks (no lines). In addition to single telephone sets, the system also accepts SUPERSET 3 and 4 telephone sets that accommodate 3 or 15 appearances respectively. Separate line cards are provided that support up to 8 lines for such sets. The system provides for adding a slave PBX in order to increase the subscriber line capacity. For this purpose, a trunk circuit from the slave PBX is connected to a line circuit of the host PABX. Additional dialing is required for communications between the PABXs.

(3) Signaling. The system interconnects both DTMF and rotary dial sets. Five DTMF receivers are provided. For pulse dialing, the signal processor detects the digits by monitoring the loop current. For trunks, supervisory signaling is loop start, ground start, and E&M. Address signaling is by DTMF, dial pulse, and E&M. The system has a wait-for-dial feature for trunk calls. Digits dialed before the second dial tone is received from the control office are not outpulsed.

(4) Data Capability. Provisions are available for a PC to send data to destinations outside the DPBX by means of a modem attached to the SUPERSET 4 line.

b. Features. The SX-50 provides features which can be characterized in the following three categories:

(1) Subscriber Features

(a) Abbreviated dial.

(b) Auto-answer (speaker phone).

(c) Auto-hold.

(d) Call forwarding.

(e) Call hold.

(f) Call pickup.

(g) Call transfer.

(h) Conference.

(i) Executive busy override.

(2) Attendant Features

(a) Automatic ring-down circuit.

(b) Automatic wake-up.

(c) Contact monitor.

(d) Do not disturb.

(e) Message waiting.

(f) Paging access.

(g) Room status.

c. System Operation Features

(1) Automatic route selection and tool control.

(2) Call direction.

(3) Direct in line.

(4) Direct inward dial trunks.

(5) Hotline.

(6) Hunt groups.

(7) Originate only extensions.

(8) Personal on-going line.

(9) Pick-up groups.

(10) Station-message detail recording.

(11) Transfer dial tone.

(12) Trunk answer from any station.

(13) Trunk groups.

(14) Voice mail port.

(15) Wait for dial tone.

d. Dialing. Dialing is in conformance with the North American Numbering, NYX-NNX-XXXX.

e. Interface. The DPBX trunk interface requires metallic conductors for central office loop or ground start or E&M types 1 or 5 dc signaling and supervision. In order to interface with an AN/TTC-39 series CS, the SX-50 would have to use an EMLTU card.

3. Navy Shipboard Switching Systems

a. Introduction. This appendix provides information on the voice systems found aboard ships.

b. Single Audio System (SAS). The SAS is a legacy analog voice switching system used primarily for tactical battle group communications. It permits association of a given TA-970 handset with a specific ANDVT, which in turn is tied to a specific radio and frequency. By flipping a selector, the tactical staff can push-to-talk access to established subnets such as ASW, sea-to-air, and SAR.

c. Interior Voice Communications System (IVCS). The IVCS was originally planned as a ship-wide nonsecure means of distributing voice circuits. It has evolved into an ISDN telephone system employing various commercial switches(e.g., HORIZON 2000, Dimension 750, and MITEL family of switches). For pier-side use, several tail circuits are patched into a public switch to provide exterior access. Since Operation DESERT STORM, the external communications capability of IVCS has expanded rapidly and continues to grow. Many major combatants have T1 pier-side access to the public switch by way of an IVCS trunk line. At sea, the IVCS can be patched into wideband SATCOM such as SHF and ATHENA and into INMARSAT. Personnel at handsets authorized to access outside lines, dial an outside access code and are switched to either outside tail circuits or an outside trunk. The IVCS ISDN switches can be programmed to block outside access to any nonauthorized hand sets. Further, it is possible to restrict and prioritize access to various media and to reserve capacity for high-priority lines. Hot lines can be established that can connect two predetermined phones whenever either goes off hook and the other rings. The speed of establishment of such connections (once defined) is governed by transmission delay and human reaction time at the distant end. (The switching time is fast when compared to these delays.) The rapid growth in IVCS to meet external communications requirements has in some cases required augmentation of the central IVCS switch with PBX switches. Use of auxiliary switching is considered a temporary expedient rather than a long-term solution to the increased demand. On some ships the PABX is integrated as a trunk extension of the IVCS, therefore, aside from additional access digits, it is transparent to the end user. On other ships the PABX requires a second handset. Often a PABX is used in conjunction with a dedicated resource such as a battle group cellular phone.

d. Battle Group (BG) Cellular Phone. Most major combatants have been outfitted with cellular relays that permit use of commercial hand sets to dial within the network. Small craft, ships, and shore are capable of contacting personnel on ships within the cellular group. (Due to the commercial applications of this technology, the Navy is restricted from using BG cellular within 50 miles of US shore lines.) With the advent of commercial SATCOM cellular networks, the Navy will be able to take advantage of these capabilities as they arise.

e. Indirect Defense Switched Network (IDSN). IDSN refers to a variety of switches and services available to/from the private sector of the public switch. This typically refers to a tail circuit but can include fractional T1 and higher. Onboard ships IDSN lines are digitized at rates from 2.4 kbps to 64 kbps and may be muxed into 64 kbps aggregates for transmission ashore where they may be demuxed and presented as tail circuits to the public switch. These are nonsecure lines, but are bulk encrypted for transmission from the ship. Included in this category is use of the International Maritime Satellite (INMARSAT) with nonsecure end user equipment (STU-IIIs can go secure on the INMARSAT after call establishment). The INMARSAT cannot be bulk encrypted due to the need to land signals though earth stations in many countries. Use of IDSN at sea under various tactical conditions can be restricted.

f. KY-68, DSVT. The KY-68 requires 16 or 32 kbps access, thereby requiring more bandwidth than other alternatives. The voice quality is similar to that of LPC-10 and much better than LPC-2, which was in use when the KY-68 was introduced. This legacy system has been installed on several ships as an expedient for interoperability with existing TRI-TAC systems. Usually this is done by taking a long local from a shore-based TRI-TAC switch which supplies dial tone. The KY-68 signal is sometimes muxed by an AN/FCC-100(V) or TD-1389 multiplexer at a NCTAMS for transmission to sea. Two command ships, USS MOUNT WHITNEY and USS BLUE RIDGE, have SMU switches onboard that can handle TRI-TAC signals without requiring a gateway through the NCTAMS. Both ships have prototype high bandwidth systems that can afford the bandwidth required to support KY-68 demands. The Navy has embarked on the 7-foot SHF antenna program and the Challenge Athena program, the latter a commercial C-band SATCOM project (see CJCSM 6231.04). Ships having high data rates access can support several KY-68 circuits, when required, and be supported by the theater CINC. Dual SHF carier operation is feasible from Numbered Naval Fleet Flagships (USS MOUNT WHITNEY, USS BLUE RIDGE, USS LASALLE, and USS CORONADO). These ships can enter tactical architectures via direct GMF connectivity to forward deployed GMF terminals or STEP locations. The Navy’s latest terminal modernization program, AN/WSC-6(V), will provide this capability to aircraft carriers and large deck amphibious flagships.

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SECTION H

DIGITAL SWITCH

1. Introduction. The Digital Switch (DS) is a down-sized version of the AN/TTC-39 series of circuit switches. It provides the internal and external shelter communications needed for secure operation of the USAF Mobile Air Operation Center (MAOC) in support of the Contingency Theater Automatic Planning System (CTAPS). The main emphasis of CTAPS is the creation and dissemination of the Air Tasking Order (ATO). The CTAPS program includes 3-in-1 expandable shelters designated the AN/TSQ-165, which includes the DS as the primary voice communications switch. The DS is a 150-termination switch for intra-and inter-site capability for access to the DSN. The switch provides the CTAPS MAOC user with the capability to transmit and receive voice traffic via ground-air-ground radio channels, direct access to long-haul transmission media, and a local intercom system with conferencing capabilities. The DS is fully interoperable with the TRI-TAC family of switches for both intratheater and DSN operations.

2. Capabilities

a. General. The DS is a fully digital and nonblocking switch which provides 150 lines for secure voice and data communications. The DS consists of a time division matrix, common equipment, a processor set, several controllers, modems, a visual display terminal, a power supply, and timing circuits. The time division matrix (TDMX) is the primary switching element. It performs the time division switching of the subscribers. The subscribers can be either individual loop subscribers (4 loops) or part of a digital transmission group (8 groups). The individual loop subscribers are connected to the TDMX through a loop modem. The groups are connected to the TDMX by eight group modems, a digital transmission group module (TGM), and a group multiplexer /demultiplexer. The DS is mounted in a standard 19-inch rack and consists of a common equipment module, automatic data processor, power processor module, blower assembly, control panel, and an associated VDT. The VDT is a man-machine interface (MNI) for entering data base classmarks. The DS provides full COMSEC management and control for LKGs, AKDC, and TEDs.

b. DS Functional Characteristics. The following characteristics (Table II-61) are associated with the DS as installed the Mobile Air Operation Center (MAOC), AN/TSQ-165.

Table II-61. DS Functional Characteristics

Item	MAOC Configured
Total external lines	150
Single channel (loops)	4
Group terminations (channels)	162
Digital transmission group	8
TSB/DSB	7
Conference bridges (5 party)	2
COMSEC interface:	
ADKC (KGX-93)	2
LKG	16
TED	1
VINSON	1
Call service position	1
Digital voice order wire	1
Peripheral interface:	
VDT	1
Printer (optional)	
Remote VDT with DSDI	1
Digital receivers	9

c. DS Switching Description. The DS is based upon a time division architecture. All switching is digital and is supported as such by both the hardware and software. The primary switching element is the time division matrix (TDMX). It interfaces directly with the central processing and control subsystems. The matrix consists of time division memory modules (TDMMs). The digitized voice of a calling person is routed into the memory modules and is transferred from one of the memory modules to the called person. The primary mode of transmission is conditioned diphase modulation. Conditioned diphase modulation is employed for transmission over wire and cable. Dipulse modulation is employed for transmission over coaxial cable to existing multichannel transmission equipment. Data exchange between the matrix and the subscriber equipment (telephone sets) is routed through a network of multiplexers and demultiplexers and modems. Call completion and connections processes are managed by the operating system software. This software controls the hardware elements throughout the switch. Operations supervised by the software include call processing, program activity, machine input/output, activity monitoring, bookkeeping and fault detection. Either loop or trunk encryption may be provided.

d. Specific

(1) Two VDT interfaces for local switch configuration, subscriber interfaces, online diagnostics, fault isolation, and remote dial-up access.

(2) Essential user bypass (EUB) to reconnect up to 60 shelter subscribers to other facilities or on-site switches when the DS fails.

(3) Interoperable with AN/TTC-39A(V)1/A(V)3/A(V)4, AN/TTC-42, SB-3865, SB-3614/A, MSE, and DSN.

(4) Interfaces to TRI-TAC and MSE networks through eight trunk group interfaces at the data transmission rates shown in Table II-62.

Table II-62. DS Trunk Group Interfaces

Trunk Group Rate (kbps)	16 kbps Circuits per Trunk Group	Trunk Group Rate (Kbps)	32 kpbs Circuits per Trunk Group
72	4.5	256	8
128	8	288	9
144	9	512	16
256	16	576	18
288	18	1024	32
512	32	1152	36
576	36	1536	48
1024	64	2048	64
1152	72	2304	72
2048	128	4096	128
2304	144	4608	144

(5) Four loop interfaces for DSVTs and DNVTs.

(6) One primary and up to five alternate trunk group clusters, to provide up to six routes per call attempt.

(7) Classmarks for subscriber privileges or restrictions.

(8) Abbreviated dialing.

(9) Compressed dialing.

(10) Call transfer.

(11) Automatic line grouping, for up to 32 groups of two to five subscribers.

(12) Two five-party conference bridges, each CIU has 30 digital conference bridge units to support 12 intercom conferences.

SECTION J

TRANSPORTABLE TROJAN MINI SWITCH

1. Introduction. The TTMS is a self-contained, transportable switching subsystem interoperable with the existing TROJAN network. The TTMS adds a distributed switching and routing architecture to the TROJAN system and provides an intratheater subsystem for contingency operations. The TTMS provides a forward-deployed switching capability tailored to support the intelligence processing and dissemination mission of the TROJAN SPIRIT II, TROJAN switch extensions, and TROJAN Lightweight Integrated Telecommunications Equipment (LITE) systems (see Appendix F, CJCSM 6231.04) during split-based contingency operations. This theater capability may be independent or connected to the existing TROJAN Network Control Center (TNCC) at Fort Belvoir, VA.

2. Capabilities

a. General

(1) The TTMS contains two (redundant) full duplex fiber optic modems, which provide the interface to the satellite or terrestrial communications system.

(2) Fifteen (15) KIV-7s are available to perform aggregate subscriber COMSEC.

(3) The TTMS contains 10 T1 interfaces.

(4) Sixteen multiplexed channels are allocated as follows: channels 1-8 for collateral circuits, and channels 9-16 allocated as SCI circuits.

(5) A rubidium clock provides the timing for intratheater operation.

(6) Two KG-94s (TED) provide encryption and decryption of the RED trunk aggregate circuits.

(7) Two variable DSCS satellite modems provide a fully redundant circuit to a satellite communications system.

b. TTMS Subsystems. Three electronic subsystems permit the TTMS to provide an extension service of the TROJAN Network Control Center (TNCC) capabilities for up to 24

TROJAN systems deployed in support of contingency operations.

(1) Circuit Switch Subsystem (CSS). The CSS consists of a DSS-1 (see Appendix F, Annex A) mounted into shock isolated shelter cabinets. The DSS is interoperable with the TROJAN Voice Data Switch (VDS) at the Fort Belvoir TTNC. The TROJAN VDS is an SDS-1 product variant. Both switches are partitioned to support collateral and SCI processing. Five SCI and five collateral trunk lines operating at 4,800 kbps are extended from the TTMS to the VDS providing the capability for deployed TROJAN systems to dial subscriber directory numbers for access to VDS and TTMS subscribers. Both switches support digital voice, facsimile, or data switching. Table II-63 lists the DSS port allocations.

Table II-63. DSS Port Allocations

Circuit	Collateral	SCI
SPIRIT subscriber	60	84
SPIRIT subscriber (spare)	15	21
TTMS subscriber	1	1
TSC trunk	10	14
TTMS tandem trunk	6	14
Unassigned	0	4
Total	92	138

(2) Router Subsystem (RS). The RS uses one each collateral and SCI AGS+ router to provide an internetworking capability for deployed TROJAN systems and a gateway to the TNCC router banks which provide access to SIPRNET and JWICS and other DOD networks. The RS is also capable of being interfaced to local MILNET access points to provide intra-theater, self-contained networking capabilities without interfacing to the TNCC.

(3) Baseband Communications Subsystem (BCS). The BCS consists of RED and BLACK multiplexing equipment, patch and test facilities, and encryption equipment.

3. Communications. The TTMS has the capability of interfacing to commercial and DSCS earth stations for intratheater satellite coverage to deployed TROJAN systems. (See Appendix F, CJCSM 6231.04.) The TTMS also requires an additional communications patch to the TNCC to provide worldwide TROJAN access to users. This path can be provided by either a commercial or military earth station or leased landline.

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