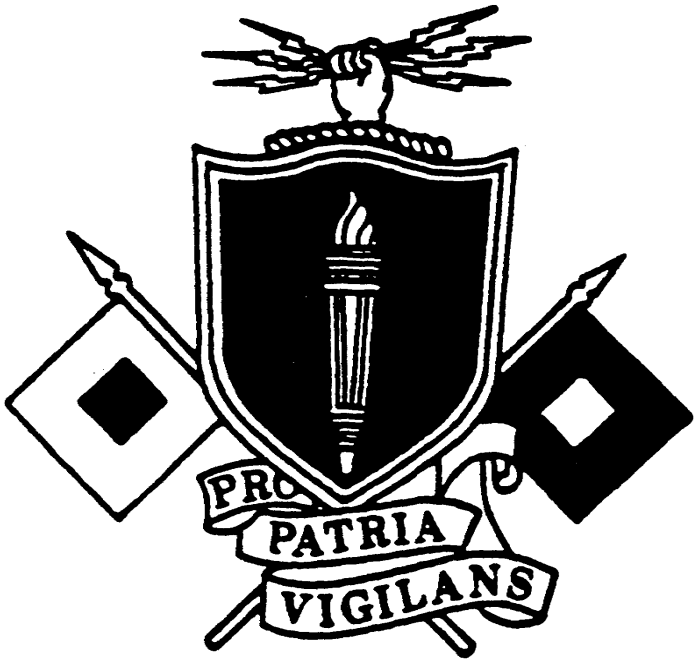
SUBCOURSE	EDITION
SS 0029	B

US ARMY SIGNAL CENTER AND FORT GORDON

PLAN TACTICAL TELEPHONE SYSTEMS



THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT
ARMY CORRESPONDENCE COURSE PROGRAM

AIPD

READINESS/
PROFESSIONALISM

THIRD
GROWTH

PLAN TACTICAL TELEPHONE SYSTEMS

Subcourse Number SS 0029

EDITION B

United States Army Signal Center and Fort Gordon
Fort Gordon, Georgia 30905-5000

2 Credit Hours

Edition Date: September 1994

SUBCOURSE OVERVIEW

This subcourse is designed to teach you the basic procedures involved in planning tactical telephone systems, including trunk group sizing, the joint operations numbering systems, and the telephone directory.

The prerequisite for this subcourse is that you be a graduate of the Signal Officer's Basic Course.

This subcourse reflects the doctrine which was current at the time it was prepared. In your own work situation, always refer to the latest official publications.

Unless otherwise stated, the masculine gender of singular pronouns is used to refer to both men and women.

TERMINAL LEARNING OBJECTIVE

ACTION: Describe the tactical telephone systems supporting a maneuver division or corps.

CONDITION: Given this subcourse.

STANDARD: To demonstrate competency of this task, a minimum of 70 percent on the subcourse examination must be achieved.

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LESSON 1

TACTICAL TELEPHONES AND SWITCHBOARDS

Critical Task: 01-5710.07-0001

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn the different telephones and switchboards used by the Army in support of a division, corps, or echelon above corps (EAC).

TERMINAL LEARNING OBJECTIVE:

ACTION: Describe the different tactical telephones and switchboards.

CONDITION: You will have this lesson material, paper, pencil, and no supervision

STANDARD: To demonstrate competency on this lesson, you must achieve a minimum of 70 percent on the subcourse examination.

INTRODUCTION

Today, the Army uses many different types of telephones and switchboards. The mission involved and units employed will determine the equipment requirements and their reconfigurations.

1. Types of telephones. We can divide the tactical telephones into two major groups-common-battery and local-battery equipment. Normally, units at company and battalion level use local-battery equipment. At the brigade level and up, we use common-battery equipment. Table 1-1 provides a list of the telephones and switchboards most commonly used. Part A of this lesson provides their technical characteristics.

Table 1-1. Tactical telephones and switchboards.

TELEPHONES	SWITCHBOARDS
TA-1/PT	SB-993/GT
TA-43/PT	SB-22/GT & SB-22A/PT
TA-312/PT	SB-3082(V)1/GT
TA-341/TT	SB-3614A(V)/TT & SB-3614A(V)/TT
TA-838/TT	AN/MTC-1 & AN/MTC-1A
TA-938/G	AN/TTC-38(V)1 & AN/TTC-38(V)2 (AUTOMATIC)
TA-954/TT (DNVT)	AN/TTC-39/39A/39D AN/TTC-41A
TSEC/KY-68 (DSVT)	AN/TTC-46
TA-1035/U (DNVT)	AN/TTC-47
	AN/TTC-48

a. Local-battery telephones.

(1) TA-1/PT is a lightweight, waterproof, sound-powered telephone. It is found at the infantry squad level. The TA-1 telephone can interface with any battery-powered telephone or switchboard. The infantry squads used the TA-1/PT for internal communications and to link with the platoon headquarters element (See Appendix A, Figure A-1.)

(2) TA-312/PT is a 2-wire battery-operated field telephone. It can operate both in the local-battery or common-battery mode. The units can use the TA-312/PT or the TA-43/PT in a point-to-point wire system or in any 2-wire ringdown communication system. The TA-312/PT and the TA-43/PT are the two primary telephones used by the maneuver battalions. (See Appendix A, Figure A-2.)

(3) TA-341/TT is a 4-wire telephone. It can operate on local-battery or common-battery mode. The TA-341/TT can be used with an automatic analog switchboard or in a point-to-point configuration. Most of the TA-341/TTs found today are assigned to the Reserve Components. Initially, the TA-341/TT telephones were issued to Corps Area Signal Battalion with the AN/TTC-38 switchboard. (See Appendix A, Figure A-3.)

b. Common-battery telephones.

(1) TA-838/TT is a rugged, solid-state field telephone It is used with the SB-3614 switchboard. It can also be used with the AN/TTC-38, AN/TTC-39, and AN/TTC-S9A. When using the TA-838/TT in the 4-wire mode, it can have up to three extensions on one phone. When we use the TA-838/TT in the 2-wire mode, we can only have one extension from one telephone. (See Appendix A, Figure A-4.)

(2) TA-938/G is a 2-wire common-battery telephone set intended for use in a sheltered area. You can bridge two sets across a single 2-wire line for extension service. (See Appendix A, Figure A-5.)

(3) TA-954/TT is a 4-wire terminal. The TA-954/TT can send and receive conditioned diphase-modulated digitized voice. It can send and receive information at 16 or 32 kb/s rate. The TA-954/TT provides digital communications interface with the joint communications (TRI-TAC) and mobile subscriber equipment (MSE) switchboards (See Appendix A, Figure A-6.)

(4) TSEC/KY-68 digital subscriber voice terminal (DSVT) provides encryption/decryption voice traffic service. It can also provide secure digitized data traffic service. The TSEC/KY-68 operates as a full-duplex or half-duplex terminal. The TSEC/KY-68 provides secure and nonsecure access to switched networks. (See Appendix A, Figure A-7.)

(5) TA-1035/U digital nonsecure voice terminal (DNVT) provides full-duplex, conditioned diphase-modulated digital voice service. It can also provide loop signaling information with wire and mobile access equipment. The TA-1035/U provides a data port for interfacing the SST and AN/UXC-7A devices. (See Appendix A, Figure A-8.)

2. Types of switchboards.

a. Tactical switchboards are divided into two major groups-manual battery and common-battery equipment. At brigade level and up, we find common-battery equipment housed in mobile units.

b. The mobile units get prewired and designed to accommodate the equipment needed for the mission. The shelter has cable receptacles for connecting the 26-pair field cables. They usually contain electrical heaters to warm the personnel and equipment during cold weather. A trailer-mounted power-generating unit provides electrical power to the shelter. The next few subparagraphs examines the different switchboards found in the field.

(1) SB-993/PT is 6-line analog 2-wire manual switchboard, capable of supporting a maximum of six local-battery telephone circuits or six trunk circuits. (See Appendix A, Figure A-9.)

(2) SB-22/PT and SB-22A/PT are tactical manual switchboards They can provide service to 12 local-battery telephone circuits. The operator can stack two SB-22s to support up to a 29-circuit system. To support 29 subscribers, the operator must remove the operator pack from the second SB-22. He then installs a 5-line pack. To interface with the automatic switches, the operator must install a TA-997/PT or tone-signaling adapter. No operator intervention is required when using the tone-signaling adapter. (See Appendix A, Figure A-10.)

(3) SB-3082(V) /GT can service up to 50 telephone circuits. The SB-3082 can be mounted on a 1/4-ton truck or in a shelter. The operator can set up a conference call for up to six subscribers. The switchboard has an emergency power system. The emergency power system runs on two 12-volt batteries. In addition, the switchboard brings a battery charger for recharging the emergency system. (See Appendix A, Figure A-11.)

(4) AN/TTC-38 can interconnect 300 or 600 telephone circuits. We can find the AN/TTC-38 deployed in an area communications center (ACC). The AN/TTC-38 is all analog. The primary telephones used with the AN/TTC-38 are the TA-341, TA-838, and the TA-938. Today, we find most of the AN/TTC-38s still in service with the Reserve Component units. (See Appendix A, Figure A-14.)

(5) AN/TTC-39A and AN/TTC-39D can service 600 or 672 trunks depending on the model on hand. The AN/TTC-39A provides, for the first time, the capability of miring analog and digital service. It can interface with existing tactical switches (manual and automatic), commercial central offices, and Defense Switched Network (DSN). In addition, the AN/TTC-39A and AN/TTC-39D can interface with North Atlantic Treaty Organization (NATO) telephone systems. We find the AN/TTC-39D at EAC. (See Appendix A, Figures A-15a through A-15d.) The AN/TTC-39A is found in Army Reserve EAC units, Air Force units, and the Joint Communications Support Element.

(6) AN/TTC-41 and AN/TTC-41A is an automatic switchboard. The AN/TTC-41 comes in several models. The AN/TTC-41(V) 1 can service up to 30 subscribers; the models V2 and V5 can service up to 60 subscribers; the models V3 and V6 can service up to 90 subscribers; and the AN/TTC-41A (V) 4 and 7 can service up to 120 subscribers. (See Appendix A, Figure A-16.) The AN/TTC-41A can interface with the DSN and dial central offices (DCOs). The switchboard is capable of providing 2- or 4-wire service.

(7) AN/TTC-46 or large extension node (LEN) switchboard has basically the same configuration as the node center switch (NCS)(AN/TTC-47). The basic difference is the termination configuration for trunks and loops. The LEN doctrinally is deployed in support of the division support command (DISCOM) in an MSE division. It can support a total of 164 subscribers using J-1077 and remote multiplexer combiners (RMCs). (See Appendix A, Figures A-17a and A-17b.)

(8) AN/TTC-47 or NCS is the hub of the MSE node. The AN/TTC-47 provides network interface for the subscriber access elements. The AN/TTC-47 provides automatic subscriber finding, deleting the need for knowledge of the subscribers' geographical location. (See Appendix A, Figures A-18a and A-18b.)

(9) AN/TTC-48 or small extension node (SEN) switch contains both switching and packet switching equipment. The communications security (COMSEC) equipment provides secure digital communications to a command post (CP). The SEN is doctrinally deployed in support of the maneuver brigades. The SENs come in two versions. The SENs can provide two DCO circuits and net radio interface (NRI) via the KY-90. We can use CX-11230 cable and line-of-sight (LOS) to interface with the node center (NC) and LEN. A planner can also interface an NC or LEN using a tactical satellite (TACSAT) terminal. There are no non-MSE divisions in the Army or National Guard. (See Appendix A. Figure A-19.)

PART A - TELEPHONES

1. TA-1/PT telephone set.

Status: STD-A; NSN: 5805-00-521-1820

General Information

The TA-1/PT is a lightweight, weatherproof, sound-powered telephone intended for use on field-wire lines in forward areas. It can be used for communications with any local battery field telephone or local battery switchboard. It includes a generator for producing 20-Hz ringing current.

Technical Characteristics

Range	Approximately 6 km (3.7 mi) using field wire WD-1/TT (10 dB working limit)
Type of Operation	Local battery
Signaling Voltage	65 to 80 V AC, 20 Hz
Type of signaling:	
Visual	Nonadjustable Maltese cross
Audible	Buzzer, adjustable from LOUD to OFF
Power Requirement	None
Weight	
Telephone	1.25 kg (2.75 lbs)
Carrying case	.0.4 kg (14 oz)

2. TA-312/PT and TA-43 PT telephone sets.

Status: STD-A; NSN: 5805-00-543-0012 (TA-312/PT)
STD-B; NSN: 5805-00-503-2775 (TA-43/PT)

General Information

The TA-312/PT and TA-43/PT are 2-wire, battery-operated field telephone They can be utilized in a point-to-point wire system or in any 2-wire ringdown subscriber position of a telephone communications system. The handset H-60 contains a PUSH-TO-TALK switch which connects power for talking. The TA-312/PT has a built-in receptacle connector U-79/U for use with a headset and an associated EXT-INT switch; the TA-43/PT does not. The TA-43/PT is being replaced by the TA-312/PT. TA-955 dual tone multifrequency (DTMF) adapter, allows pushbutton operational interface with automatic analog switches.

Technical Characteristics

Range:	
Wet	Approximately 22.5 km (14 mi) on WD-1/TT. (36 dB working limit)
Dry	Approximately 36.4 km (22 mi) on WD-1/TT (36 dB working limit)
Type of Operation:	
Common Battery	Voice transmission and signaling power supplied by switchboard
Local battery	Voice transmission power supplied by two BA-30s, signaling power is supplied by a hand-crank generator
Common-Battery Signaling	Signaling power supplied by switchboard, voice transmission provided by two BA-30s
Signaling (Outgoing)	Hand generated, 90 to 100 V AC, 20 Hz
Signaling (Incoming)	Audible tone, adjustable volume

3. TA-341/TT telephone set.

Status: STD-A; NSN: 5805-00-910-8844

General Information

The TA-341/TT is a 4-wire, transistorized, local-battery telephone intended for use in sheltered areas. It is designed for use with tactical automatic switches but can also be used in a point-to-point mode. Up to four sets can be bridged across a single 4-wire line for extension service. DTMF tones activated by a pushbutton key sender are used for signaling.

Technical Characteristics

Range	3 m (2 mi) from AN/TTC-38 under the worst conditions
Type of Operation:	Local or common battery
Signaling (Outgoing)	900 to 3400 Hz DTMF
Signaling (Incoming)	90 V AC, 20 Hz
Type of Signal	Audible tone, adjustable volume
Power Requirement	6 V DC (four BA-42s or equivalent)
Weight	3.2 kg (7 lbs)

4. TA-838/TT telephone set

Status: STD-A; NSN: 5805-00-124-8678

General Information

The TA-838/TT is a rugged, solid-state field telephone designed for use with switchboards SB-3614/TT and SB-3614/AT or with the tactical automatic switches AN/TTC-25, AN/TTC-38, AN/TTC-39, and AN/TT-39A and is capable of compatible interoperation with TA-341/TT and C-6709 (NRI) equipment. It is a 2- or 4-wire local or common-battery set using DTMF tones for signaling and will work with any DTMF semiautomatic or automatic circuit. Using the TA-838/TT, up to three extensions may be added in the 4-wire mode and only one extension may be used in the 2-wire mode.

Technical Characteristics

Range	3.2 km (2 mi) from SB-3614/TT under the worst conditions
Type of Operation	Local or common battery
Signaling (Outgoing)	900 to 3400 Hz DTMF
Signaling (Incoming)	90 V AC, 20 Hz
Type of Signal	Audible tone, adjustable volume
Power Requirement	6 V DC (four BA-42s or BA-2042s)
Weight	3.6 kg (8 lbs)

5. TA-938/G telephone set

Status: STD-A; NSN: 5805-00-134-2599

General Information

The TA-938/G is a 2-wire common-battery telephone set intended for use in sheltered areas. The telephone set uses DTMF signaling. Two sets can be bridged across a single 2-wire line for extension service.

Technical Characteristics

Range	Approximately 8 km (5 mi) from the DCO
Type of Operation	Common battery
Signaling Voltage	90 V AC, 20 Hz
Type of Signal	Bell
Power Requirement	Supplied by the DCO
Weight	1.8 kg (4 lbs)

6. TA-954/TT DNVT.

Status: STD-A; NSN: 5805-01-159-9691

General Information

The DNVT TA-954/TT is a 4-wire terminal contained in a ruggedized case, which transmits and receives conditioned diphase-modulated digitized voice and loop signaling information at 16 kb/s or 32 kb/s. The DNVT has a 16-key pushbutton keyboard, receiver and ring volume controls, an incoming call/off-hook indicator light, and writing pad. It contains a built-in protection from nuclear energy electromagnetic pulses and lightning. Handset H-350/U is issued with the DNVT. The microphone element is activated when the handset is removed from the cradle (hot mike). The PUSH-TO-NRI switch is only pressed to key the C-6709. The DNVT provides a digital communications interface with TRI-TAC and MSE circuit switches.

Technical Characteristics

Channel Interface-Field Wire	4-wire field cable
Transmission Range	4 km (2.4 mi) max
Input Power-Power Drain	
On Hook	300 mW, max
Off Hook	1.5 W, max
Power Requirement	+24 to +56 V DC
Current Drain:	
On Hook	12.5 mA, +24 V DC
	5 mA, +56 V DC
Off Hook	62 mA, +24 V DC
	25 mA, +56 V DC
Weight	2.7 kg (5.8 lbs)

7. TSEC/KY-68 digital subscriber voice terminal.

Status: STD-A; NSN: 5810-01-082-8404

General Information

The DSVT KY-68 is used for encrypting/decrypting voice traffic and provides secure digitized data traffic. It operates as a full-duplex or half-duplex voice/data subscriber terminal at 16 to 32 kb/s. The KY-68 provides secure and nonsecure access to the switched networks and secure access to nonswitched networks. Handset H-350/U is normally issued with the DSVT and includes a PUSH-TO-TALK switch which is used when the DSVT is operating in the half-duplex mode to allow for voice transmission. The terminal consists of a five-position function switch, audio and ring volume controls, ring/busy, extension, and nonsecure warning indicators. The DSVT provides a digital communications interface with TRI-TAC and MSE circuit switches. The DSVT KY-68 also has a data port for interfacing the communications terminal (CT) and AN/UXC-7.

Technical Characteristics

Channel Interface-Field Wire	4-wire field cable
Power Requirement	-21 to -56 V DC (DC voltage is provided by the auxiliary power supply HYP-71/TSEC)
Weight	6.3 kg (14 lbs)

8. TA-1035/U DNVT.

Status: To be determined; NSN: 5805-01-246-6826

General Information

As a prime subscriber terminal, the TA-1035/U provides fill-duplex, conditioned, diphase digital voice and loop signaling information with wire and mobile access equipment. It also provides supervisory, clock, plain text, and voltage reference signals with data devices. The TA-1035/U provides a data port for interfacing the CT and AN/UXC-7 data devices to the MSE network. The TA-1035/U operates in a common-battery power mode, deriving its power from the switch line termination circuit.

Technical Characteristics

Power Requirements..... 48 V DC
Power Consumption:
Off-Hook (Powered Up)..... 1.5 W (max)
On-Hook (Powered Down)..... 300 mW (max)

PART B - SWITCHBOARDS

9. SB-993/GT manual telephone switchboard.

Status: STD-A; NSN: 5805-00-708-2202

General Information

The SB-993/GT is a lightweight, portable switchboard capable of handling six local-battery telephone lines. It is designed for use in forward combat areas. It requires the use of either a local-battery telephone or a sound-powered telephone (not a component).

Technical Characteristics

Type of Operation	Manual with local battery
Line Capacity	1 operator line and 6 local-battery circuits
Signaling (Outgoing)	90 V AC, 20 Hz
Signaling (Incoming)	90 V AC, 20 Hz
Type of Signal	Neon glow lamp
Power Requirement	None
Weight	2.04 kg (4.5 lbs)

10. SB-22/PT and SB-22A/PT manual telephone switchboards

Status: STD-A; NSN: 5805-00-257-3602 (SB-22/PT)
STD-A; NSN: 5805-00-715-6171 (SB-22A/PT)

General Information

The SB-22/PT and the SB-22A/PT are tactical manual switchboards that can be rapidly installed to provide field facilities for interconnecting 12 local-battery telephone circuits, remote controlled radio circuits, or voice frequency (VF) teletypewriter circuits. Two SB-22/PTs may be stacked to provide a 29-circuit capability by removing one TA-221/PT (operator's pack) and inserting five TA-222/PTs (line packs). Replacing a line pack with a trunk pack permits one-way ringdown and one-way automatic trunk circuits between the SB-22A/PT and any other switchboard with common-battery signaling. Tone-signaling adapter TA-977/PT provides the operator with a 2-wire pushbutton tone-signaling capability for interfacing automatic switches without operator intervention.

Technical Characteristics

Type of Operation	Manual with local battery
Line Capacity	12
Signaling (Outgoing)	90 to 100 V AC, 20 Hz
Signaling (Outgoing) w/Adapter	DTMF
Signaling (Incoming)	90 V AC, 20 Hz
Type of Signal	Audible or visual alarm
Power Requirement:	
Operator's Talking Circuit	3 V DC (two BA-30s)
Night Alarm and Panel Light	3 V DC (two BA-30s)
Weight	15.4 kg (34 lbs)

11. SB-3082(V)1/GT cordless manual telephone switchboard.

Status: STD-B; NSN: 5805-00-235-5035

General Information

The SB-3082(V) 1/GT is a 50-termination telephone switchboard that can be mounted in a 1/4-ton truck or in a shelter. The switchboard has no cords and connections are made by pushbutton switches. The operator can connect any two terminations, can perform preemption of any termination in use, and can establish a conference for up to six subscribers. The switchboard includes a battery charger to keep the two 12-volt emergency batteries charged.

Technical Characteristics

Type of Operation	Manual with local- or common-battery signaling
Line Capacity	50
Common-Battery Signaling/Common Battery/ 20-Hz Ringdown Line/Trunk	Any of the 50
1600 Hz Ringdown Trunk	1 through 24 only
Tactical Automatic Switch Trunk	1 through 24 only
DC Closure Civilian Lines	47 through 50 only
Signaling (Outgoing)	90 V AC, 20 Hz or 1600 Hz
Signaling (Incoming)	90 V AC, 20 Hz or 1600 Hz
Type of Signal	Audible tone and lamp
Power Requirement	105 to 125 V AC, 50, 60, or 400 Hz or +12 V DC and -12 V DC (24 V DC center tapped) emergency use only
Weight	127 kg (280 lbs)

12. SB-3614(V)/TT and SB-3614A(V)/TT telephone switchboards.

Status STD-A; NSN: 5805-01-032-1694 (SB-3614(V)/TT)
STD-A; NSN: 5805-01-216-0887 (SB-3614A(V)/TT)

General Information

The SB-3614 is a tactical, ruggedized, 30-terminal automatic switchboard. It provides rapid, cordless service to various interfaces. It may operate as a 30-terminal, single-switching facility or may be connected with additional switchboards to form a 60 or 90-line system. The switchboard operator can monitor, answer, initiate, extend, preempt, and release calls using the four-by-four keysender and other functional pushbuttons. Any connection can be broken down manually, through operator intervention and action, or automatically, through a subscriber going to an on-hook condition. Up to 18 terminals may be connected as either 4-wire DTMF signaling trunks, or DC closure dial pulse or DTMF trunks, E&M dial pulse or DTMF lines or trunks. The switchboards provide fully automatic operation with touch tone subsets and 2- and 4-wire trunks and limited service with rotary dial pulse subsets. The SB-3614(V)/TT requires manual tandem dialing when dialing outside of your local switchboard. The SB-3614A(V)TT automatically routes the call through the network using primary or alternate routes. For common-battery signaling or ringdown lines and trunks without DTMF capability, the switchboard provides call extension service. DTMF subscribers have direct distant dialing (7-, 10-, and 13-digit) and DSN, DCO, and commercial access capabilities. Other features of the SB-3614A(V)/TT include facsimile service, call forwarding, preemption by precedence, conference calling, and subscriber (loop) hunting.

Technical Characteristics

Type of Operation	Manual or automatic
Power Requirement	24 V DC, 5 amp (max)
Terminals	30 in each switchboard; 60 or 90 in expanded mode
Simultaneous Conversations	15 for one switchboard; 30 for expanded operation
Precedence Levels	SB-3614(V)/TT: ROUTINE and PRIORITY SB-3614ACV) /7T: ROUTINE, PRIORITY, IMMEDIATE, FLASH, and FLASH OVERRIDE

Technical Characteristics (Cont)

Types of Terminal Printed Circuit Boards (PCB).....Types I, II, III, IV, V, VI (SB-3614A(V)/TT only), and XI (SB-3614A(V)/TT only)

13. AN/MTC-1 and AN/MTC-1A manual telephone central office.

Status: STD-A; NSN: 5805-00-926-0255 (AN/MTC-1)
STD-A; NSN: 5805-00-167-7628 (AN/MTC-1A)

General Information

The AN/MTC-1 and -1A are air- or vehicular-transportable manual central offices which provide switching for 196 local-battery or common-battery subscriber lines and 20 manual or dial trunk circuits. The AN/MTC-1 and the -1A are each housed in two shelters-the AN/MTA-3 and the AN/MTA-4. The MTA-3 contains three parallel switchboard positions. The AN/MTA-4 houses the relays, frames, storage batteries, and power panel.

Major Components

AN/MTC-1

1 shelter S-179/MTA-3
(modified S-141/G)
3 switchboards SB-249A/TTC
3 telephone sets TA-312/PT
1 shelter S-180/MTA-4
(modified S-141/G)
3 main distribution frames
TA-257/TTC
2 line relays TA-223A/TTC
1 line relay TA-226A/TTC
1 power distribution panel
SB-1032/TTC
4 batteries BB-46
3 telephone sets TA-312/PT

AN/MTC-1A

1 shelter S-280B/G (modified)(MTA-3)
3 switchboards SB-1398/GTA
2 telephone sets TA-312/PT
1 shelter S-280B/G (modified)(MTA-4)
3 main distribution frames
TA-454/GTA-14
2 line relays TA-452/GRA-14
1 line relay TA-226/TTC
1 power distribution panel
SB-1399/GTA
4 batteries BB-46
3 telephone sets TA-312/PT
2 intercommunications stations
LS-147F/FI

Technical Characteristics

Power requirement ..... 115 V AC, 50 to 60 Hz
Power Consumption ..... 7,556 W
Weight:
AN/MTA-3 ..... 2,038 kg (4,490 lbs)
AN/MTA-4..... 1,970 kg (4,339 lbs)
Vehicular Requirement ..... Two 2 1/2-ton trucks

14. AN/TTC-38(V)1 and AN/TTC-38(V)2 automatic telephone central offices.

Status: STD-A; NSN: 5805-00-186-0681 (AN/TTC-38(V)1)
STD-A; NSN: 5805-00-186-0640 (AN/TTC-38(V)2)

General Information

The AN/TTC-38(V)1 and the AN/TTC-38(V)2 are air- or vehicular-transportable automatic central offices used to provide switching facilities in an area communications system They are capable of interconnecting either 300 (AN/TTC-38(V)1) or 600 (AN/TTC-38(V)2) VF or wideband telephone circuits. Each is installed in a shelter S-280/B. DTMF telephone sets TA-341/TT, TA-838/TT, or TA-938/G can be used with these central offices. The AN/TTC-38(V) includes the control test maintenance group OK-267(V)/TTC-38 which provides an enclosed area for the operation of a remote operator position of automatic telephone central office (AN/TTC-38(V) and maintenance test equipment used to perform the prescribed maintenance mission. The OK-267 is housed in shelter S-541/TTC-30(V).

Technical Characteristics

Power Requirement	115/20 V AC; 3-phase; 4-wire; 50, 60, or 400 Hz
Power Consumption:	
AN/TTC-38(V)1	2,359 W
AN/TTC-38(V)2	2,624 W
Weight:	
AN/TTC-38(V)1	2,667 kg (5,875 lbs)
AN/TTC-38(V)2	3,151 kg (6,940 lbs)
Vehicular Requirement	One 2 1/2-ton truck (TTC-38)
	One 2 1/2-ton truck (OK-267)

15. AN/TTC-39A(V) 4 and AN/TTC-39D 712-line, and AN/TTC-39A(V) 3 300-line automatic telephone central office.

Status: STD-B; NSN: 5805-01-122-3414 (AN/TTC-39D)
STD-B; NSN: 5805-01-121-4395 (AN/TTC-39A(V)3)
STD-B; NSN: 5805-01-121-9560 (AN/TTC-39A(V)4)

General Information

The AN/TTC-39D and AN/TTC-39A(V)4 service up to 672 analog and digital loops/trunks at EAC. The AN/TTC-39 permits factory or depot level reconfiguration into a family of circuit switches containing various quantities, types, and mixes of analog and digital switching terminations. The AN/TTC-39A(V)3 performs like functions, but at a 600-line capacity. The AN/TTC-39 interfaces with DSN, automatic secure voice communications (AUTOSEVOCOM), existing tactical switches (manual and automatic), and commercial central offices. The AN/TTC-39 interfaces with NATO telephone systems using CV-3478. Up to three remote control call service positions supplement the call service function in the AN/TTC-39. It uses analog in-band, out-of-band digital (common channel), and dibits. It signals and supervises trunks and lines, including ringdown, DC closure, dial pulse, tone, or digital and provides a compatible connector between subscribers.

Major Components

712 Line	600 Line
1 switching module assembly	1 switching plus control module assembly (combined) S-250B/G (modified)
1 storage shelter S-640	1 maintenance shelter S-250
1 maintenance shelter S-639	1 storage shelter S-250
1 master power distribution unit ON-224/T	1 master power distribution unit ON-224/T
2 electric power plants AN/MJQ-12 (60 kW)	
1 intershelter cable reel trailer V-528/T	

Technical Characteristics

Vehicular Requirements:

39D, 39A(V) 4	One 5-ton truck, two 2 1/2-ton trucks
A(V)3	One or two CUCV or HUMMV trucks
Power Requirement	115/208 V AC, 3-phase 50/60 Hz ((V) 4 at 400 Hz)

16. AN/TTC-39A(V)1 automatic telephone central office.

Status: STD-B; NSN: 5805-01-241-9710

General Information

The AN/TTC-39A(V) is modular/transportable switching communications and nodal control equipment that provides secure automatic switching and technical control for both digital and analog communications. It is a hybrid circuit switch with a 744-line capacity (96 analog and 648 digital). The facility provides technical control functions including channel reassignment and multiplexing, line testing, engineering orderwire, atomic timing standard, and analysis or trouble reports, alarms, and system data. It signals and supervises analog and digital trunks and lines. This includes 20-Hz/1600-Hz ringdown, DC closure, dial pulse, DTMF/multifrequency, and 6-wire E&M using tone burst, confirmation, nonconfirmation, common channel, and dibits signaling.

Major Components

1 switching module assembly S-280B/G (modified)
1 storage shelter S-640
1 maintenance shelter S-639
1 master power distribution unit ON-224T
2 PU-406 electric power units (30 kW) AN/MJQ-10A

Technical Characteristics

Total External Lines	744
Digital Matrix	648
Analog Matrix	96
Maximum Local Loops/Trunks (within this total)	240
Digital Local Loops	144
Analog Local Loops/Trunks	96
Maximum Analog Loops via DTGs	60
Switch Rate	16/32 kb/s
Total DTGs	30
Maximum Channels Per DTG	144
In-Band Digital Trunks (Long Loops)	200
Call Rate	7,500 (calls per busy hour)
Analog Bandwidth	108 kHz
Numbering Plan	TRI-TAC NATO, 13 digits; military tactical, 7 digits; DSN, 10 digits
Power	120/208 V AC; 50, 60, 400 Hz; three-phase
Vehicle Requirements	One 5-ton truck (TTC39A); 2 1/2-ton trucks (S-640)(S-639)

17. AN/TTC-41( ) automatic telephone central office.

Status: STD-A; NSN: 5805-01-028-8393 (AN/TTC-41(V)1)
STD-A; NSN: 5805-01-028-8394 (AN/TTC-41(V)2)
STD-A; NSN: 5805-01-028-8392 (AN/TTC-41(V)3)
STD-A; NSN: 5805-01-044-8869 (AN/TTC-41(V)4)
STD-A; NSN: 5805-01-044-8870 (AN/TTC-41(V)5)
STD-A; NSN: 5805-01-045-3157 (AN/TTC-41(V)6)
STD-A; NSN: 5805-01-044-8871 (AN/TTC-41(V)7)

General Information

The AN/TTC-41 is an air- or vehicular-transportable assemblage used to provide rapid automatic switching to tactical units in an area-type communications system. The AN/TTC-41( ) provides cordless service to 2-wire common-battery signaling lines, 20-Hz ringdown lines or trunks, common-battery dial pulse or DTMF lines, and 4-wire tone signaling trunks. The AN/TTC-41(V) 1 provides 30 lines of service in a shelter configuration. The AN/TTC-41(V) 2 and AN/TTC-41(V) 5 provide 60 lines of service. The AN/TTC-41(V) 3 and AN/TTC-41(V) 6 provides 90 lines of service. The AN/TTC-41(V) 4 and AN/TTC-41(V) 7 provides 120 lines of service in a shelter configuration. The (V) 1 through (V) 4 models are shelter configurations and (V) 5 through (V) 7 are trailer configurations.

Major Components

1 shelter S-561 TTC-41( )(modified shelter S-250/G)((V)1-(V)4 models)
1 trailer assembly V-498/TTC-41(V) (modified trailer M-569)((V) -5-(V) 7 models)
1 intercommunications station LS-147F/FI (All models)
1 telephone set TA-938/G pushbutton (all models)
1 through 5 switchboards SB-3614(V)/TT or SB-3614A(V)/TT and headset H-182/PT (depending on the model)
1 or 2 power supplies PP-6224/U (depending on the model)
1 headset switchbox (all models)

Technical Characteristics

Power Requirement .....115 V AC; 60 Hz; single phase
Power Consumption:
(V)1 .....5.1 kW, 1,031 kg (2,270 lbs)
(V)2 .....5.2 kW, 1,058 kg (2,330 lbs)
(V)3 .....5.3 kW, 1,090 kg (2,400 lbs)
(V)4 .....6.5 kW, 1,167 kg (2,570 lbs)
(V)5 .....2.1 kW, 945 kg (2,080 lbs)
(V)6 .....2.2 kW, 963 kg (2,120 lbs)
(V)1 .....3.5 kW, 1,050 kg (2,310 lbs)

Vehicular Requirement..... 1 1/4-ton truck (V)1-(V)4, one 1/4-ton truck, and one 3/4-ton truck

18. AN/TTC-46 large extension node switch.

Status: To be determined; NSN: To be determined

General Information

The large extension node switch (LENS) is configured in two S-250( )/G-the ON-305/TTC-46 switching shelter and the OL-412/TTC-46 operations shelter. Each shelter is transported to an M-1037 high mobility multipurpose wheeled vehicle (HMMWV). The LENS is configured basically the same as the NC switch with the basic difference in termination configuration for trunks and loops. The switching shelter provides the external interface, circuit switching, and associated functions. The operations shelter provides the central processing and operator interface functions. Power to both assemblages is provided by a PU-753/M, 10-kW, trailer-mounted, diesel generator towed by the operations shelter's prime mover.

Major Components

	ON-305	OL-412
Shelter S-250/G		1
Shelter S-250E/G	1	
Switch subsystem AN/TTC-46:		
LCSP*		1
Switching processor subsystem*		1
Plasma display unit*		1
TDSGM		
STED KG-194A	3	
Loop key generator KG-112	8	
Automatic key distribution control KGX-93	1	
Transition unit HGF-93	1	
Net control device KYX-15		1
Communications modem		1
VINSON COMSEC KY-57		1
Secure device NRI KY-90		1
Environmental control unit		1
Junction box J-1077/U		8
Intercommunications station LS-147		1
Workstation (UXC-86)		1
DNVT TA-1035/U		1
Super high frequency (SHF) control unit	2	
Signal cable CX-4566	2	
Intershelter cables		6
Power cables CX-7453 and CX-7705**		1
Packet switch AN/TYC-20	2	

* Part of AN/TTC-46

Technical Characteristics

Power Requirements	115 V AC, 50 or 60 Hz, single phase
Channel Rates	16 kb/s
Digital Terminations	648
Trunk Signaling Buffers	4
Digital Inband Signaling Buffers	4
Digital Transmission Groups	8
Digital Receivers	20
Digital Loops	84
Analog Loop (Commercial Interface)	4
Conference Bridge Unit	4

19. AN/TTC-47 NCS.

Status: To be determined; NSN: To be determined

General Information

The NCS is configured in two S-250( )/G shelters-a wit g shelter and an operations shelter, each transported on an M-1037 (HMMWV). The NCS is the hub of the MSE node providing network interface for the subscriber access elements. The ON-306/TTC-47 switching shelter provides the external interface, circuit switching, and associated functions. The OL-413/TTC-47 operations shelter provides the central processing and operator interface functions. The NCS provides automatic subscriber finding features which allow permanent subscriber address assignment and negates the need for knowledge of subscriber geographical location and switch affiliation at the subscriber level. Power to both assemblages is provided by a PU-753/M, 10-kW, trailer-mounted, diesel generator.

Major Components

	ON-306	OL-413
Shelter S-250/G		1
Shelter S-250E/G	1	
Switch subsystem AN/TTC-47:		
LCSP*		1
Switching processor system*		1
Plasma display unit*		1
TDSGM	2	
Trunk encryption device KG-194A's	15	
Loop key generator KG-112	8	
Automatic key distribution control KGX-93	1	
Transition unit HGF-93	1	
Net control device KYX-15		1
Communication modem		1
VINSON COMSEC KY-57		1
Environmental control unit		1
Junction box J-1077/U		2
Intercommunications station LS-147	1	1
Workstation		1
DNVT TA-1035/U		1
Signal cable CX-4566	2	
Intershelter cables		6
Power cables CX-7453 and CX-7705 **		1
Packet switches AN/TYC-19 and -20	1	

* Part of AN/TTC-47
** Shelter power cables are connected in series

Technical Characteristics

Power Requirements	115 V AC, 50 or 60 Hz, single phase
Channel Rates	16 kb/s
Digital Terminations	648
Trunk Signaling Buffers	8
Digital Inband Signaling Buffers	10
Digital Transmission Group	16
Digital Receivers	20
Digital Loops	24
Analog Interfaces (STANAG 5040)	8
Conference Bridge Units	4(20 ports)

20. AN/TTC-48(V) small extension node switch.

Status: To be determined; NSN: To be determined

General Information

The small extension node switch (SENS) consists of an S-250E shelter transported on an M-1037 (HMMWV). The SENS contains switching, packet switching, and COMSEC equipment which supports the secure digital communications of a CP. The SENS is provided in two versions—(V)1 and (V)2. The (V)1 provides 26 digital lines and 10 digital trunks. The (V) 2 provides 41 digital lines and 13 digital trunks. Both versions provide two DC closure commercial office interface and a secure digital NRI KY-90. The SENS can interface with a LENS or NCS directly via CX-11230/G cable, via LOS or via TACSAT terminal AN/TSC-85B or AN/TSC-93B. Power is provided by a PU-753/M, 10-kW, trailer-mounted, diesel generator.

Major Components

1 shelter S-250(E) /G
2 telephone switchboards SB-4303
1 DNVT TA-1035/U
1 communication modem
1 trunk encryption device KG-194A
1 packet switch AN/TYC-20
2 cables CX-4566 (25 feet)(SEN V1)
1 cable CX-4566 (250 feet)(SEN V1)
2 cables CX-4566 (25 feet)(SEN V2)
4 cables CX-4566 (250 feet)(SEN V2)

mounts and cables for:
1 very high frequency (VHF) radio set AN/GRC-224
1 secure digital net radio interface unit KY-90
1 frequency modulated (FM) radio
1 VINSON COMSEC equipment KY-57
1 secure digital net radio interface unit KY-90
1 inverter, avionics
1 environmental control unit
3 junction boxes J-1077/U ((V) 1)
5 junction boxes J-1077/U ((V) 2)

Technical Characteristics

Power Requirements..... 115 V AC, 50 or 60 Hz, single phase

LESSON 1

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the key that follows. If you answer any item incorrectly, study gain that part of the lesson which contains the portion involved.

1. Common-battery equipment is often housed in mobile shelters. The electrical power required to operate these shelters is normally supplied by which of the following?

   A. Dry cells
   B. Wet cells
   C. Commercial power
   D. Power-generating equipment

2. Which of the following is a sound-powered telephone?

   A. TA-312/PT
   B. TA-838/TT
   C. TA-1/PT
   D. TA-43

3. Which telephone provides digital communications interface with TRI-TAC and MSE circuit switches?

   A. TA-838/TT
   B. TA-954/TT
   C. TA-938/G
   D. TA-1035/U

4. The _____ is all analog. Today, we find most of them assigned to the Reserve Components.

   A. AN/TTC-38
   B. AN/TTC-41A
   C. AN/TTC-46
   D. AN/TTC-39A

5. The _____ provides two DCO circuits and NRI using the KY-90.

   A. AN/TTC-48
   B. AN/TTC-47
   C. AN/TTC-41A
   D. AN/TTC-46

6. The _____ telephone is primarily used for internal communications between a mechanized infantry platoon and its three squads.

   A. TA-312/PT
   B. TA-43/PT
   C. TA-838/TT
   D. TA-1/PT

7. The _____ can service 50 telephone circuits. The operator can set up a conference call for up to six subscribers.

   A. SB-3082(V)1/GT
   B. SB-22/PT
   C. AN/TTC-41A
   D. AN/TTC-48

8. The _____ can provide 164 subscribers with 52 trunk access, and is usually found at DISCOM and Corps Support Command.

   A. AN/TTC-39D
   B. AN/TTC-47
   C. AN/TTC-46
   D. AN/TTC-48

9. The _____ is the hub of the MSE node.

   A. AN/TTC-41A(V)1
   B. AN/TTC-47
   C. AN/TTC-46
   D. AN/TTC-48(V) 2

10. The _____ can service 600 or 672 trunks depending on the model. It provides, for the first time, the capability to mix analog and digital services.

    A. AN/TTC-39
    B. AN/TTC-38
    C. AN/TTC-39A
    D. AN/TTC-46

LESSON 1

PRACTICE EXERCISES

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1	D. Power-generating equipment A trailer-mounted power-generating unit provides electrical power to the shelter. (page 1-3, para 2a and 2b)
2	C. TA-1/PT The TA-1/PT is a lightweight, waterproof, sound-powered telephone. (page 1-2, para a(1))
3	B. TA-954/TT The TA-954/TT provides digital communications interface with the TRI-TAC and MSE switchboards. (page 1-3, para lb(3))
4	A. AN/TTC-38 The AN/TTC-38 is all analog. Today, we find most of the AN/TTC-38s still in service with the Reserve Component units. (page 1-4, para 2b(4))
5	A. AN/TTC-48 The AN/TTC-48 can provide two dial central office circuits and net radio interface via the KY-90. (page 1-5, para 2b(9))
6	D. TA-1/PT The infantry squads used the TA-1/PT for internal communications and to link with the platoon headquarters element. (page 1-2, para a(1))
7	A. SB-3082(V)1/GT The SB-3082(V) 1/GT can service up to 50 telephone circuits. The operator can set up a conference call for up to six subscribers. (page 1-4, para 2b(3))

Item	Correct Answer and Feedback
8	C. AN/TTC-46 AN/TTC-46 or LEN switchboard has basically the same configuration as the NCS. The LEN doctrinally is deployed in support of the DISCOM. It can support a total of 164 subscribers. (page 1-4, para 2b(7))
9	B. AN/TTC-47 AN/TTC-47 or NCS is the hub of the MSE node. (page 1-4, para 2b(8))
10	C. AN/TTC-39A The AN/TTC-39A can service 600 or 672 trunks depending on the model on hand. The AN/TTC-39A provides, for the first time, the capability of analog and digital services. (page 1-4, para 2b(5))

LESSON 2

TACTICAL NUMBERING SYSTEM

Critical Task.: 01-5710.07-0001

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn the joint and Army tactical numbering system.

TERMINAL LEARNING OBJECTIVE:

ACTION: Explain the tactical numbering system.

CONDITION: You will have this lesson material, paper, pencil, and no supervision.

STANDARD: To demonstrate competency on this lesson, you must achieve a minimum of 70 percent on the subcourse examination.

INTRODUCTION

This lesson provides a discussion of the telephone numbering system as well as the several numbering plans which may be found in tactical networks. Included are limitations due to the design constraints of some of the tactical circuit switch/switchboard equipment still in use.

The AN/TTC-39/39A is extremely flexible in its ability to adapt to different numbering plans. The AN/TTC-39 routes traffic based upon telephone numbers. To route the traffic systematically, it requires the use of a numbering plan. Since there are several numbering plans in use, the system planner must be familiar with those plans. The planner must know how to program the switch to route calls using those plans.

1. Numbering plan structure. There are several levels in the numbering plan. These are as follows:

- National identification number (9YX)
- Area code (MYX)
- Primary zone/switch location (PRSL) or local exchange (NNX)
- Subscriber number XXX or XXXX where--

X = 0-9
Y = 0 or 1
M = 2-8
N = 2-9
PR = 72-99 (except 80, 81, 90, 91, and 99)
SL = 00-99

a. National identification number. NATO members have reached a standardization agreement (STANAG) to use a unique three-digit national identification (NI) number. This number takes the form of 9YX (where Y = 0 or 1; X = 0 through 9) for each member country. The NI code serves as the first three digits of a 13-digit telephone number for NATO intercountry calls. The NI code for the tactical United States (US) forces is 914.

b. Area code. The next level uses a three-digit area code similar to a commercial area code. This code takes the form of MYX (where M = 2 geographic areas or such organizations as a division, a corps, or a larger command area. In assigning tactical area codes, planners should avoid duplicating existing DSN area codes. The existing DSN area codes are--

312 CONUS
313 Caribbean
314 Europe
315 Pacific
317 Alaska

If tactical and DSN area codes are not duplicated, the switch can distinguish between DSN and tactical calls by the area code.

c. PRSL or NNX

d. Each MYX area can be partitioned by one of three methods. In method one, the MYX area is called a PRSL subnetwork. In a PRSL subnetwork, the MYX area can get divided in up to 23 primary zones or areas switch (PR). In each PR, every switch will have its own unique (SL). PRs can equal 72 through 99, except 80, 81, 90, 91, and 99. (Numbers 80, 81, 90, and 91 are reserved for DSN. PR 99 is reserved for fixed directory dialing.) Each can contain up to 100 SLs.

e. In an NNX subnetwork, an MYX area can be partitioned in up to 640 switching center (NNX) codes.

f. In a mixed subnetwork, both PRSL and NNX subnetworks coexist within a single MYX area Within each MYX area, each PR area and each NNX code must be unique. An MYX area containing mixed subnetworks, must have no NNX code in which the NN portion is the same as a PR code. In the same way, within each PR area, each SL code must be unique.

g. Subscriber number. The last three digits in a PRSL numbering scheme make up the subscriber number. In an NNX numbering scheme, the last four digits make up the subscriber number. The subscriber number takes the form of XXX or XXXX where X = 0-9.

2. Numbering plan. This paragraph provides general information concerning numbering plans found in the fixed and tactical environments.

a. Commercial numbering plan. The commercial telephone systems use a 10-digit numbering plan as follows:

- NYX-NNX-XXXX, where--

  NYX = area code
  NNX = switch code
  XXXX = subscriber's number

- We use the following numbers:

  N = 2-9
  Y = 0, 1
  X = 0-9

b. DSN numbering plan. This is a subset of the commercial numbering plan.

- NYX-NNX-XXXX, where -

  NYX = area code
  NNX = switch code
  XXXX = subscriber's number

- We use the following numbers:

  N = 2-9
  Y = 0, 1
  X = 0-9

c. Tactical numbering plan Tactical units use a seven-digit numbering plan.

- PR-SL-XXX, where-

  PR = primary zone
  SL = switch location
  XXX = subscriber's number

- We use the following numbers:

  P = 7-9
  R = 2, 9
  S = 0-9
  L = 0-9
  X = 0-9

(1) The PR-SL plan is a 3/4 numbering plan. In Appendix B, there is a list of tactical PR codes developed jointly for use around the world.

(2) The MYX codes are to be used by a DSN subscriber to access the tactical subscriber when activated by Defense Information System Agency (DISA). These MYX codes are essentially the area codes for the tactical network.

3. Tactical circuit switch (CS) switchboard numbering plans. This paragraph discusses the numbering plans available for the several CS/switchboards used.

a. AN/TTC-39/39A CS numbering plan. We can program the AN/TTC-39 and AN/TTC-39A to support three distinct numbering plans. They are as follows:

- General tactical PR-SL-XXX (7 digits)
- Strategic NYX-NNX-XXXX (10 digits)
- NATO 9YX-MYX-NNX-XXXX (13 digits)

b. AN/TTC-38 CS numbering plan. We can program the AN/TTC-38 to support the general tactical numbering plan.

- PR = 72-98, except 80, 81, 90 and 91
- SL = 00-99
- XXX = 0.000 Restricted for operator
- 001-099 DC closure lines
- 100-699 Local subscribers
- 700-999 Trunks to automatic switches, manual switchboards, or local subscribers

c. AN/TTC-30 CS numbering plan. We can program the AN/TTC-30 to support a five-digit numbering plan.

- DX = EXX, where-

  DX = switch location
  EXX = subscriber's number

- The following numbers are allowed:

  DX = 5X except 54
  = 6X, except 67
  = 7X
  = 8X
  = 9X
  EXX = 1XX-4XX (except 100, 101)

- The number 5XX-9XX 000 cannot be dialed by an AN/TTC-30 CS subscriber.

d. SB-3614 switchboard numbering plan. The SB-3614 (AN/TTC-41 CS) uses a three-digit numbering plan.

NXX or NSL, where-

N = 1-6
XX = 1-30, 31-60, 61-90 and
SL = depends on switch locations and terminal assignment

4. Joint numbering plan and the initial joint command. Control communications system will use the following numbering plan:

PR = 89
SL = 50-59 (except 54), ARFOR
SL = 60-69 (except 67), Joint
= 70-79, MARFOR
= 88-99, (except 88), AFFOR

All joint subscribers will have DSN access by dialing the proper code.

5. Joint tactical telephone subscriber numbering plan. Subscribers provided service from the joint task force (JTF), joint signal officer task force (JSOTF) and components, and CS/switchboards will be assigned numbers as outlined in Appendix B. Secure subscribers assigned numbers in the 8XX series cannot call from an AN/TTC-30 CS without operator assistance. The dialing limitations of the switch that provides the subscriber service must be followed when assigning numbers.

6. Numbering plan restriction (AN/TTC-30). If an AN/TTC-30 is included in the circuit switched network and the planner desires to provide the subscriber automatic access to the network, a number of restrictions are encountered. They are-

a. Restriction of SL codes from 50 through 99 (except 54 and 67).

b. Restriction of subscriber codes 102 through 499 (numbers 100 and 101 are reserved for operator positions).

7. If the AN/TTC-30 subscribers are to have automatic access to all members of the network, all other switches in the network must adhere to e restrictions. If the AN/TTC-30 is connected to an AN/TTC-39/39A, the AN/TTC-30 subscriber cannot dial SL-000 and reach the AN/TTC-39/93A operator.

LESSON 2

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the key that follows. If you answer any item incorrect, study again that part of the lesson which contains the portion involved.

1. NATO members have reached a STANAG to use a unique three-digit identification number. The first three digits of a 13-digit telephone number represents which of the following?

   A. National identification number
   B. Area code
   C. Subscriber number
   D. Primary zone/switch location

2. In assigning tactical area codes, a planner must not duplicate existing DSN area codes.

   A. True
   B. False

3. Which is the NI code for the tactical US forces?

   A. 312
   B. 317
   C. 914
   D. 315

4. What is a mixed subnetwork?

   A. The MYX area where the NNX and PRSL subnetworks coexist
   B. The MYX area is divided into 640 switching center (NNX) codes
   C. The MYX area can be divided into 23 primary zones or areas (PR)
   D. A and B

5. What do the first three digits in the commercial numbering plan represent?

   A. Switch code
   B. Area code
   C. Subscriber number
   D. Dial tone

6. Tactical units use a _____ numbering plan.

A. 10-digit
B. 5-digit
C. 13-digit
D. 7-digit

7. The _____ can support the general tactical, strategic, and NATO numbering systems.

A. AN/TTC-30
B. AN/TTC-38
C. AN/TTC-39/39A
D. SB-3614

8. If the circuit switched network includes the AN/TTC-30 and the planner wants to provide the subscriber with automatic access to the automated network, the planner must meet certain restrictions. One of those restrictions is as follows:

A. Restriction of SL codes from 50 through 99 (except for 54 and 67)
B. If AN/TTC-30 subscribers are connected to an AN/TTC-39/39A, the AN/TTC-30 subscriber can dial SL-000 and reach the AN/TTC-39/39A operator
C. Restrictions of subscriber codes 102 through 499 (the planner must reserve numbers 100 and 101 for operator positions)
D. A and C

9. All joint subscribers will access the DSN by dialing the proper code.

A. True
B. False

10. The following numbers cannot be dialed by an AN/TTC-30 CS subscriber.

A. 6XX-9XX 000
B. 7XX-9XX 000
C. 4XX-9XX 000
D. 5XX-9XX 000

LESSON 2

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1	A. National identification number NATO members have reached a standardization agreement (STANAG) to use a unique three-digit national identification number. The NI code serves as the first three digits of a 13-digit telephone number for NATO intercountry calls. (page 2-2, para 1a)
2	A. True In assigning tactical area codes, planners should avoid duplicating existing DSN area codes. (page 2-2, para 1b)
3	C. 914 The NI code for the tactical US forces is 914. (page 2-2, para 1a)
4	A. The MYX area where the NNX and PRSL subnetworks coexist In a mixed subnetwork, both PRSL and NNX subnetworks coexist within a single MYX area. (page 2-3, para 1f)
5	B. Area code The NYX in the commercial numbering systems represents the area code. (page 2-3, para 2a)
6	D. 7-digit Tactical units use a seven-digit numbering plan. (page 2-4, para 2c)
7	C. AN/TTC-39/39A We can program the AN/TTC-39 and the AN/TTC-39A to support three distinct numbering plans-general tactical, strategic, and NATO. (page 2-4, 3a)

Item	Correct Answer and Feedback
8	D. Restriction of SL codes from 50 through 99 (except 54 and 67) and restriction of subscriber codes 102 through 499. (The planner must reserve numbers 100 and 101 for operator positions). (page 2-6, para 6)
9	A. True All joint subscribers will have DSN access by dialing the proper code. (page 2-5, para 4)
10	D. 5XX-9XX 000 The number 5XX-9XX 000 cannot be dialed by an AN/TTC-30 subscriber. (page 2-5, para 3c)

LESSON 3

INTRODUCTION TO TRUNK GROUP SIZING

Critical Task: 01-5710.07-0001

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn how to determine the trunk group sizing in support of EAC.

TERMINAL LEARNING OBJECTIVE:

ACTION: Determine a trunk group sizing.

CONDITION: You will have this lesson material, paper, pencil, and no supervision.

STANDARD: To demonstrate competency on this lesson, you must achieve a minimum of 70 percent on the subcourse examination.

INTRODUCTION

Many times signal officers simply install systems and circuits. They may not understand the process it takes to plan and engineer those systems. Most signal officers take for granted that someone has taken the time to program the proper number of trunks between switchboards. Many times we tried to install the same number of circuits and trunks that worked in the previous exercise.

1. The tendency to do as we have done in the past can be a costly waste of resources. These resources are in the form of equipment; personnel; repair parts; petroleum, oils, and lubricants (POL); food for personnel; and increased accident rate.

2. A tactical communications network is defined by its nodes and by the trunk group linking these nodes. Nodal circuit switches are complex; currently we use the AN/TTC-39A as the primary nodal circuit switch. The network also includes several other switching facilities. Large extension switches (LES) and small extension switches (SES) serve subscribers too far away from major nodal switches to be directly connected. Most of these switching facilities will be unit level circuit switches of various configurations.

3. They may be semiautomatic, fully automatic, or manual in nature. They can also vary in type from analog to digital and range in size from 12 to 600 lines. The SES connects to only one node while the LBS will connect to more than one node. All switches dump into and receive traffic from the major switches. When calculating the size of the trunk group cluster (TGC) between nodes, the traffic the SES and LES have to offer must be determined first. Before calculating the size of a TGC, a switch's traffic profile must be determined. A switch's traffic profile is obtained by metering reports that the automatic switches produce on a reoccurring basis.

4. Before we continue, clarification must be made. The SEN and LEN we normally hear when speaking about MSE are not the same as the LES and SES we are referring to throughout these lessons. In MSE, we do not need to determine the TGC, since flood search is automatic and done without regard to paths assigned.

PART A - DEFINITIONS

1. Before we continue, you must understand the items listed below.

a. Trunk is defined as a single circuit between two points, both of which are switching centers and/or individual distribution points.

b. Trunk groups are trunks with identical characteristics (designation, signaling, and traffic route) with the same destination.

c. Trunk group cluster is a set of trunks with different characteristics (including analog and digital types) with the same destination.

d. Grade of service (GOS) is the number of calls completed divided by the number of calls attempted.

e. SES is a switchboard that has only one possible path in or out for all traffic.

f. LES is a switchboard that has more than one possible path in or out for all traffic. This switchboard may or may not provide tandem service. An LES will also have extensive local traffic.

g. A node has numerous paths in and out and extensive tandem service provided. There is minimum local traffic and that traffic is normally reserved for signal personnel's command and control of the network.

h. Erlang is the international unit of measurement for traffic intensity. One Erlang is the intensity in a traffic path continuously occupied. An Erlang can measure the intensity in one or more traffic paths for one call-hour per hour period. Each trunk has a maximum capacity of 36 call completed second (CCS) per hour. A CCS is the number of calls multiplied by the average holding time for the calls. The CCS cannot exceed 3,600 call-second.

i. Off-hook time (OHT) is the amount of time a telephone is off-hook or in use.

j. Off-hook factor is the representation in percentage of the off-hook time.

k. Tandem is traffic that flows through a switch but does not begin or terminate at that switch. A node will have most of its traffic in the form of tandem service as it is mainly a hub or a point at which traffic is relayed or redirected throughout the network. LES can also have some tandem service. Tandem service will affect the way in which TGC sizing is calculated.

l. Average call rate (ACR) is the average number of calls made by a switch during a one-hour period during the busiest period of the day.

2. Grade of service (GOS).

a. GOS is defined as the number of calls completed divided by the number of calls attempted. As planners, we must target our network for a GOS of 90 percent; this translates into a 10 percent blockage rate.

b. A blockage rate is needed to protect the switch from becoming overloaded and crashing. This is what happened in Germany when Siemens activated the European Telephone Service (ETS). Siemens did not program a blockage rate and when the American Forces began using ETS, it quickly became overloaded and crashed. It then took weeks to recover and reprogram with a protection blockage rate. A 10 percent blockage ratio will prevent total breakdown of the switch. When a switch hits this blockage level it will automatically take precautions to ensure that high priority users have continuous access to the network. Some of this protection is in the form of restricted access to the switchboard and preemption for the priority users. These programmed precautions are done in the initial setup or programming of the switch in its data base.

3. Switch traffic profile.

a. The switch traffic profile is the percent of a switch's total traffic that falls into any of the four categories listed below:

(1) Local.

(2) Incoming.

(3) Outgoing.

(4) Tandem.

b. You can determine the traffic profile from the metering reports generated by the switch. Tactical units normally require their switchboard operators to produce their metering reports at least twice daily.

4. Trunk group sizing procedures. The procedure to determine the trunk group sizing has five steps. To better understand the process, we will work together an example. The switchboard in the example is an SES. Use a clean piece of paper to work the example.

PART B - SMALL EXTENSION SWITCH (EXAMPLE)

NUMBER OF SUBSCRIBERS	30	CALL RATIO:	
AVERAGE HOLD TIME	4	LOCAL	.25
AVERAGE CALL RATE	3	INCOMING	.40
		OUTGOING	.35

1. Determine the busy hour call-minutes. The call-minutes (CM) equal the amount of call-minutes during the busiest hour. It refers to how many minutes the subscribers use a trunk.

a. To determine the call-minutes, we multiply the number of subscribers by the ACR.

__ (# of subs) x __(ACR) = __
30 (# of subs) x 3 (ACR) = 90

b. Then we take the results and multiply it by the average hold time (AHT).

90 x 4 (AHT) = 360 CM

2. Determine the total amount of trunk traffic offered. The total percentage of calls that use a TGC is computed by adding the percentages of incoming and outgoing together and multiplying it by the total CM results from the previous step to get an overall percentage. Local traffic will not be considered when calculating the total traffic. Local traffic does not go over any trunk.

#CM x (incoming + outgoing) = offered trunk traffic
360 (CM) x (.40 + .35) = offered trunk traffic
360 (CM) x .75 = 270 CM

3. Determine the distribution of offered trunk traffic. Remember the SES has only one trunk path. The traffic offered to the trunk group equals the amount of traffic going over the trunk. Since the SES has only one path, the total traffic going over the trunk equals 100 percent or 1.00.

4. The Erlang charts found in Table 3-1 use call-seconds as a traffic measurement. If you review your work, we have been using call-minutes to measure our traffic load. In this step, we will convert the call-minutes into call-seconds. To make the conversion, we multiply our call-minutes by the constant Ke. The constant Ke equals .60.

_____ CM x _____ TGC % (% of traffic) x Ke = _____ CCS
270 CM x 1 TGC % x .60 = 162 CCS

5. Determine the desired overflow. To determine the desired overflow, first we must determine how large these trunk groups must be. After we know the size of the trunk, we can determine the GOS. Next we multiply the total call-seconds offered by the GOS desired.

Overflow = CCS offered to a trunk x GOS
Overflow = 162 CCS x .10 = 16.2 CCS

As a rule of thumb, always remember what happened in Europe when Siemens forgot to program a blockage rate for the switch.

6. Determine the number of trunks needed for CCS offered. The two known quantities provide us with the traffic offered and the desired overflow. In Table 3-1, the charts have the traffic offered listed in the extreme left and extreme right. The intent is to make it easier to read the charts. Start by finding the traffic offered in our example--162 CCS.

a. Next, we need to find the desired overflow. In our example, the desired overflow is 16.2 CCS. When the desired overflow falls between two values, like in our example, by rule of thumb we always round up to the next value. In our example, we will round up to 25 CCS.

b. Once we intersect both numbers (162 CCS and 25 CCS), we read straight up to find the total number of trunks needed. In this case, the correct answer is six trunks.

7. If you want to work another problem here is the information. You will still determine the number of trunks needed for SES. The correct answer can be found in the Answer Key and Feedback section at the end of this lesson.

NUMBER OF SUBSCRIBERS	22	CALL RATIO:	
AVERAGE HOLD TIME	6	LOCAL	.20
AVERAGE CALL RATE	8	INCOMING	.35
		OUTGOING	.45

Table 3-1. Erlang B alternate routing tables.
(Part 1 of 10)

Hundred Call-Seconds Carried by and Overflowing From Each Trunk Shown in Column Headings and Total CCS Carried on Group

	Trunk Number												
	1			2			3			4			
CCS Offered	Carried			Carried			Carried			Carried			CCS Offered
	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	
5	4	4	1										5
6	5	5	1										6
7	6	6	1										7
8	6	6	2										8
9	7	7	2										9
10	8	8	2										10
11	8	8	3										11
12	9	9	3										12
13	10	10	3										13
14	10	10	4										14
15	11	11	4	3	14	1							15
16	11	11	5	4	15	1							16
17	11	11	6	5	16	1							17
18	12	12	6	5	17	1							18
19	12	12	7	5	17	2							19
20	13	13	7	5	18	2							20
21	13	13	8	6	19	2							21
22	14	14	8	6	20	2							22
23	14	14	9	6	20	3							23
24	14	14	10	7	21	3							24
25	15	15	10	7	22	3							25
26	15	15	11	7	22	4							26
27	15	15	12	8	23	4							27
28	16	16	12	8	24	4							28
29	16	16	13	9	25	4							29
30	16	16	14	9	25	5	4	29	1				30
31	17	17	14	9	26	5	4	30	1				31
32	17	17	15	9	26	6	4	30	2				32
33	17	17	16	10	27	6	4	31	2				33
34	18	18	16	10	28	6	4	32	2				34
35	18	18	17	10	28	7	5	33	2				35
36	18	18	18	11	29	7	5	34	2				36
37	18	18	19	11	29	8	5	34	3				37
38	19	19	19	11	30	8	5	35	3				38
39	19	19	20	11	30	9	6	36	3				39
40	19	19	21	12	31	9	6	37	3				40
41	19	19	22	13	32	9	6	38	3				41
42	19	19	23	13	32	10	6	38	4				42
43	19	19	24	13	32	11	7	39	4				43
44	20	20	24	13	33	11	7	40	4				44
45	20	20	25	14	34	11	7	41	4				45
46	20	20	26	14	34	12	7	41	5				46
47	20	20	27	14	34	13	8	42	5	3	45	2	47
48	21	21	27	14	35	13	8	43	5	3	46	2	48
49	21	21	28	14	35	14	8	43	6	4	47	2	49
50	21	21	29	15	36	14	8	44	6	4	48	2	50

Table 3-1. Erlang B alternate routing tables.
(Part 2 of 10)

Hundred Call-Seconds Carried by and Overflowing
From Each Trunk Shown in Column Headings and
Total CCS Carried on Group

CCS Offered	Trunk Number 1 Carried			2 Carried			3 Carried			4 Carried			5 Carried			6 Carried			CCS Offered
	Tot	Tot	Ovf	Tot	Tot	Ovf	Tot	Tot	Ovf	Tot	Tot	Ovf	Tot	Tot	Ovf	Tot	Tot	Ovf	
51	21	21	30	15	36	15	9	45	6	4	48	2							51
52	21	21	31	15	36	16	9	45	7	5	50	2							52
53	21	21	32	16	37	16	9	46	7	5	51	2							53
54	22	22	32	16	37	17	10	46	7	5	52	2							54
55	22	22	33	16	38	17	10	47	7	5	53	2							55
56	22	22	34	17	38	16	10	48	8	5	54	3							56
57	22	22	35	17	38	17	10	48	8	5	54	3							57
58	23	23	35	17	39	18	10	49	9	6	55	3							58
59	23	23	36	17	40	18	10	50	9	6	56	3							59
60	23	23	37	17	40	19	11	50	9	6	57	3							60
61	23	23	38	17	40	20	11	51	10	6	57	4							61
62	23	23	39	17	40	21	12	51	10	6	58	4							62
63	23	23	40	17	40	22	12	52	10	7	58	4							63
64	23	23	41	18	41	22	12	52	11	7	59	4							64
65	23	23	42	18	41	23	12	53	12	7	60	5							65
66	23	23	43	18	41	24	12	53	12	7	61	5							66
67	23	23	44	19	42	24	13	54	12	7	62	5	3	56	2				67
68	23	23	45	19	42	25	13	55	13	7	62	6	4	57	2				68
69	24	24	45	19	43	25	13	56	13	7	63	6	4	58	2				69
70	24	24	46	19	43	26	13	56	14	8	64	6	4	58	2				70
71	24	24	47	19	43	27	13	56	15	8	64	7	4	59	3				71
72	24	24	48	19	43	28	13	57	15	8	65	7	4	59	3				72
73	24	24	49	20	44	28	14	58	15	8	66	7	4	70	3				73
74	24	24	50	20	44	29	14	58	16	9	67	7	4	71	3				74
75	24	24	51	20	44	31	14	58	17	9	67	8	5	72	3				75
76	24	24	52	20	44	32	14	59	17	9	68	8	5	73	3				76
77	25	25	52	20	45	32	15	60	17	9	68	8	5	74	3				77
78	25	25	53	20	45	33	15	60	18	9	69	9	5	74	4				78
79	25	25	54	20	45	34	15	60	19	10	70	9	5	75	4				79
80	25	25	55	20	45	35	15	60	20	10	70	10	6	76	4				80
81	25	25	56	21	46	35	15	61	20	10	71	10	6	77	4				81
82	25	25	57	21	46	36	15	62	20	10	72	10	6	78	4				82
83	25	25	58	21	46	37	16	62	21	11	72	11	6	78	5				83
84	25	25	59	21	46	38	16	62	22	11	73	11	6	79	5				84
85	25	25	60	21	46	39	16	63	22	11	74	11	6	80	5				85
86	25	25	61	21	46	40	17	63	23	11	74	12	7	81	5				86
87	25	25	61	21	47	40	17	64	23	11	75	12	7	82	5				87
88	25	25	62	21	47	41	17	64	24	11	75	13	7	82	6	4	86	2	88
89	25	25	63	22	48	41	17	65	24	11	76	13	7	83	6	4	87	2	89
90	25	25	64	22	48	42	17	65	25	12	77	13	7	84	6	4	88	2	90
91	25	25	65	22	48	43	17	65	26	12	77	14	7	84	7	4	88	3	91
92	25	25	66	22	48	44	17	65	27	12	77	15	8	85	7	4	89	3	92
93	25	25	67	22	48	45	17	65	27	12	78	15	8	86	7	4	90	3	93
94	25	25	68	22	48	46	18	66	28	13	79	15	8	87	7	4	91	3	94
95	25	25	69	23	48	46	18	67	28	13	80	16	8	88	7	4	92	3	95
96	25	25	70	23	48	47	18	67	29	13	80	16	8	88	8	5	93	3	96
97	25	25	71	23	48	48	18	67	30	13	80	17	8	88	9	5	93	4	97
98	25	25	72	23	48	49	19	68	30	13	81	17	8	89	9	5	94	4	98
99	25	25	73	23	48	50	19	68	31	13	81	18	9	90	9	5	95	4	99
100	26	26	74	23	49	51	19	68	32	14	82	18	9	91	9	5	96	4	100
102	27	27	75	23	50	52	19	69	33	14	83	19	9	92	10	6	98	4	102
104	27	27	77	23	50	54	19	69	35	15	84	20	9	93	11	6	99	5	104
106	27	27	79	23	50	56	20	70	36	15	85	21	10	95	11	6	101	5	106
108	27	27	81	24	51	57	20	71	37	15	86	22	10	96	12	6	102	6	108
110	27	27	83	24	51	59	20	71	39	16	87	23	10	97	13	7	104	6	110
112	27	27	85	24	51	61	21	72	40	16	88	24	11	98	13	7	105	6	112
114	27	27	87	24	51	63	21	72	42	16	88	26	12	100	14	7	107	7	114
116	27	27	89	25	52	64	21	73	43	16	89	27	12	101	15	7	108	8	116
118	27	27	91	25	52	66	21	73	45	17	90	28	12	102	16	8	110	8	118
120	28	28	92	25	53	67	21	74	46	17	91	29	12	103	17	8	111	9	120
122	28	28	94	25	53	68	22	75	47	17	92	30	13	104	17	8	113	9	122
124	28	28	96	25	53	71	22	76	49	17	92	32	13	106	18	9	114	10	124
126	28	28	98	25	53	73	22	76	51	18	93	33	14	107	19	9	116	10	126
128	28	28	100	25	54	74	22	76	52	18	94	34	14	108	20	9	117	11	128
130	28	28	102	25	54	76	22	76	54	19	95	35	14	109	21	9	118	12	130

Table 3-1. Erlang B alternate routing tables.
(Part 3 of 10)

Hundred Call-Seconds Carried by and Overflowing
From Each Trunk Shown in Column Headings and
Total CCS Carried on Group

CCS Offered	Trunk 1 Carried			Trunk 2 Carried			Trunk 3 Carried			Trunk 4 Carried			Trunk 5 Carried			Trunk 6 Carried			CCS Offered
	Tfc	Tot	Ofl	Tfc	Tot	Ofl	Tfc	Tot	Ofl	Tfc	Tot	Ofl	Tfc	Tot	Ofl	Tfc	Tot	Ofl	
132	28	28	104	26	54	78	23	77	55	19	96	36	14	110	22	10	120	12	132
134	28	28	106	26	54	80	23	77	57	19	96	38	15	111	23	10	121	13	134
136	28	28	108	26	54	82	23	77	59	20	97	39	15	112	24	10	122	14	136
138	28	28	110	26	55	83	23	78	60	20	98	40	15	113	25	11	124	14	138
140	28	28	111	26	55	85	23	78	62	20	98	42	15	114	26	11	125	15	140
142	28	28	113	26	55	87	24	78	63	20	99	43	16	115	27	11	126	16	142
144	28	28	115	26	55	89	24	79	65	20	99	45	16	115	29	12	127	17	144
146	28	28	117	27	56	90	24	80	66	20	100	46	16	116	30	12	128	18	146
148	28	28	119	27	56	92	24	80	68	20	100	48	17	117	31	12	129	19	148
150	28	28	121	27	56	94	24	80	70	21	101	49	17	118	32	13	131	19	150
152	28	28	123	27	56	96	25	81	71	21	102	50	17	119	33	13	132	20	152
154	28	28	125	27	56	98	25	81	73	21	102	52	17	119	35	14	133	21	154
156	28	28	127	27	56	100	25	81	75	21	102	54	18	120	36	14	134	22	156
158	30	30	128	27	57	101	25	82	76	21	103	55	18	121	37	14	135	23	158
160	30	30	130	27	57	103	25	82	78	22	104	56	18	122	38	14	136	24	160
162	30	30	132	27	57	105	25	82	80	22	104	58	19	123	39	14	137	25	162
164	30	30	134	27	57	107	25	82	82	22	104	60	19	123	41	15	138	26	164
166	30	30	136	27	57	109	26	83	83	22	105	61	19	124	42	15	139	27	166
168	30	30	138	27	57	111	26	83	85	23	106	62	19	125	43	15	140	28	168
170	30	30	140	27	57	113	26	83	87	23	106	64	19	125	45	16	141	29	170
172	30	30	142	28	58	114	26	84	88	23	107	65	19	126	46	16	142	30	172
174	30	30	144	28	58	116	26	84	90	23	107	67	20	127	47	16	143	31	174
176	30	30	146	28	58	118	26	84	92	24	108	68	20	128	48	16	144	32	176
178	30	30	148	28	58	120	26	84	94	24	108	70	20	128	50	17	145	33	178
180	30	30	150	28	58	121	26	85	95	24	109	71	20	129	51	17	146	34	180
182	30	30	152	29	59	123	26	85	97	24	109	73	20	130	52	17	146	36	182
184	30	30	154	29	59	125	26	85	99	24	109	75	21	130	54	17	147	37	184
186	30	30	156	29	59	127	26	85	101	24	109	77	21	130	56	18	148	38	186
188	30	30	158	29	59	129	27	86	102	24	110	78	21	131	57	18	149	39	188
190	30	30	160	29	59	131	27	86	104	24	110	80	22	132	58	18	150	40	190
192	30	30	162	29	59	133	27	86	106	24	110	82	22	132	60	18	150	42	192
194	30	30	164	29	59	135	27	86	108	25	111	83	22	133	61	18	151	43	194
196	30	30	166	29	60	137	27	86	110	25	111	85	22	133	63	19	152	44	196
198	30	30	167	29	60	139	27	87	111	25	112	86	22	134	64	19	153	45	198
200	31	31	169	29	60	140	27	87	113	25	112	88	22	134	66	19	153	47	200
202	31	31	171	29	60	142	28	87	115	25	112	90	23	135	67	19	154	48	202
204	31	31	173	29	60	144	28	88	116	25	113	91	23	136	68	19	154	50	204
206	31	31	175	29	60	146	28	88	118	25	113	93	23	136	70	19	155	51	206
208	31	31	177	29	60	148	28	88	120	25	113	95	23	136	72	20	156	52	208
210	31	31	179	29	60	150	28	88	122	26	114	96	23	137	73	20	157	53	210
212	31	31	181	29	60	152	28	88	124	26	114	98	23	137	75	20	157	55	212
214	31	31	183	29	60	154	28	88	126	26	114	100	24	138	76	20	158	56	214
216	31	31	185	29	61	156	28	88	128	26	114	102	24	138	78	21	159	57	216
218	31	31	187	30	61	157	28	89	129	26	115	103	24	139	79	21	160	58	218
220	31	31	189	30	61	159	28	89	131	26	115	105	24	139	81	21	160	60	220
222	31	31	191	30	61	161	28	89	133	26	115	107	24	139	83	21	160	62	222
224	31	31	193	30	61	163	28	89	135	27	116	10811	24	140	84	21	161	63	224
226	31	31	195	30	61	165	29	89	137	27	116	0	24	140	86	22	162	64	226
228	31	31	197	30	61	167	29	90	138	27	117	111	24	141	87	22	163	65	228
230	31	31	199	30	61	169	29	90	140	27	117	113	24	141	89	22	163	67	230
232	31	31	201	30	61	171	29	90	142	27	117	115	24	141	91	22	163	69	232
234	31	31	203	30	61	173	29	90	144	27	117	117	25	142	92	22	164	70	234
236	31	31	205	30	61	175	29	90	146	27	117	119	25	142	94	22	164	72	236
238	31	31	207	30	61	177	29	90	148	28	118	120	25	143	95	22	165	73	238
240	31	31	209	30	61	179	29	90	150	28	118	122	25	143	97	22	165	75	240
242	31	31	211	30	61	181	29	90	152	28	118	124	25	143	99	23	166	76	242
244	31	31	213	31	62	182	29	91	153	28	118	125	25	144	100	23	167	77	244
246	31	31	215	31	62	184	29	91	155	28	119	127	25	144	102	23	167	79	246
248	31	31	217	31	62	186	29	91	157	28	119	129	25	144	104	24	168	80	248
250	31	31	219	31	62	188	29	91	159	28	119	131	25	144	106	24	168	82	250
252	31	31	221	31	62	190	29	91	161	28	119	133	25	144	108	24	168	84	252
254	31	31	223	31	62	192	29	91	163	28	119	135	26	145	109	24	169	85	254
256	31	31	225	31	62	194	29	91	165	28	119	137	26	145	111	24	169	87	256
258	31	31	227	31	62	196	30	92	166	28	119	138	26	146	112	24	170	88	258
260	31	31	229	31	62	198	30	92	168	28	120	140	26	146	114	24	170	90	260

Table 3-1. Erlang B alternate routing tables.
(Part 4 of 10)

Hundred Call-Seconds Carried by and Overflowing
From Each Trunk Shown in Column Headings and
Total CCS Carried on Group

	Trunk Number																		
	1			2			3			4			5			6			
CCS Offered	Carried			Carried			Carried			Carried			Carried			Carried			CCS Offered
	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	
262	31	31	231	31	62	200	30	92	170	28	120	142	26	146	116	25	171	91	262
264	31	31	233	31	62	202	30	92	172	28	120	144	26	146	118	25	171	93	264
266	32	32	234	31	63	203	30	93	173	28	121	145	26	147	119	25	172	94	266
268	32	32	236	31	63	205	30	93	175	28	121	147	26	147	121	25	172	96	268
270	32	32	238	31	63	207	30	93	177	28	121	149	26	147	123	25	172	98	270
272	32	32	240	31	63	209	30	93	179	28	121	151	26	148	124	25	173	99	272
274	32	32	242	31	63	211	30	93	181	28	121	153	26	148	126	25	173	101	274
276	32	32	244	31	63	213	30	93	183	29	121	155	27	148	128	25	173	103	276
278	32	32	246	31	63	215	30	93	185	29	122	156	27	149	129	25	174	104	278
280	32	32	248	31	63	217	30	93	187	29	122	158	27	149	131	25	174	106	280
282	32	32	250	31	63	219	30	93	189	29	122	160	27	149	133	25	175	107	282
284	32	32	252	31	63	221	30	93	191	29	122	162	27	149	135	25	175	109	284
286	32	32	254	31	63	223	30	93	193	29	122	164	27	149	137	26	175	111	286
288	32	32	256	31	63	225	30	93	195	29	122	166	27	149	139	26	175	113	288
290	32	32	258	31	63	227	30	93	196	29	123	167	27	150	140	26	176	114	290
292	32	32	260	31	63	229	31	94	198	29	123	169	27	150	142	26	176	116	292
294	32	32	262	31	63	231	31	94	200	29	123	171	28	151	143	26	177	117	294
296	32	32	264	31	63	233	31	94	202	29	123	173	28	151	145	26	177	119	296
298	32	32	266	31	63	235	31	94	204	29	123	175	28	151	147	26	177	121	298
300	32	32	268	31	63	237	31	94	206	29	123	177	28	151	149	27	178	122	300
305				32	64	241	31	95	210	29	124	181	28	152	153	27	179	126	305
310				32	64	246	31	95	215	30	124	186	28	152	158	27	179	131	310
315				32	64	251	31	95	220	30	125	190	28	153	162	27	180	135	315
320				32	64	256	31	95	225	30	125	195	29	154	166	27	181	139	320
325				32	64	261	31	95	230	30	125	200	29	154	171	27	181	144	325
330				32	64	266	31	95	235	30	125	205	29	154	176	27	182	148	330
335				32	65	270	31	96	239	30	126	209	29	155	180	27	183	152	335
340				32	65	275	31	96	244	30	12	214	29	155	185	28	183	157	340
345				32	65	280	31	96	249	31	126	219	29	155	190	28	183	162	345
350				32	65	285	31	96	254	31	127	223	29	156	194	28	184	166	350
355				32	65	290	31	96	259	31	127	228	29	157	198	28	185	170	355
360				32	65	295	31	96	264	31	127	233	29	157	203	29	186	174	360
365				32	65	300	31	96	269	31	127	238	30	157	208	29	186	179	365
370				32	65	305	32	97	273	31	128	242	30	158	212	29	187	183	370
375				32	65	310	32	97	278	31	128	247	30	158	217	29	187	188	375
380				32	65	315	32	97	283	31	128	252	30	158	222	29	187	193	380
385				32	65	320	32	97	288	31	128	257	31	159	226	29	188	197	385
390				32	65	325	32	97	293	31	128	262	31	159	231	29	188	202	390
395							32	98	297	31	129	266	31	160	235	29	189	206	395
400							32	98	302	31	129	271	31	160	240	29	189	211	400
405							32	98	307	31	129	276	31	160	245	29	189	216	405
410							32	98	312	31	129	281	31	160	250	30	190	220	410
415							32	98	317	32	130	285	31	161	254	30	191	224	415
420							32	98	322	32	130	290	31	161	259	30	191	229	420
425							32	98	327	32	130	295	31	161	264	30	191	234	425
430							32	98	332	32	130	300	31	161	269	30	191	239	430
435							33	99	336	32	131	304	31	162	273	30	192	243	435
440							33	99	341	32	131	309	31	162	278	30	192	248	440
445							33	99	346	32	131	314	31	162	283	30	192	253	445
450										32	131	319	31	162	288	31	193	257	450
455										32	131	324	32	162	293	31	193	262	455
460										32	131	329	32	163	297	31	194	266	460
465										32	131	334	32	163	302	31	194	271	465
470										32	131	339	32	163	307	31	194	276	470
475										32	131	344	32	163	312	31	194	281	475
480													32	164	316	31	195	285	480
485													32	165	320	31	196	289	485
490													32	165	325	31	196	294	490
495													32	165	330	31	196	299	495
500													32	165	335	31	196	304	500
505													32	165	340	31	196	309	505
510													32	165	345	31	196	314	510
515													32	165	350	31	196	319	515
520													32	165	355	32	197	323	520
525													32	165	360	32	197	328	525

Table 3-1. Erlang B alternate routing table
(Part 5 of 10)

Hundred Call-Seconds Carried by and Overflowing From Each Trunk Shown in Column Headings and Total CCS Carried on Group

CCS Offered	Trunk Number															CCS Offered
	Carried			Carried			Carried			Carried			Carried			
	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	
110	3	107	3													110
112	3	109	3													112
114	4	111	3													114
116	4	112	4													116
118	4	114	4													118
120	5	116	4													120
122	5	118	4													122
124	5	119	5													124
126	5	121	5													126
128	6	123	5													128
130	6	124	6													130
132	6	126	6													132
134	6	127	7	4	131	3										134
136	7	129	7	4	133	3										136
138	7	131	7	4	135	3										138
140	7	132	8	4	136	4										140
142	8	134	8	4	138	4										142
144	8	135	9	5	140	4										144
146	8	136	10	5	141	5										146
148	9	138	10	5	143	5										148
150	9	140	10	5	145	5										150
152	9	141	11	5	146	6										152
154	9	142	12	6	148	6										154
156	9	143	13	6	149	7	4	153	3							156
158	10	145	13	6	151	7	4	155	3							158
160	10	146	14	7	153	7	4	157	3							160
162	10	147	15	7	154	8	4	158	4							162
164	11	149	15	7	156	8	4	160	4							164
166	11	150	16	7	157	9	4	161	5							166
168	11	151	17	8	159	9	4	163	5							168
170	11	152	18	8	160	10	5	165	5							170
172	12	154	18	8	162	10	5	167	5							172
174	12	155	19	8	163	11	5	168	6							174
176	12	156	20	9	165	11	5	170	6							176
178	12	157	21	9	166	12	6	172	6							178
180	12	158	22	9	167	13	6	173	7							180
182	13	159	23	10	169	13	6	175	7	4	179	3				182
184	13	160	24	10	170	14	6	176	8	4	180	4				184
186	14	162	24	10	172	14	6	178	8	4	182	4				186
188	14	163	25	10	173	15	7	180	8	4	184	4				188
190	14	164	26	10	174	16	7	181	9	4	185	5				190
192	15	165	27	10	175	17	7	182	10	5	187	5				192
194	15	166	28	11	177	17	7	184	10	5	189	5				194
196	15	167	29	11	178	18	8	186	10	5	191	5				196
198	15	168	30	11	179	19	8	187	11	5	192	6				198
200	16	169	31	12	181	19	8	189	11	5	194	6				200
202	16	170	32	12	182	20	8	190	12	5	195	7				202
204	16	171	33	12	183	21	9	192	12	5	197	7				204
206	16	171	35	13	184	22	9	193	13	6	199	7	3	202	4	206
208	16	172	36	13	185	23	9	194	14	6	200	8	4	204	4	208
210	16	173	37	13	186	24	10	196	15	6	202	8	4	206	4	210
212	17	174	38	13	187	25	10	197	16	6	203	9	4	207	5	212
214	17	175	39	13	188	26	10	198	16	7	205	9	4	209	5	214
216	17	176	40	14	190	26	10	200	16	7	207	9	4	211	5	216
218	17	177	41	14	191	27	10	201	17	7	208	10	5	213	5	218
220	18	178	42	14	192	28	10	202	18	7	209	11	5	214	6	220

Table 3-1. Erlang B alternate routing tables.
(Part 6 of 10)

Hundred Call-Seconds Carried by and Overflowing
From Each Trunk Shown in Column Headings and
Total CCS Carried on Group

	Trunk Number																		
	7			8			9			10			11			12			
CCS Offered	Carried			Carried			Carried			Carried			Carried			Carried			CCS Offered
	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	
222	18	178	44	15	193	29	11	204	18	7	211	11	5	216	6				222
224	18	179	45	15	194	30	11	205	19	8	213	11	5	218	6				224
226	18	180	46	15	195	31	11	206	20	8	214	12	5	219	7				226
228	18	181	47	15	196	32	12	208	20	8	216	12	5	221	7				228
230	19	182	48	15	197	33	12	209	21	8	217	13	6	223	7				230
232	19	182	50	16	198	34	12	210	22	9	219	13	5	225	7	3	228	4	232
234	19	183	51	16	199	35	12	211	23	9	220	14	6	226	8	4	230	4	234
236	20	184	52	16	200	36	12	212	24	9	221	15	6	227	8	4	231	5	236
238	20	185	53	16	201	37	13	214	24	9	223	15	6	229	9	4	233	5	238
240	20	185	55	16	201	39	13	214	26	10	224	16	7	231	9	4	235	5	240
242	20	186	56	17	203	39	13	216	26	10	226	16	7	233	9	4	237	5	242
244	20	187	57	17	204	40	13	217	27	10	227	17	7	234	10	4	238	6	244
246	20	187	59	17	204	42	14	218	28	10	228	18	7	236	11	5	240	6	246
248	20	188	60	17	205	43	14	219	29	11	230	18	7	237	11	5	242	6	248
250	21	189	61	17	206	44	14	220	30	11	231	19	7	238	12	5	243	7	250
252	21	189	63	18	207	45	14	221	31	11	232	20	8	240	12	5	245	7	252
254	21	190	64	18	208	46	14	222	32	11	233	21	8	241	13	6	247	7	254
256	21	190	66	18	208	48	15	223	33	12	235	21	8	243	13	6	248	7	256
258	21	191	67	18	209	49	15	224	34	12	236	22	8	244	14	6	250	8	258
260	22	192	68	18	210	50	15	225	35	12	237	23	9	246	14	6	252	8	260
262	22	193	69	18	211	51	15	226	36	12	238	24	9	247	15	6	253	9	262
264	22	193	71	19	212	52	15	227	37	12	239	25	9	248	16	7	256	9	264
266	22	194	72	19	213	53	16	229	37	12	241	25	9	250	16	7	257	9	266
268	22	194	74	19	213	55	16	229	39	13	242	26	9	251	17	7	258	10	268
270	22	194	76	20	214	56	16	230	40	13	243	27	10	253	17	7	260	10	270
272	22	195	77	20	215	57	16	231	41	13	244	28	10	254	18	7	261	11	272
274	23	196	78	20	216	58	16	232	42	14	246	28	10	256	18	7	263	11	274
276	23	196	80	20	216	60	17	233	43	14	247	29	10	257	19	7	264	12	276
278	23	197	81	20	217	61	17	234	44	14	248	30	10	258	20	8	266	12	278
280	23	197	83	21	218	62	17	235	45	14	249	31	10	259	21	8	267	13	280
282	23	198	84	21	219	63	17	236	46	14	250	32	11	261	21	8	268	13	282
284	23	198	86	21	219	65	17	236	48	15	251	33	11	262	22	8	270	14	284
286	23	198	88	21	219	67	18	237	49	15	252	34	11	263	23	8	271	15	286
288	24	199	89	21	220	68	18	238	50	15	253	35	11	264	24	9	273	15	288
290	24	200	90	21	221	69	18	238	51	15	254	36	12	266	24	9	275	15	290
292	24	200	92	21	221	71	19	240	52	15	255	37	12	267	25	9	276	16	292
294	24	201	93	21	222	72	19	241	53	15	256	38	12	268	26	10	278	16	294
296	24	201	95	21	222	74	19	241	55	16	257	39	12	269	27	10	279	17	296
298	24	201	95	21	222	76	19	242	56	16	258	40	12	270	28	10	280	18	298
300	24	202	98	22	224	76	19	243	57	16	259	41	13	272	28	10	282	18	300
305	24	203	102	22	225	80	20	245	60	16	261	44	14	275	30	10	285	20	305
310	25	204	106	23	227	83	20	247	63	17	264	46	14	278	32	10	288	22	310
315	25	205	110	23	228	87	20	248	67	18	266	49	14	280	35	11	291	24	315
320	25	206	114	23	229	91	21	250	70	18	268	52	15	283	37	11	294	26	320
325	26	207	118	23	230	95	21	251	74	19	270	55	16	286	39	12	298	27	325
330	26	208	122	24	232	98	21	253	77	19	272	58	16	288	42	13	301	29	330
335	26	209	126	24	233	102	22	255	80	19	274	61	16	290	45	13	303	32	335
340	27	210	130	24	234	106	22	256	84	19	275	65	17	292	48	14	306	34	340
345	27	210	135	25	235	110	23	258	87	20	278	67	17	295	50	14	309	36	345
350	27	211	139	25	236	114	23	259	91	20	279	71	18	297	53	14	311	39	350
355	27	212	143	25	237	118	23	260	95	21	281	74	18	299	56	15	314	41	355
360	27	213	147	25	238	122	24	262	98	21	283	77	18	301	59	16	317	43	360
365	27	213	152	26	239	126	24	263	102	21	284	81	19	303	62	16	319	46	365
370	27	214	156	26	240	130	24	264	106	22	286	84	19	305	65	17	322	48	370
375	28	215	160	26	241	134	24	265	110	22	287	88	20	307	68	17	324	51	375
380	28	215	165	26	242	138	25	267	113	22	289	91	20	309	71	17	326	54	380
385	28	216	169	26	243	142	25	268	117	22	290	95	20	310	75	18	328	57	385
390	28	216	174	27	243	147	26	269	121	23	292	98	20	312	78	18	330	60	390
395	28	217	178	27	244	151	26	270	125	23	293	102	21	314	81	19	333	62	395
400	29	218	182	27	245	155	26	271	129	23	294	105	22	316	84	19	335	65	400

Table 3-1. Erlang B alternate routing table
(Part 7 of 10)

Hundred Call-Seconds Carried by and Overflowing From Each Trunk Shown in Column Headings and Total CCS Carried on Group

	Trunk Number																		
	1			2			3			4			5			6			
	Carried			Carried			Carried			Carried			Carried			Carried			
CCS Offered	To	Tot	Ot	To	Tot	Ot	To	Tot	Ot	To	Tot	Ot	To	Tot	Ot	To	Tot	Ot	CCS Offered
405	23	218	187	28	246	159	26	272	133	23	295	110	22	317	88	20	337	68	405
410	23	219	191	28	247	163	26	273	137	24	297	113	22	319	91	20	339	71	410
415	23	220	195	28	248	167	26	274	141	24	298	117	22	320	95	20	340	75	415
420	23	220	200	28	248	172	26	274	146	25	299	121	23	322	98	20	342	78	420
425	23	220	205	28	248	177	27	275	150	25	300	125	23	323	102	21	344	81	425
430	23	221	209	28	249	181	27	276	154	25	301	129	23	325	106	21	345	84	430
435	23	222	213	28	250	185	27	277	158	25	302	133	23	326	109	21	347	88	435
440	30	222	218	28	251	189	27	278	162	25	303	137	24	327	113	22	348	91	440
445	30	222	223	28	251	194	27	278	167	26	304	141	24	328	117	22	350	95	445
450	30	223	227	28	252	198	27	279	171	26	305	145	24	329	121	23	351	98	450
455	30	223	232	28	252	203	27	280	175	26	306	149	24	330	125	23	353	102	455
460	30	224	236	28	253	207	27	281	179	26	307	153	25	331	128	23	354	106	460
465	30	224	241	28	253	212	28	281	184	27	308	157	25	333	132	23	356	109	465
470	30	224	246	28	254	216	28	282	188	27	309	161	25	334	136	23	357	113	470
475	30	224	251	28	254	221	28	282	193	27	309	166	25	335	140	23	358	117	475
480	30	225	255	30	256	225	28	283	197	27	310	170	26	336	144	24	360	120	480
485	30	226	259	30	256	229	28	284	201	27	311	174	26	337	148	24	361	124	485
490	30	226	264	30	256	234	28	284	206	28	312	178	26	338	152	24	362	128	490
495	30	225	269	30	256	239	29	285	210	28	313	182	26	339	156	24	363	132	495
500	30	226	274	30	256	244	29	285	215	28	313	187	27	340	160	25	365	135	500
505	31	227	278	30	257	248	29	286	219	28	314	191	27	341	164	25	366	139	505
510	31	227	283	30	257	253	30	287	223	28	315	195	27	342	168	25	367	143	510
515	31	227	288	30	257	258	30	287	228	28	315	200	27	342	173	26	368	147	515
520	31	228	292	30	258	262	30	288	232	28	316	204	27	343	177	26	369	151	520
525	31	228	297	30	258	267	30	288	237	28	316	209	28	344	181	26	370	155	525
530	31	228	302	31	259	271	30	289	241	28	317	213	28	345	185	26	371	159	530
535	31	228	307	31	259	276	30	289	246	28	317	218	28	345	190	27	372	163	535
540	31	229	311	31	260	280	30	290	250	28	318	222	28	346	194	27	373	167	540
545	31	229	316	31	260	285	30	290	255	29	319	226	28	347	198	27	374	171	545
550	31	229	321	31	260	290	30	290	260	29	319	231	28	347	203	27	374	176	550
555				31	261	294	30	291	264	29	320	236	28	348	207	27	375	180	555
560				31	261	299	30	291	268	29	320	240	28	348	212	28	376	184	560
565				31	261	303	30	291	274	30	321	244	28	348	216	28	377	188	565
570				31	262	308	30	292	278	30	322	248	28	350	220	28	378	192	570
575				31	262	313	30	292	283	30	322	253	28	351	224	28	379	196	575
580				31	262	318	30	292	288	30	322	258	29	352	228	28	379	201	580
585							30	293	292	30	323	262	29	352	233	28	380	205	585
590							31	294	296	30	324	266	29	353	237	28	381	209	590
595							31	294	301	30	324	271	30	354	241	28	382	213	595
600							31	294	305	30	324	276	30	354	246	28	382	218	600
605							31	294	311	30	324	281	30	354	251	29	383	222	605
610							31	295	315	30	325	285	30	355	255	29	384	226	610
615							31	295	319	30	326	289	30	356	259	29	385	230	615
620							31	295	324	30	326	294	30	356	264	29	385	235	620
625							31	296	329	30	326	299	30	356	268	29	385	240	625
630							31	296	334	31	327	303	30	357	273	29	386	244	630
635							31	296	339	31	327	308	30	357	278	29	386	249	635
640							31	297	343	31	328	312	30	358	282	29	387	253	640
645							31	297	348	31	328	317	30	358	287	30	388	257	645
650							31	297	353	31	328	322	30	358	292	30	388	262	650
655							31	298	357	31	329	326	30	359	296	30	389	266	655
660							31	298	362	31	329	331	30	359	301	30	389	271	660
665										31	330	335	30	360	305	30	390	275	665
670										31	330	340	30	360	310	30	390	280	670
675										31	330	345	31	361	314	30	391	284	675
680										31	330	350	31	361	319	30	391	289	680
685										31	330	355	31	361	324	30	391	294	685
690													31	362	328	30	392	298	690
695													31	362	333	30	392	303	695
700													31	362	337	30	393	307	700
705													31	363	342	30	393	312	705

Table 3-1. Erlang B alternate routing tables.
(Part 8 of 10)

Hundred Call-Seconds Carried by and Overflowing From Each Trunk Shown in Column Headings and Total CCS Carried on Group

	Trunk Number																		
	13			14			15			16			17			18			
	Carried			Carried			Carried			Carried			Carried			Carried			
CCS Offered	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	Trk	Tot	Ofl	CCS Offered
258	4	254	4																258
260	4	256	4																260
262	4	257	5																262
264	4	259	5																264
266	4	261	5																266
268	4	262	6																268
270	4	264	6																270
272	5	266	6																272
274	5	268	6																274
276	5	269	7																276
278	5	271	7																278
280	5	272	8																280
282	5	274	8	4	278	4													282
284	6	276	8	4	280	4													284
286	6	277	9	4	281	5													286
288	6	279	9	4	283	5													288
290	6	281	9	4	285	5													290
292	6	282	10	4	286	6													292
294	6	284	10	4	288	6													294
296	6	285	11	5	290	6													296
298	7	287	11	5	292	6													298
300	7	289	11	5	294	6													300
305	7	292	13	6	297	8													305
310	8	296	14	6	302	8	4	306	4										310
315	9	300	15	6	306	9	4	310	5										315
320	9	303	17	6	310	10	4	314	6										320
325	9	307	18	7	314	11	4	318	7										325
330	10	311	19	7	318	12	5	323	7										330
335	11	314	21	8	322	13	5	327	8										335
340	11	317	23	8	325	15	6	331	9	4	335	5							340
345	11	320	25	9	329	16	6	335	10	4	339	6							345
350	12	323	27	9	332	18	7	339	11	5	344	7							350
355	12	326	29	10	336	19	7	343	12	5	348	7							355
360	13	330	30	10	340	20	7	347	13	5	352	8							360
365	13	332	33	11	343	22	7	350	15	6	356	9	4	360	5				365
370	13	335	35	11	346	24	8	354	16	6	360	10	4	364	6				370
375	14	338	37	11	349	26	9	358	17	6	364	10	4	368	7				375
380	15	341	39	12	353	27	9	362	18	6	368	12	5	373	7				380
385	15	343	42	13	356	29	9	365	20	7	372	13	5	377	8				385
390	16	346	44	13	359	31	9	368	22	8	376	14	5	381	9	4	385	5	390
395	16	349	46	13	362	33	10	372	23	8	380	15	5	385	10	4	389	6	395
400	16	351	49	13	364	36	11	375	25	9	384	16	6	390	10	4	394	6	400
405	16	353	52	14	367	38	11	378	27	9	387	18	6	393	12	5	398	7	405
410	17	356	54	14	370	40	12	382	28	9	391	19	6	397	13	5	402	8	410
415	18	358	57	15	373	42	12	385	30	9	394	21	7	401	14	5	406	9	415
420	18	360	60	15	375	45	13	388	32	10	398	22	7	405	15	6	411	9	420
425	18	362	63	16	378	47	13	391	34	10	401	24	8	409	16	6	415	10	425

Table 3-1. Erlang B alternate routing tables.
(Part 9 of 10)

Hundred Call-Seconds Carried by and Overflowing
From Each Trunk Shown in Column Headings and
Total CCS Carried on Group

	Trunk Number																		
	13			14			15			16			17			18			
	Carried			Carried			Carried			Carried			Carried			Carried			
CCS Offered	Trk	Trk	Ovf	Trk	Trk	Ovf	Trk	Trk	Ovf	Trk	Trk	Ovf	Trk	Trk	Ovf	Trk	Trk	Ovf	CCS Offered
430	18	364	66	16	380	50	14	394	36	11	405	25	8	413	17	6	419	11	430
435	19	366	69	17	383	52	14	397	38	11	408	27	9	417	18	6	423	12	435
440	19	368	72	17	385	55	14	399	41	12	411	28	9	420	20	7	427	13	440
445	20	370	75	17	387	58	15	402	43	12	414	31	10	424	21	7	431	14	445
450	20	372	78	18	390	60	15	405	45	12	417	33	10	427	23	8	435	15	450
455	21	374	81	18	392	63	15	407	48	13	420	35	10	430	25	8	438	17	455
460	21	376	84	18	394	66	16	410	50	13	423	37	11	434	26	8	442	18	460
465	21	377	88	19	396	69	16	412	53	14	426	39	11	437	28	9	446	19	465
470	22	379	91	19	398	72	17	415	55	14	429	41	11	440	30	9	449	21	470
475	22	380	95	20	400	75	17	417	58	14	431	44	12	443	32	10	453	22	475
480	22	382	98	20	402	78	17	419	61	15	434	46	12	446	34	10	456	24	480
485	23	384	101	20	404	81	18	422	63	15	437	48	13	450	35	10	460	25	485
490	23	385	105	21	406	84	18	424	66	16	440	50	13	453	37	11	464	26	490
495	23	386	109	21	407	88	19	426	69	16	442	53	13	455	40	11	466	29	495
500	23	388	112	21	409	91	19	428	72	16	444	56	14	458	42	12	470	30	500
505	23	389	116	22	411	94	19	430	75	17	447	58	14	461	44	12	473	32	505
510	23	390	120	22	412	98	20	432	78	17	449	61	15	464	46	12	476	34	510
515	24	392	123	22	414	101	20	434	81	17	451	64	15	466	49	13	479	36	515
520	24	393	127	23	416	104	20	436	84	18	454	66	15	469	51	13	482	38	520
525	24	394	131	23	417	108	21	438	87	18	456	69	16	472	53	13	485	40	525
530	24	396	135	23	418	112	21	439	91	19	458	72	16	474	56	14	488	42	530
535	25	397	138	23	420	115	21	441	94	19	460	75	17	477	58	14	491	44	535
540	25	398	142	23	421	119	22	443	97	19	462	78	17	479	61	15	494	46	540
545	25	399	146	23	422	123	22	444	101	20	464	81	17	481	64	15	496	49	545
550	26	400	150	24	424	126	22	446	104	20	466	84	18	484	66	15	499	51	550
555	26	401	154	24	425	130	22	447	108	21	468	87	18	486	69	16	502	53	555
560	26	402	158	24	426	134	22	448	112	21	469	91	18	488	72	16	504	56	560
565	26	403	162	24	427	138	23	450	115	21	471	94	19	490	75	16	506	59	565
570	26	404	166	25	429	141	23	451	119	21	473	97	19	492	78	17	509	61	570
575	26	405	170	25	430	145	23	452	122	22	475	100	19	494	81	17	511	64	575
580	26	405	174	25	431	149	23	454	126	22	476	104	20	496	84	17	513	67	580
585	26	407	178	25	432	153	24	456	129	22	478	107	20	498	87	18	516	69	585
590	27	408	182	25	433	157	24	457	133	23	480	110	20	500	90	18	518	72	590
595	27	409	186	25	434	161	24	458	137	23	481	114	21	502	93	18	520	75	595
600	27	409	191	26	435	165	24	459	141	23	482	118	21	503	97	19	522	78	600
605	27	410	195	26	436	169	25	461	144	23	484	121	21	505	100	19	524	81	605
610	27	411	199	26	437	173	25	462	148	23	485	125	22	507	103	19	526	84	610
615	27	412	203	26	438	177	25	463	152	23	486	129	22	508	107	20	528	87	615
620	28	413	207	26	439	181	26	465	155	23	488	132	22	510	110	20	530	90	620
625	28	413	212	27	440	185	26	466	159	24	490	135	22	512	113	20	532	93	625
630	28	414	216	27	441	189	26	467	163	24	491	139	22	513	117	21	534	96	630
635	29	415	220	27	442	193	26	468	167	24	492	143	23	515	120	21	536	99	635
640	29	416	224	27	443	197	26	469	171	24	493	147	23	516	124	21	537	103	640
645	29	417	228	27	444	201	26	470	175	25	495	150	23	518	127	21	539	106	645
650	29	417	233	27	444	206	27	471	179	25	496	154	23	519	131	21	540	110	650

Table 3-1. Erlang B alternate routing tables.
(Part 10 of 10)

Hundred Call-Seconds Carried by and Overflowing
From Each Trunk Shown in Column Headings and
Total CCS Carried on Group

CCS Offered	Trunk Number 13			14			15			16			17			18			CCS Offered
	Carried			Carried			Carried			Carried			Carried			Carried			
	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	Trk	Tot	Ovf	
655	29	418	237	27	445	210	27	472	183	25	497	158	23	520	135	22	542	113	655
660	29	418	242	28	446	214	27	473	187	25	498	162	24	522	138	22	544	116	660
665	29	419	246	28	447	218	27	474	191	25	499	166	24	523	142	23	546	119	665
670	29	419	251	28	447	223	27	474	196	26	500	170	24	524	146	23	547	123	670
675	29	420	255	28	448	227	27	475	200	26	501	174	25	526	149	23	548	126	675
680	29	421	259	28	449	231	27	476	204	26	502	178	25	527	153	23	550	130	680
685	29	421	264	28	449	236	28	477	208	26	503	182	25	528	157	24	552	133	685
690	30	422	268	28	450	240	28	478	212	26	504	186	25	529	161	24	553	137	690
695	30	422	273	28	451	244	28	479	216	26	505	190	26	531	164	24	555	140	695
700	30	423	277	28	452	248	28	480	220	26	506	194	26	532	168	24	556	144	700
705	30	423	282	28	452	253	28	480	225	26	507	198	26	533	172	24	557	148	705
710	30	424	286	29	453	257	28	481	229	26	508	202	26	534	176	24	558	152	710
715	30	425	290	28	454	261	28	482	233	27	509	206	26	535	180	25	560	155	715
720	30	425	295	28	454	266	28	482	238	27	509	211	27	536	184	25	561	159	720
725	30	425	300	29	454	271	29	483	242	27	510	215	27	537	188	25	562	163	725
730	30	426	304	29	455	275	29	484	246	27	511	219	27	538	192	25	563	167	730
735	30	426	309	29	455	280	29	484	251	28	512	223	27	539	196	25	564	171	735
740	30	427	313	29	456	284	29	485	255	28	513	227	27	540	200	25	565	175	740
745	30	427	318	30	457	288	29	486	259	28	514	231	27	541	204	26	567	178	745
750	30	428	322	30	458	292	29	487	263	28	515	235	27	542	208	26	568	182	750
755	30	428	327	30	458	297	29	487	268	28	515	240	27	543	212	26	569	186	755
760	30	429	332	30	459	302	29	487	273	29	516	244	28	544	216	26	570	190	760
765				30	460	306	29	488	277	29	517	248	28	545	220	26	571	194	765
770				30	460	311	29	488	282	29	517	253	28	545	225	27	572	198	770
775				30	461	315	29	489	286	29	518	257	28	546	229	27	573	202	775
780				30	461	320	29	490	290	29	519	261	28	547	233	27	574	206	780
785				30	462	325	29	490	295	29	519	266	28	547	238	27	574	211	785
790							30	491	299	29	520	270	28	548	242	27	575	215	790
795							30	492	303	29	521	274	29	549	246	27	576	219	795
800							30	492	308	29	521	279	29	550	250	27	577	223	800
810							30	493	317	29	522	288	29	551	259	28	579	231	810
820							30	494	326	29	523	297	29	552	268	28	580	240	820
830							30	495	335	30	525	305	29	554	276	28	582	248	830
840										30	526	314	29	555	285	28	583	257	840
850										30	527	323	29	556	294	29	585	265	850
860										30	528	332	29	557	303	29	586	274	860
870										30	529	341	30	559	311	29	588	282	870
880													30	560	320	29	589	291	880
890													30	561	329	29	590	300	890
900													30	562	338	29	591	309	900
910																30	592	317	910
920																30	594	326	920
930																30	595	335	930
940																31	596	344	940
950																31	597	353	950

LESSON 3

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

For questions 1 through 9, match the description in the left column with the corresponding answer in the right column.

1. Only one path in or out.
2. A single circuit between two switchboards.
3. Trunks with identical transmission characteristics between two switchboards.
4. Calls completed versus calls attempted.
5. Average number of calls made per hour.
6. Amount of time a telephone is off at the hook or in use.
7. Traffic that flows through a switch, but does not begin or end at the switch.
8. International unit of measurement for traffic intensity.
9. A switchboard that has more than one possible path in or out for all traffic.

___ A. TGC

___ B. OHT

___ C. Trunk

___ D. SES

___ E. Trunk group

___ F. Tandem

___ G. LES

___ H. GOS

___ I. ACR

___ J. Erlang

10. In the final step of calculating trunk group sizing, you must use the Erlang charts. What do you do to your CCS value?

    A. Round the value up
    B. Round the value down
    C. Swag it

LESSON 3

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1	D. SES An SES has only one possible path in or out for all traffic (page 3-2, para 1e)
2	C. Trunk A trunk is a single circuit between two points (page 3-2, para 1a)
3	E. Trunk group Trunks which have the same or identical characteristics (destination, signaling, and traffic route) with the same destination. (page 3-2, para 1b)
4	H. GOS GOS is the number of calls completed divided by the number of calls attempted. (page 3-2, para 1d; page 3-3, para 2a)
5	L ACR Average number of calls made by a switch during a one-hour period. (page 3-3, para 1l)
6	B. OHT The amount of time a telephone is off the hook or in use. (page 3-3, para 1i)
7	F. Tandem Traffic that flows through a switch, but does not begin or end at that switch. (page 3-3, para 1k)
8	J. Erlang International unit of measurement for traffic intensity. One Erlang is the intensity in a traffic path continuously occupied. (page 3-2, para 1h)

Item	Correct Answer and Feedback
9	G. LES A switchboard that has more than one possible path in or out for all traffic. This switchboard may or may not provide tandem service. (page 3-2, para 1f)
10	A. Round the value up As a rule of thumb, always round up to the value when the answer falls between values. (page 3-5, para 6a)

Here is the answer to paragraph 7 on page 3-5:

Step 1. Determine the busy hour call-minutes.

22 (# of subs) x 8 (ACR) x 6 (AHT) = 1056 CM

Step 2. Determine the total amount of traffic offered.

1056 CM x (.35 + .45) = 844.8 CM

Step 3. Determine the distribution of offered traffic.

844.8 CM x .60 (Ke) = 506.88 CCS

Step 4. Determine the desired overflow.

506.88 CCS x .10 = 50.688 CCS

Step 5. Determine the number of trunks needed.

506.88 CCS need to be rounded up to 510 CCS

50.688 CCS need to be rounded up to 61 CCS as the desired overflow

The correct answer is 16 trunks needed. (Refer to Table 3-1.)

LESSON 4

TELEPHONE DIRECTORY

Critical Task: 01-5710.07-0001

OVERVIEW

LESSON DESCRIPTION:

In this lesson, you will learn how to develop a telephone directory for a non-MSE unit.

TERMINAL LEARNING OBJECTIVE:

ACTION: Describe a telephone directory of a non-MSE unit.

CONDITION: Given this lesson material, paper, pencil, and no supervision.

STANDARD: To demonstrate competency on this lesson, you must achieve a minimum of 70 percent on the subcourse examination.

INTRODUCTION

Throughout the first three lessons of this subcourse, you learned some of the tools necessary for planning a tactical telephone system. You learned the different types of telephones and switchboards we use now in the field. In Lesson 2, you learned the numbering system used today with the automatic switches. Finally in Lesson 3, you learned the technique to determine the trunk group sizing. In Lesson 4, you will learn how to prepare a telephone directory.

The effectiveness of automatic switching within a tactical signal system depends on planning, engineering, and control. Even if all facilities are available, the switch will not function efficiently unless properly programmed to accept and complete the calls. Therefore the switch must be able to identify all the users in the network. To assist the switch and the users, the tactical automatic switch network uses a tactical numbering plan. In Lesson 2, we examined the different numbering systems used by the automatic switchboards. In this lesson, we will concentrate on the tactical numbering plan. The principles used in creating your tactical telephone directory can be applied for a fixed or a strategic numbering plan.

Before we continue, the differences between the commercial numbering system and the tactical numbering system should be identified. The commercial system uses a 10-digit plan, while the tactical system uses a 7-digit number. We also need to remember that the terms used in the tactical and commercial system differ.

1. Situation: You will develop a telephone directory for a non-MSE unit.

2. Development of the tactical telephone numbering system. The tactical telephone numbering plan is based on Military Standard 188C. The plan considers the limited number of automatic switches in the field. In addition, the standard considers the management, engineering, and planning involved in the development of a tactical automatic switch network. The tactical telephone numbering system provides the commanders the flexibility necessary to satisfy mission requirements. MIL-STD 188C provides standardization across the network to include EAC.

a. The grid system. Using the grid system, PRs correspond to a specific geographic or grid area assigned to theater, corps, and division. Each grid area will have assigned the necessary PRs required to service the area without affecting the service. Within each grid, switch designators are normally used to designate automatic switches, manual switchboards, and semiautomatic switchboards. The theater communications system planning element (CSPE) makes the PR and SL assignments for each level of command.

b. PR assignment by grid. The first two digits of the seven-digit tactical telephone number represents a PR or area within the theater of operations. Normally, a Theater Army or a corps will probably only use one PR To simplify the planning, a grid system can be used to assign the PRs. The theater commander, through the CSPE, will designate geographical PRs based on the war plans, unit's mission, and terrain. The theater commander, through the CSPE, can also determine adjacent PRs permitting the planning of communication systems before the advance of friendly forces.

c. Although we can use the grid system to assign our PRs in a theater of operations, this should not restrict us in the number of PRs we assign to our system. The number of subscribers and the size of the area should be our guide in determining how many PRs we will have. The advantage of assigning PRs by grid is that a corps or division can retain the assigned PR for an indefinite period of time, establishing an identity with a particular PR.

3. PR numbers. The tactical telephone numbering plan uses PR numbers the same way as the commercial system uses area codes. The theater commander can designate PRs in a way that will allow him to identify elements within his command. Some of the tactical PRs are listed in Appendix B.

4. SL numbers. The second pair of digits (third and fourth digits) designate a specific location in a PR. SL numbers are assigned to switches in each PR. The SL in the tactical environment serves the same purpose as the telephone exchange number in the commercial system.

a. As a planner, you must consider designating all your combat units with unique SL numbers. Assign a different SL number to the brigade main, alternate, and supply area. By using this method, combat units can move throughout the combat zone and only the PR digits of the telephone number must be changed.

b. A system planner must also be aware of and consider unique switches such as the AN/TTC-30 used by the Air Force. This switch cannot access every PR available. Therefore, special considerations must be made when planning an interface with these switches.

5. Directory numbers. The third element of the seven-digit telephone number is the last three-digit directory number or subscriber's number. Knowing what the different directory number forms represent is important for planning and engineering a telephone network. The numbers are assigned to subscribers who are identified by title and located within a CP. The numbers can be used also to identify activities within the CP area, such as the G3 operations, combat support, and combat service support units.

6. Dialing. To place a call from one automatic switch to another, or to a manual switchboard, the entire seven-digit number must be dialed. If the call is to a local subscriber connected to the same automatic switchboard, only the last three digits need to be dialed. However, if the called number is serviced by a manual switchboard, all seven digits must be dialed, even if the called party is a local subscriber connected to the same automatic switchboard.

7. Fixed directory service. The fixed directory service is a feature whereby roving subscribers or units are given a fixed number. This constant seven-digit number is used regardless of the subscribers or unit location within a given area code.

8. Directory services. The telephone directory, as a minimum, should include the following:

a. A complete listing of all elements within the theater, corps, and division. This is to include all combat service and combat service support units.

b. Instructions on dialing throughout the network, to include how to access a subscriber service by a manual switchboard. In a fully automated switch network, the telephone directory should include the seven-digit tactical automatic switching addresses for all the switches.

c. The telephone directory should include a list of all the emergency phone numbers, to include telephone repair and the operator information.

d. Operating instructions for subscribers with manual telephones and rotary telephones to list a few.

e. An explanation as to how the precedence system in the switchboard works. Provide the subscriber with instructions on what to do in case they get preempted.

NOTE: Appendix B has an example of a telephone directory. Use it as a guide if you have to develop or publish a telephone directory for your unit.

LESSON 4

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answers with the key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

1. In a circuit switch diagram we find four digits. What do the first two digits represent?

   A. Primary zone
   B. Switch number
   C. Switch designator
   D. None of the above

2. What do the second numbers on a circuit switch diagram represent?

   A. Switch designator
   B. Geographic area of operation
   C. Subscriber phone number
   D. Special feature codes

3. The theater _____ makes the PR and SL assignments for each level of command.

   A. CSCE
   B. Signal officer
   C. CSPE
   D. Commander

4. Normally a corps or Theater Army will probably use only one PR

   A. True
   B. False

5. A subscriber in an automatic switchboard network must dial the seven-digit number to access a distant switchboard subscriber.

   A. True
   B. False

6. A local subscriber can reach another subscriber service on the same automatic switch by dialing which of the following?

A. The last three digits
B. The entire seven-digit number
C. The last two digits

7. The theater commander can designate adjacent PRs for future planning.

A. True
B. False

For questions 8 through 10, refer to Lesson 2 and Appendix B.

8. You are working at the J6 office and have to assign a telephone number to the commander of the VII Corps (US). Which are the first two digits of his phone number?

A. 76
B. 72
C. 75
D. 74

9. What is the area code used by the VII Corps to call through foreign systems?

A. 814
B. 815
C. 515
D. 514

10. The signal brigade commander calls you and reports that the NI codes were not included in the telephone directory. He needs the NI code for Norway. What is the code?

A. 911
B. 913
C. 912
D. 910

LESSON 4

PRACTICE EXERCISE

ANSWER KEY AND FEEDBACK

Item	Correct Answer and Feedback
1	A. Primary zone The first two digits in the seven-digit telephone numbering system represent a specific geographic area of operations of PR. (page 4-2, para 2b)
2	A. Switch designator The second pair of digits (third and fourth digits) represent a particular location or switch designator within a PR. (page 4-3, para 4)
3	C. CSPE The theater CSPE makes the PR and SL assignments for each level of command. (page 4-2, para 2a)
4	A. True Normally a Theater Army or a corps will probably only use one PR. (page 4-2, para 2b)
5	A. True To place a call from one automatic switch to another or to a manual switchboard, the entire seven-digit number must be dialed. (page 4-3, para 6)
6	A. The last three digits If the call is to a local subscriber connected to the same automatic switchboard, only the last three digits need to be dialed. (page 4-3, para 6)
7	A. True The theater commander through the CSPE can also determine adjacent PRs permitting the planning of communication systems before the advance of friendly forces. (page 4-2, para 2b)

Item	Correct Answer and Feedback
8	C. 75 (Lesson 2 and Appendix A)
9	D. 514 (Lesson 2 and Appendix A)
10	D. 910 (Lesson 2 and Appendix A)