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CDC 49350B

COMMUNICATIONS-COMPUTER SYSTEMS CONTROL SPECIALIST

Volume 3. Technical Control Facilities

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BECAUSE OF THE large amount of information that had to be covered to fulfill the requirements of your specialty training standard (STS), your career development course (CDC) has been constructed in two parts. This is the third volume of the second part. Again, like the 49350A CDC, one lesson builds on another lesson and progresses from volume to volume to parallel the requirements of the STS. There may be times when you need to review some basic concepts presented in the 49350A CDC; therefore, make use of your glossary supplement in finding these subject areas. You need to make sure you understand thoroughly each lesson before you go to the next.

This third volume of CDC 49350B deals with technical control facilities throughout the Defense Communications System (DCS). The information provided in this volume will show you various facilities, both mobile and fixed. There will also be sections in each of the units to show the different components and how they all fit together. We will also include in this volume a unit on systems management to familiarize you with some of the paperwork our career field must do.

Unit 1 begins with coverage of the organizational structure of the Tactical Air Control System. The equipment of the 407L and TRI-TAC systems is then discussed. The unit concludes with a discussion of the mobile technical control facilities used by both the 407L and TRI-TAC systems.

Unit 2 starts with a discussion on fixed technical control facilities, touching briefly on associated facilities, red/black concept, patch bays, signal trains, and how to perform fault isolation.

Unit 3 covers systems management, including the use of forms, reports, and paperwork we use daily on our job.

Foldouts 1 and 2 are bound in the back of this volume. Use them as the text directs.

Acronyms, abbreviations, and terms used in this volume are explained in glossaries which are printed separately as a supplement. The supplement is included as a part of this course package, to be used with all volumes. Being published as a separate supplement will allow you to refer simultaneously to terms, acronyms, etc., used throughout the text and should reduce the time you might spend skimming for definitions of previously covered items.

Code numbers appearing on figures are for preparing agency identification only.

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This volume is valued at 24 hours (8 points).

NOTE:

In this volume, the subject matter is divided into self-contained units. A topic page begins each unit, identifying the lesson headings and numbers. After reading the topic page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then do the Unit Review Exercises (UREs).

Please read the topic page for Unit 1 and begin. ➡

MOBILE COMMUNICATIONS-COMPUTER SYSTEMS

Page

You may spend many years, perhaps even an entire career, as a technical controller and never come in contact with the mobile community. But, if you should get an assignment in the Tactical Air Control System (TACS), you may be surprised at just how big, diverse, and complex its elements are. In fact, many surprises are in store for you when you receive such an assignment.

You will find that working in a tactical environment challenges you in ways you never imagined possible. You will be faced with physical and emotional demands that many people find hard to withstand. You will experience morale problems that have frustrated the best of supervisors for years. Also, you will be involved in many exercise and deployment scenarios that may seem senseless or perhaps even wasteful. To overcome these difficulties, you must develop the right attitude, a keen awareness, and an understanding of the relevance and importance of your part in the mission.

This unit covers the mission and organization of TACS and defines its elements. It then describes the communications equipment used in the system under two programs:

- The 407L system.
- The Joint Tactical Communications System (TRI-TAC).

The 407L system, in existence for many years now, was named for the type of cables used to interconnect its communications equipment vans. TRI-TAC, a newer system, offers many advantages over the 407L system. It is being integrated into all active duty tactical units.

Last, the unit covers the two mobile technical control facilities you are most likely to work in:

- The AN/TSC-62A communications central for the 407L system.
- The AN/TSQ-111 Communications Nodal Control Element (CNCE) for the TRI-TAC system.

1-1. Mission and Organization of TACS

You must understand the mission and organizational elements of the Tactical Air Control System to be a good TACS technical controller. To fully understand the purpose of TACS, you must first understand the purpose and composition of a joint task force and that of a tactical air force.

400. Organizational characteristics of a joint task force and a tactical air force

Joint Task Force (JTF). Military operations frequently require the joint efforts of Army, Navy and tactical Air Force units—a joint task force. The Air Force component of the JTF is responsible for air defense, interdiction, air support, airlift and reconnaissance. To fulfill these responsibilities, tactical aircraft (fighters, transports etc.) at an air base some distance from the combat lines must be directed and controlled to provide effective close support to Army units. Also, detection and tracking of enemy aircraft is required. There also must be navigational aids, en route and terminal air traffic control, target area controls, and overall mission control.

A JTF may be deployed in response to several types of contingencies. Usually, a JTF is deployed under the operational control of a commander in chief (CINC), as directed by the Joint Chiefs of Staff. The typical command relationship, with the service component structure, is in figure 1-1. This command relationship is typical, but actual organizational structure depends on the type of contingency the JTF responds to.

From a joint military perspective, each service component is tasked to form a supporting force that, in turn, makes up the JTF. The service component retains responsibility to provide both administrative and logistical support to its individual forces. Each force has a headquarters element for all units under it. Specifically, the TAF and TAF Headquarters are a part of the Air Force forces (AFFOR).

The service components provide all communications equipment and facilities needed to support their respective headquarters and any subordinate elements. Further, the service components must include the equipment and people at both ends of all terrestrial communication systems between their headquarters and the JTF. As with the JTF, the size and makeup of air forces deployed depend on the type of contingency.

Tactical Air Force (TAF). Once tasked by the JCS, the Air Force organizes a force and (normally) assigns or attaches it to a JTF. The TAF normally has one or more tactical air bases (TABs), Tactical Air Control System (TACS) components, and a headquarters element. The typical structure of TAF major components and their support elements is shown in figure 1-2. The functions of many of these elements are discussed later in the unit.

TACS also has airborne elements, such as the airborne warning and control system (AWACS) and an airborne battlefield command and control center (ABCCC), that play major roles in tactical air operations.

Communications within the TAF can be generalized into two major categories: the communications provided by the combat information systems groups (CISG), and the communications integral to the TACS. Typically, the CISG provides resources or communication facilities to support the TAF Headquarters and the TAB(s). Communications for the TACS is integral to the TACS units themselves.

TAF Headquarters (TAFH). The TAFH is the tactical headquarters from which the air component commander directs the air part of the battle. Figure 1-3 shows the communications equipment configuration for a TAFH based on capabilities provided by the new TRI-TAC system. Its communications requirements are:

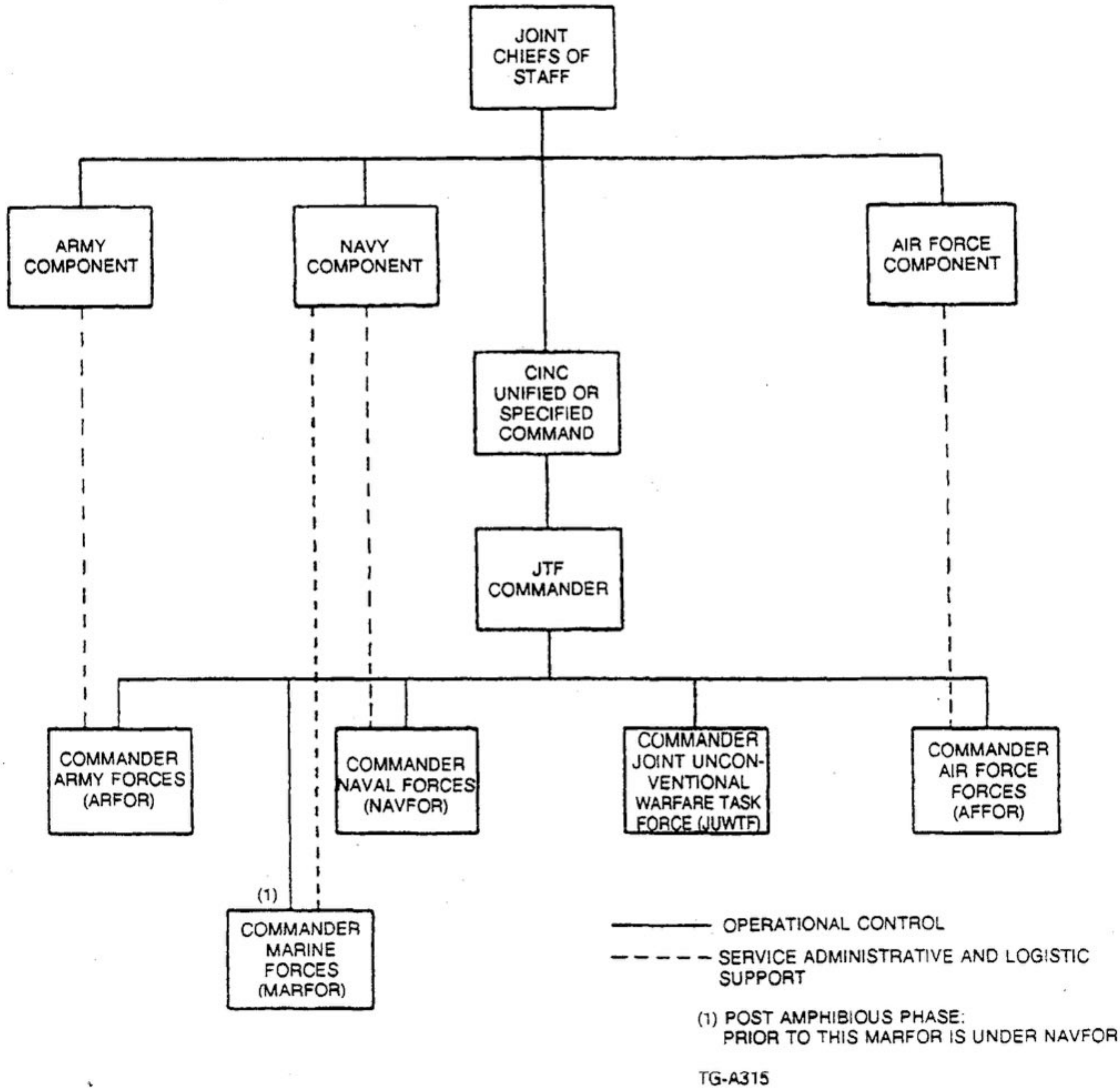


Figure 1-1. Command relationships.

a. Wideband radio communications to the JTF, ARFOR, MARFOR, and TAB(s).

b. SHF satellite into the DCS and the TAB(s).

c. HF radio for automated message switching of TAF network TTY traffic (both R and Y communities) and to the TAB(s).

d. Circuit switching to include local subscriber access throughout the TACS, AUTOVON trunks into the DCS, and interswitch trunks to the JTF, ARFOR, MARFOR, TAB(s) and tactical air control center (TACC).

Technical controllers may be assigned to a tactical air force Headquarters working out of an AN/TSC-62A or an AN/TSQ-111 van.

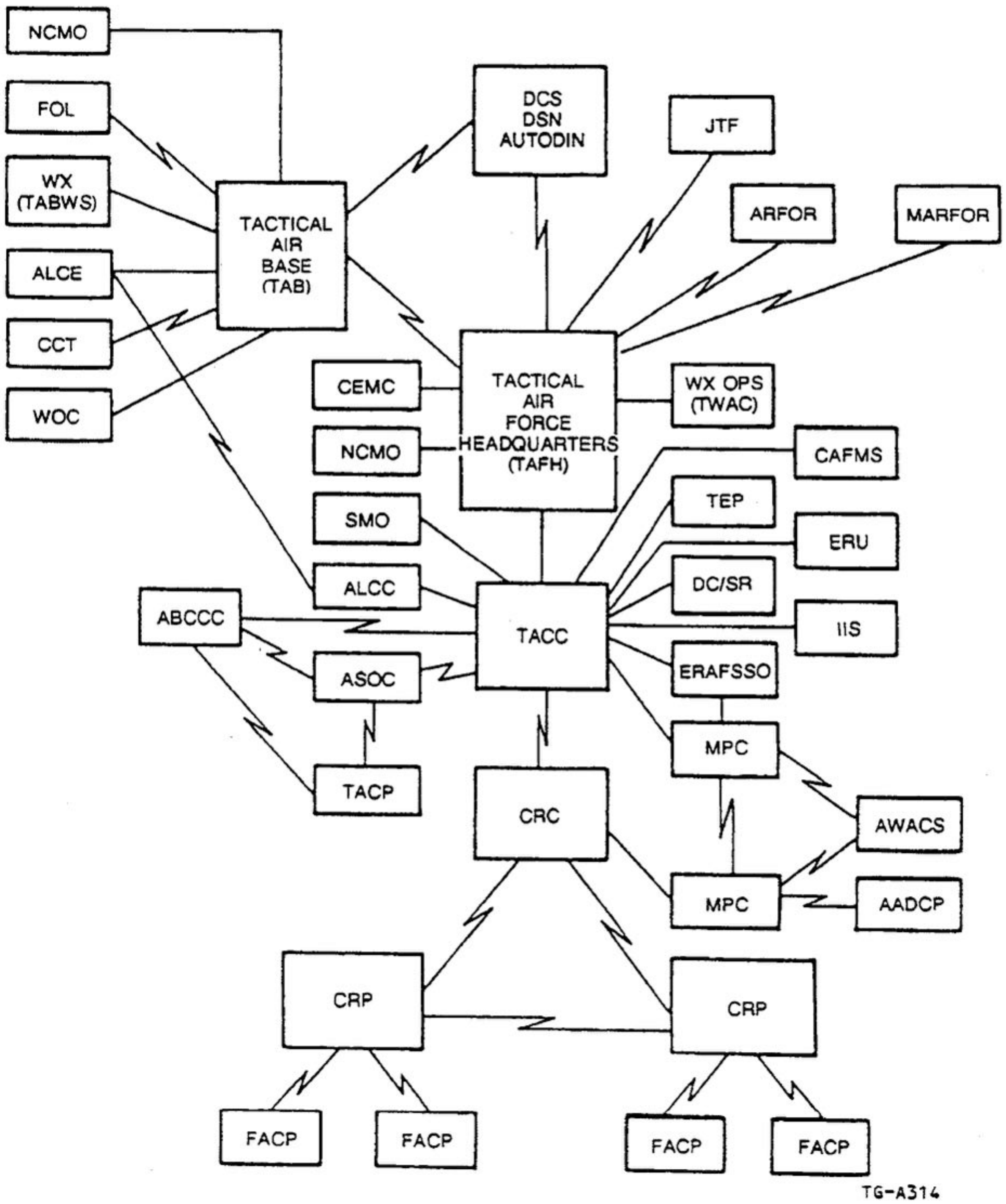


Figure 1-2. Typical TAF structure.

401. The mission and organizational elements of the Tactical Air Control System

TACS is the organization and equipment used to plan, direct, and control all tactical air operations and to integrate the air operations with the other forces of a JTF. It has elements that permit tailoring, on a small or large scale, of operations in various intensities of warfare. These TACS elements are highly mobile and flexible and may form a complete or partial control system. They are the workhorses of the TAFH.

As each of the major elements are described below, you may wish to refer to figure 1-2 to see how they interrelate. The communications requirements described here are based on TRI-TAC capabilities. A description of the communications equipment the TACS elements use is in the 407L and TRI-TAC equipment sections of this unit.

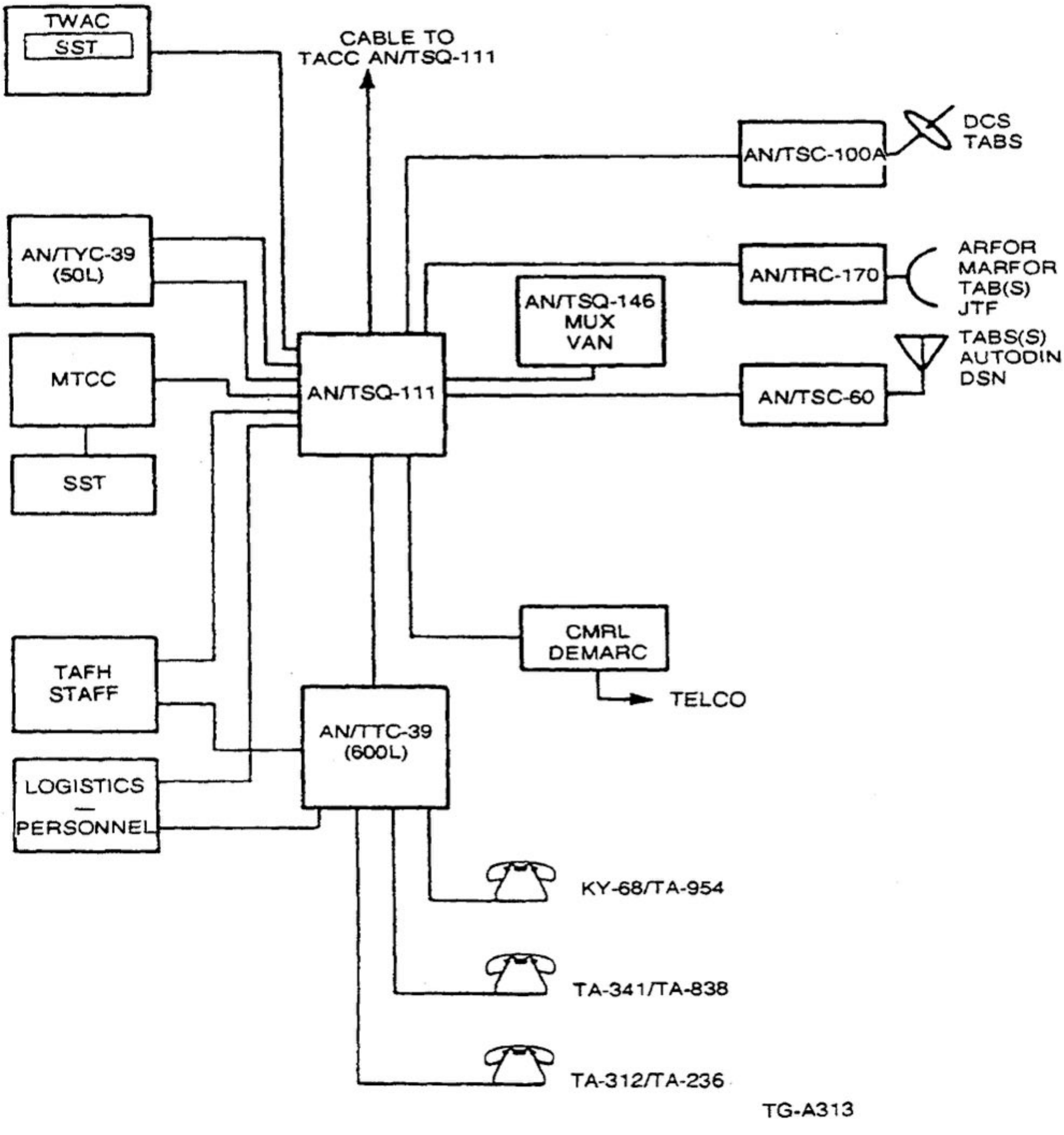


Figure 1-3. TAFH communications equipment configuration.

Tactical Air Base. The major function of a TAB is to provide a base of operations for the air resources assigned to it. Once aircraft are launched from a TAB, command and control is turned over to the appropriate TACS element for the duration of the mission. Figure 1-4 shows the communications equipment configuration for a tactical air base. The communications requirements of a TAB are:

a. Wideband radio to the TAFH and to adjacent TABs.

b. SHF satellite to the TAFH.

c. HF radio to the TAFH and DCS.

d. Circuit switching to include local subscriber access and interswitch trunks.

Technical controllers may be assigned to a TAB working out of an AN/TSC-62A or AN/TSQ-111 van.

Tactical Air Control Center (TACC). The TACC is the operations center from which the TAF commander has centralized the functions of planning, directing, and controlling tactical air resources. As the combat operations center, the TACC normally is located with or near the TAF. As the senior air operations element of the TACS, the TACC directs all subordinate TACS elements. Its major communications requirements, as shown in figure 1-5, include:

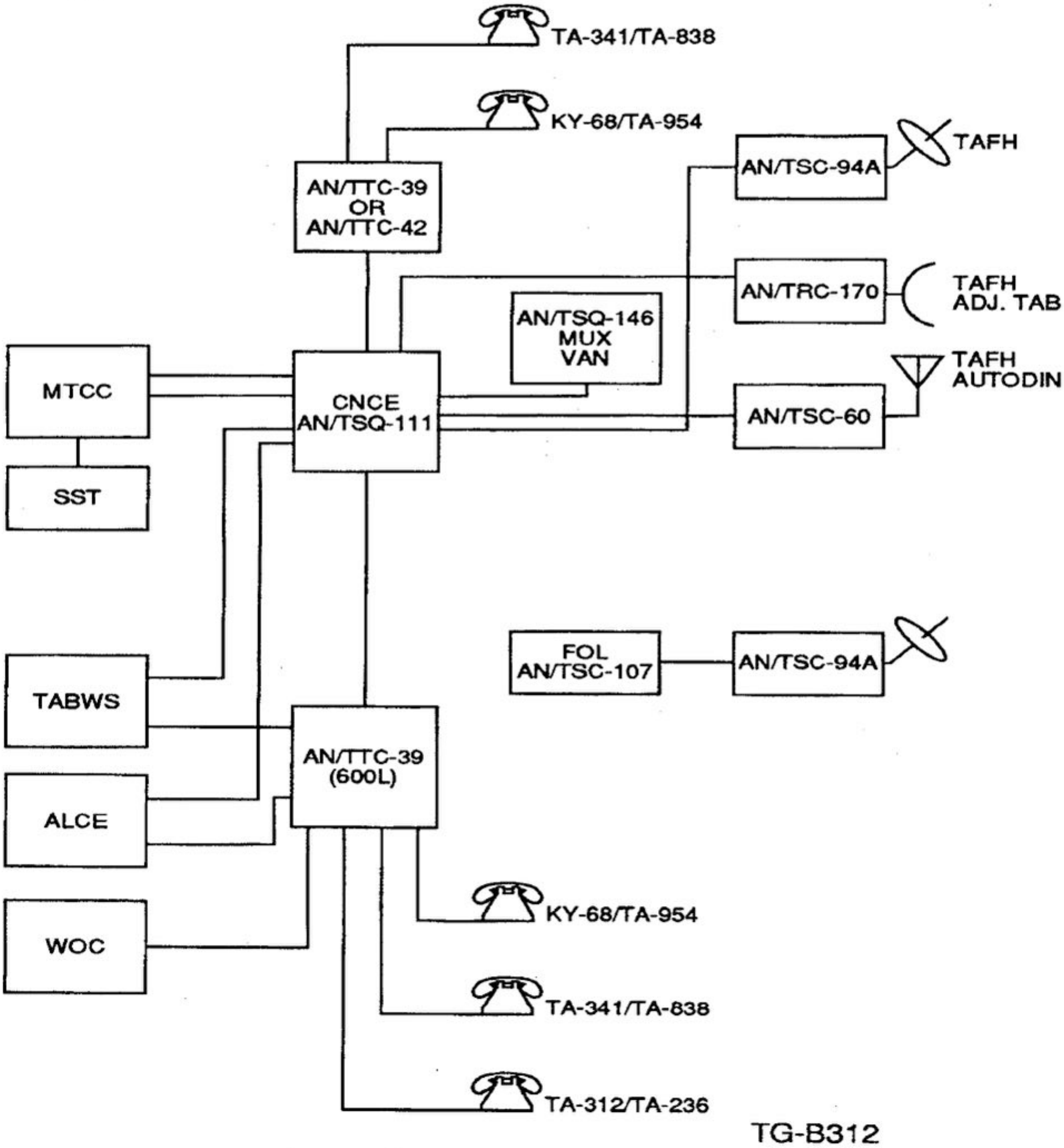


Figure 1-4. TAB communications equipment configuration.

a. Wideband radio to the control and reporting center (CRC), the control and reporting posts (CRPs), and air support operations centers (ASOC).

b. SHF satellite to the CRC, CRPs, and ASOCs.

c. HF radio to the ABCCC, AWACS aircraft, CRC, and ASOCs.

d. UHF ground-to-air connectivity.

e. Circuit switching to include local subscriber access and interswitch trunks to the TAFH, CRC, and CRPs.

Air Support Operations Center. The ASOC plans, coordinates, and directs immediate tactical air support for ground forces. The ASOC is supported by a tactical air control party (TACP) usually colocated with the ground unit it supports. Figure 1-6 shows the communications equipment configuration for an ASOC. Its communications requirements include:

a. Wideband radio communications to the TACC and CRC.

b. SHF satellite to the TACC as well as CONUS gateway connectivity.

c. HF radio to the TACC, ABCCC, TACP, CRC, and forward air control post (FACP).

d. Circuit switching for local subscriber access using one of several manual telephone switchboards.

Technical controllers are assigned to ASOCs working out of the AN/TSQ-93 operations central complex.

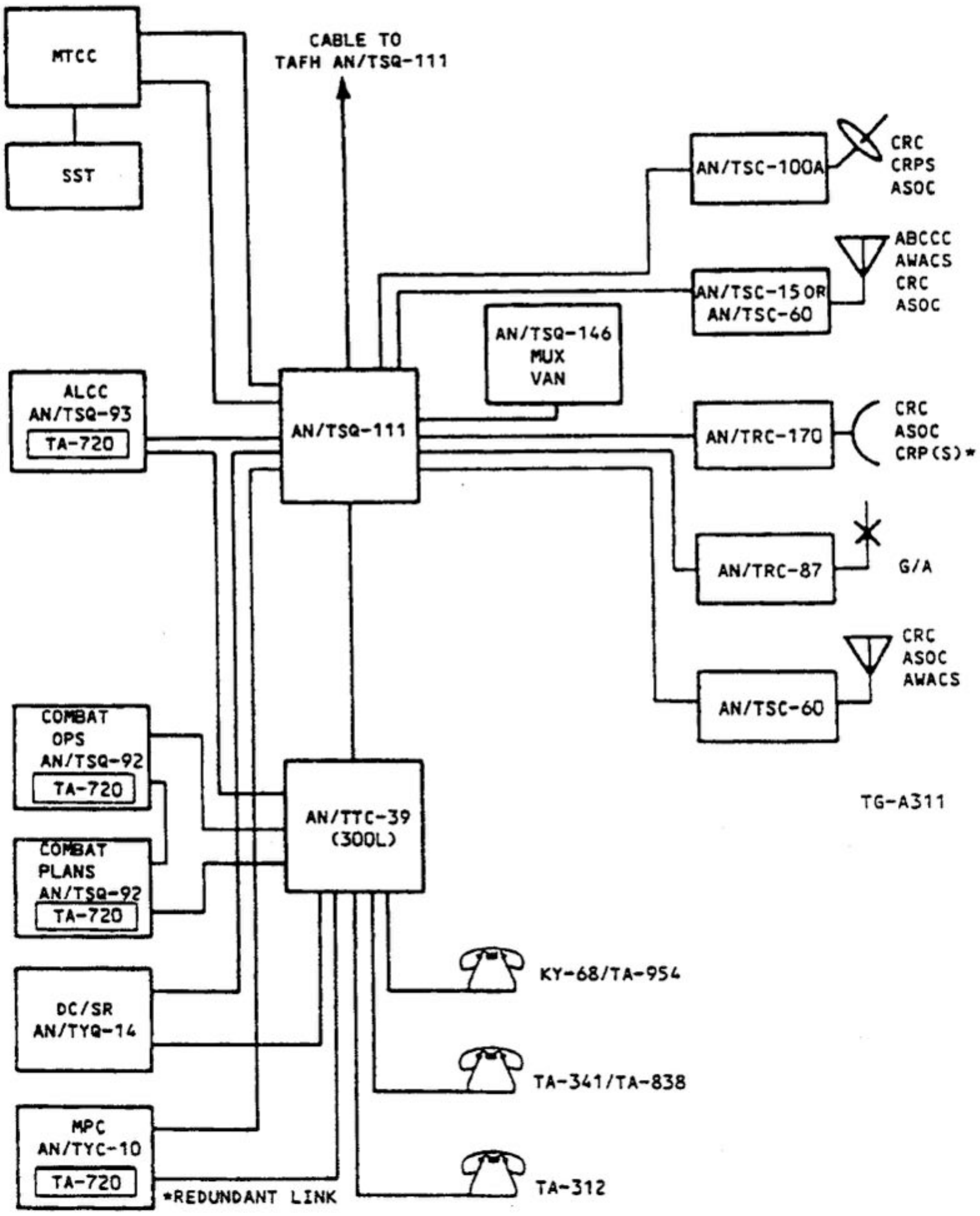


Figure 1-5. TACC communications equipment configuration.

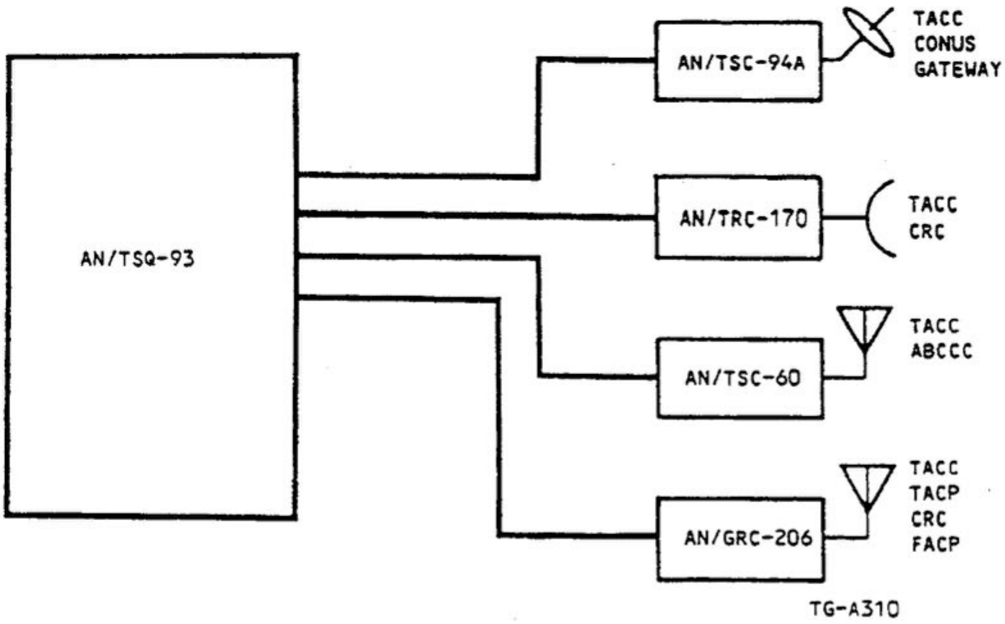


Figure 1-6. ASOC communications equipment configuration.

Airborne Battlefield Command and Control Center. The ABCCC supports the TACC and ASOCs by controlling specific air operations in forward battle areas, usually beyond the range of ground-based TACS elements. As an on-scene extension of TACS, the ABCCC may direct strikes to fleeing targets or provide target area weather information.

Airborne Warning and Control System. The AWACS is composed of E-3A aircraft that do air surveillance and warning. They control missions independently or with ground-based surveillance and control elements such as a CRC.

Message Processing Center (MPC). An MPC ties together the automated TACS elements through its tactical digital information link (TADIL) network. MPCs can be with a TACC, CRC, CRP, or ASOC or can be remoted in a stand-alone configuration. Real-time data, down linked from AWACS aircraft, is provided to the TACS elements through two types of links: TADIL A and TADIL B.

TADIL A is a ground-to-air HF or UHF link that passes aircraft track information between air and ground elements. TADIL B is a multichannel link that passes aircraft track information between ground elements. A technical controller deployed with each MPC acts as the automatic data link coordinator (ADLC).

Control and Reporting Center. A CRC provides air surveillance, identification and weapons control for the TAF. Within its area of responsibility, the CRC controls a given region or sector. It serves as the primary radar element of the TACS. A CRC may have assigned to it one or more CRPs that could assume its responsibilities if the mission changes or if the parent CRC is destroyed.

Technical controllers assigned to a CRC work out of either an AN/TSC-62A or AN/TSQ-111 van and may provide ADLC manning if an MPC is assigned to the unit. Figure 1-7 shows the communications equipment configuration for a CRC. Its communications requirements are as follows:

a. Wideband radio to the TACC, CRPs, and ASOCs.

b. SHF satellite to the TACC and CRPs.

c. HF radio to the TACC, AWACS, and ASOCs.

d. UHF ground-to-air connectivity.

e. Circuit switching to include local subscriber access and interswitch trunks to the TACC, CRPs, and FACPs.

Control and Reporting Post. A CRP has duties almost identical to those of its parent CRC. It keeps control of an assigned subsection or part of the region the CRC is responsible for, thereby extending the CRC's surveillance and control capabilities. The communications equipment configuration for a typical CRP is depicted in figure 1-8. As can be seen from this diagram, a CRP can easily assume the duties of a CRC when needed. The CRP's communications requirements are as follows:

a. Wideband radio communications to the TACC, CRC, FACPs, and other CRPs.

b. SHF satellite to the TACC, CRC, and FACPs.

c. HF radio to the AWACS, CRC, and FACPs.

d. UHF ground-to-air connectivity.

e. Circuit switching to include local subscriber access and interswitch trunks to the FACPs.

Forward Air Control Post. A FACP is a highly mobile radar element normally deployed on the front lines to extend radar coverage and provide control of air operations, early warning, and gap filling duties. FACPs may be subordinate to either a CRP or CRC. Though technical controllers are normally not assigned to a FACP, we must work very closely with them to support the very demanding communications requirements of their mission. Figure 1-9 shows the communications equipment configuration for a FACP. Its communications requirements include:

a. Wideband radio to the CRP (or CRC).

b. SHF satellite to the CRP.

c. Circuit switching to include local subscriber access and interswitch trunks to the CRP.

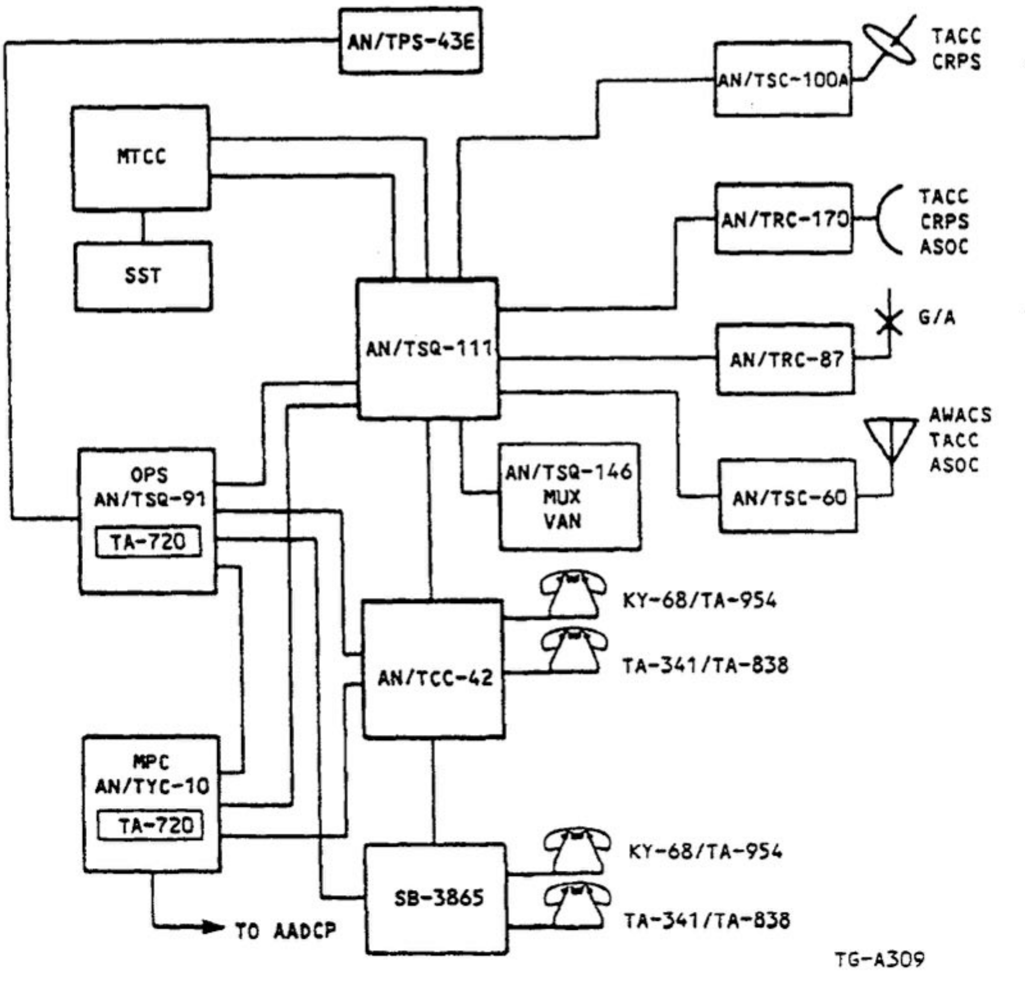


Figure 1-7. CRC communications equipment configuration.

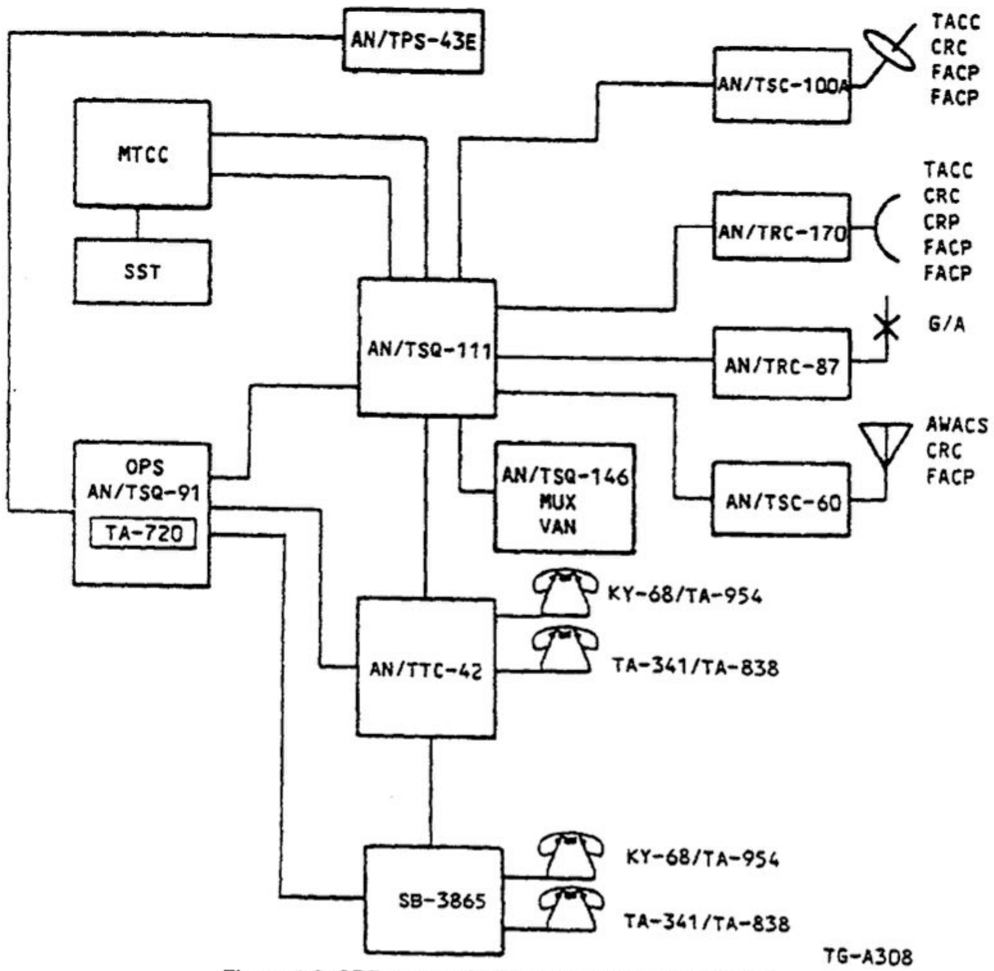


Figure 1-8. CRP communications equipment configuration.

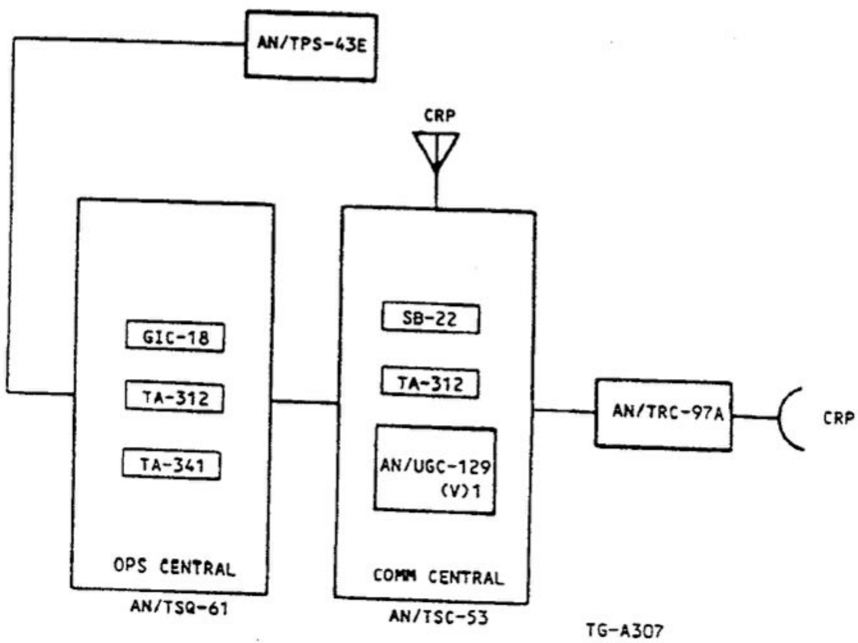


Figure 1-9. FACP communications equipment configuration.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF TEST QUESTIONS

400. Organizational characteristics of a joint task force and a tactical air force

1. What is the composition of a joint task force?

   Army Navy & Air Force task units

2. What are the responsibilities of the air component of a joint task force? Air defense interdiction air support airlift & recon.

3. Where is the air portion of a battle run from?

   TAFH

401. The mission and organizational characteristics of the Tactical Air Control System

1. What is the tactical air control system?

   organization with its equip't that plans directs & controls tactical air operations

2. Match the TACS element in column A with the best description of its basic function in column B. The choices in column B may be used once, more than once, or not at all.

Column A

C (1) ABCCC

I (2) TACC.

B (3) ASOC.

J (4) CRC.

G (5) FACP.

A (6) CRP.

F (7) AWACS.

E (8) TAB.

H (9) MPC.

Column B

a. Extends the radar surveillance and control capability of the CRC. Maintains the capability to assume CRC duties.
b. Designed to plan, coordinate, and direct immediate tactical air support for ground forces.
c. A nonradar element, it provides airborne command and control of tactical air missions in forward battle areas.
d. The headquarters for the air component commander.
e. A base of operations for the air resources of a tactical air force.
f. Controls missions independently or in conjunction with ground-based elements.
g. Extends the CRP's radar coverage to forward areas.
h. Passes aircraft track information between air and ground elements.
i. The senior air operations element of the TACS.
j. The primary radar element of the TACS.
k. Its elements permit tailoring in various intensities of warfare.

1-2. 407L Equipment

As mentioned earlier, two equipment systems are in use in the TACS. These two systems represent two generations of equipment. TRI-TAC, the newer of the two, is discussed in the next section of this unit. The 407L system has been around for many years and has proven itself as a highly versatile system in the tactical environment.

As we look at the equipment of the 407L system, keep in mind many variations exist within each functional area of equipment. Due to space limits, only some of the equipment is presented here.

402. 407L mobility support equipment

A/E 24U-8 Power plant. When a TACS element deploys to a remote location in the middle of a forest, it is reasonable to assume there won't be an electrical outlet on the side of every tree to plug equipment into. The A/E 24U-8 (commonly called the -8) is a transportable 120 kW, 400 Hertz (Hz) power plant that supplies power for TACS equipment in deployed scenarios. As you can see in figure 1-10, it has two fully equipped EMU-30/E gasoline turbine generators and associated distribution equipment mounted on a pallet. It can run for extended periods under global environmental conditions. The generators may work individually or in parallel. If the online generator degrades, the other starts automatically.

A/E 32C-24 Environmental Control Unit (ECU). An ECU provides ventilation, cooling, heating, pressurization, filtering, and dehumidification for the communications, operations, and other functional vans of the TACS system. The -24 supplies a 36,000 BTU/HR cooling capacity with manual or automatic temperature control. The unit is connected to equipment vans (fig. 1-11) by way of two air ducts.

M-720 Transport Mobilizer. Figure 1-12 shows the M-720. This mobilizer has a 3-ton capacity for transporting equipment. It has two axles, a towing bar, and a steering mechanism for the front axle.

M-35 Truck. The M-35 is a 2 1/2-ton general-purpose cargo or passenger carrier. Technical controllers assigned to mobile units become intimately familiar with this truck. With a 300-mile range, this 3-axle, 5-speed vehicle has a road speed of 58 mph and a 5,000-pound payload capacity.

403. The 407L operations centers

AN/TSQ-91 Operations Central. Figure 1-13 shows the AN/TSQ-91. This operations van is used at either a CRC or CRP and does surveillance and weapons control functions for a given area of tactical responsibility. An inflatable shelter allows the operations modules to be joined together into one large room housing operations people, manual display boards, consoles, and communications equipment. To this basic complex is added ancillary and data processing equipment and an air conditioning module to form a minimum configuration operations center. There are seven operator console positions in the AN/TSQ-91:

- SSO - search scope operator.
- ASO - air surveillance operator.
- M&I - movements and identification officer.
- SD - senior director.
- WAO - weapons assignment officer.
- WD/ATC - weapons director/air traffic controller.
- ADALO - air defense artillery liaison officer.

You will work closely with people in each of these positions. You must do your best to make sure they receive the best communications support possible.

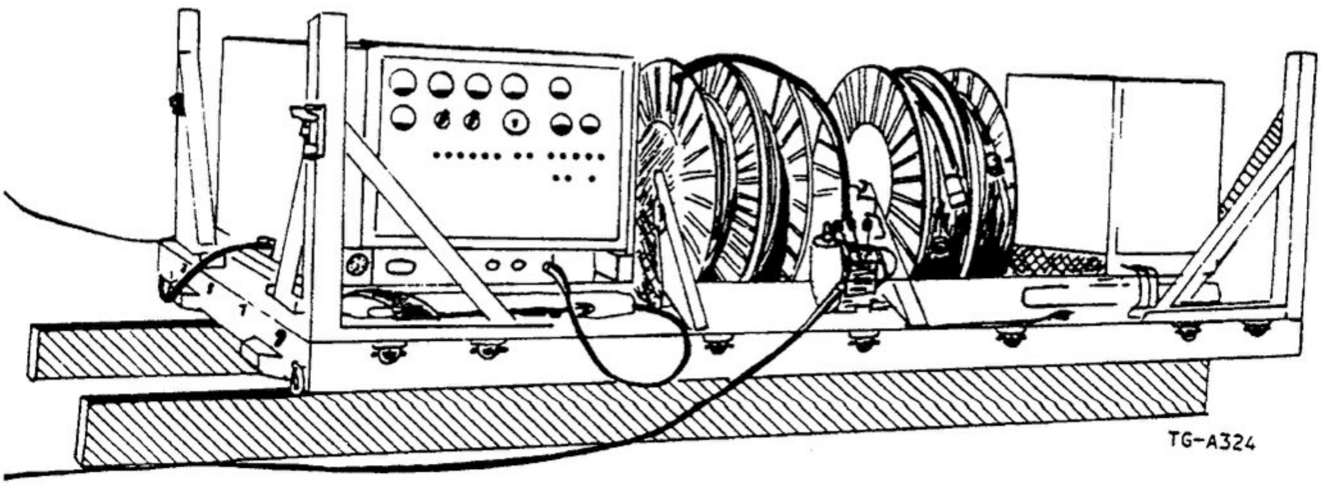


Figure 1-10. A/E 24U-8 power plant.

AN/TSQ-93 Operations Central. This is the operations complex found at ASOCs. It has an M-820 "expando" van, a communications van, an operations van, and an ECU. These four modules are enclosed in a shelter similar to the one used for the AN/TSQ-91.

Technical controllers working in the AN/TSQ-93 have the responsibility of ensuring intersite and end-to-end communications integrity for the ASOC. This is done through use of the patch and test facility (PTF) in the operations van. A separate patch panel is in the communications van for added flexibility. ASOC technical controllers have additional responsibilities, such as installing telephones and other user end instruments, and helping maintenance people in installing teletype equipment.

AN/TGC-28 Teletype Communications Center. The AN/TGC-28 is a deployable communications shelter equipped to do the functions of message preparation, transmission, and reception. This van has four full duplex encrypted circuits.

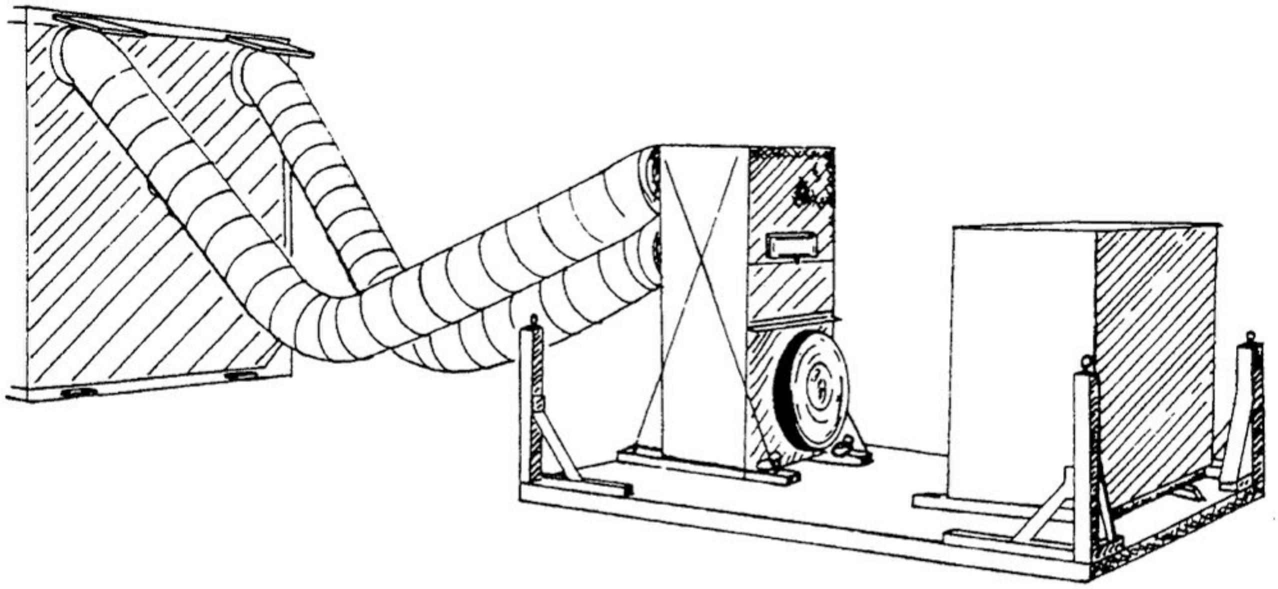


Figure 1-11. A/E 32C-24 environmental control unit.

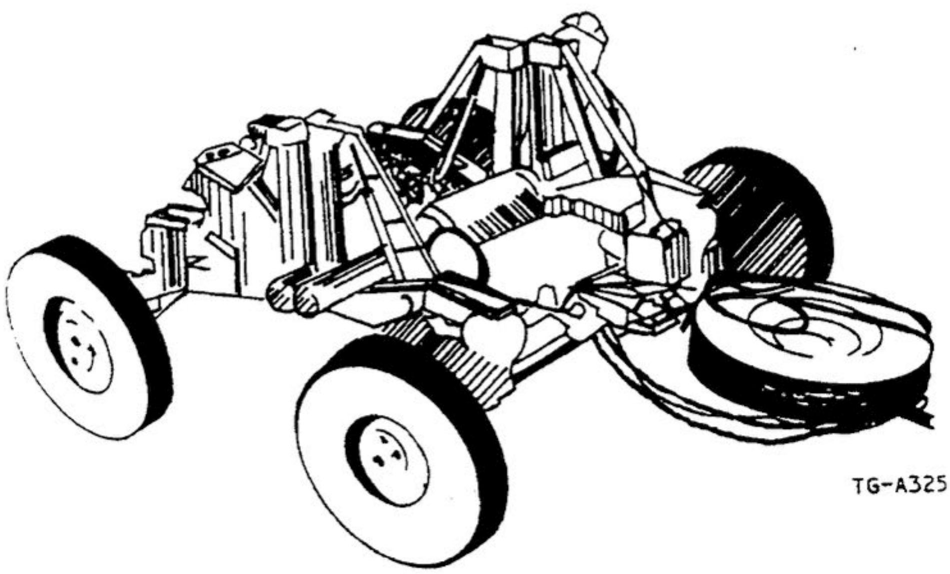


Figure 1-12. M-720 transport mobilizer.

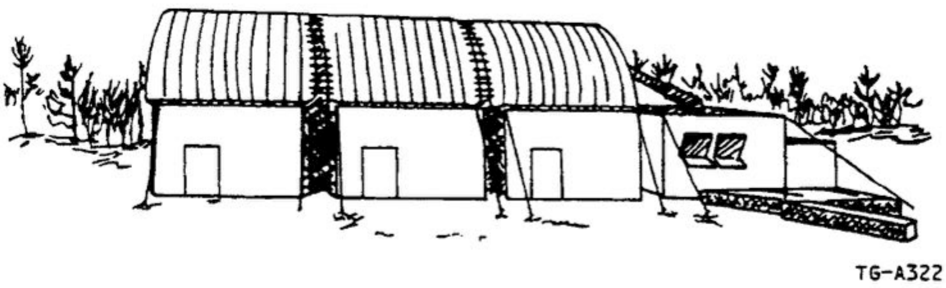


Figure 1-13. AN/TSQ-91 operations central.

404. The 407L communications central equipment

AN/TSC-53 Communications Central. The AN/TSC-53 is a transportable communications set that provides both HF voice and teletype and VHF/UHF air-to-ground communications facilities for a forward air control post (FACP). It also provides an intrasite and intersite communications network.

Since the 53 van is deployed with a FACP to the front lines, it must be mobile to survive. As you can see, the van is designed to be highly mobile (fig. 1-14). Erection time is about 1 hour, and teardown can be done in only minutes.

AN/TSC-60 Communications Central. The AN/TSC-60 is an HF/SSB radio housed in an air-conditioned shelter. It has two 1-kilowatt (kW) transmitters, receivers, and associated equipment to provide voice, teletype, high-speed data, multiplexed teletype, and speech-plus-teletype signals. This van is used in most of the TACS elements discussed in the previous section of this unit.

AN/TSC-62A Communications Central. The AN/TSC-62A is the van most technical controllers assigned to the TACS (under the 407L system) work in. This van has a deployable, air-conditioned shelter equipped with circuit patching facilities, test equipment, and a 12-line switchboard to provide efficient and rapid implementation of intrasite and intersite communications. The major functions done by technical controllers in the 62 van are:

a. Performance of circuit and radio channel quality control.

b. Restoration and rerouting of telephone, teletype, and digital communications under adverse conditions.

c. Continuous supervision of each of the communications facilities operating conditions.

In short, practically all communications traffic of the TACS elements pass through the 62 van. As in any technical control facility, (TCF), customer service is our number one job. This van is covered in detail in the next section of this unit.

405. 407L radio and radar equipment

AN/TRC-87 Radio Set. The AN/TRC-87 is a two-way communications set with availability for 3,500 UHF frequencies. It provides five AM voice channels, four of which use manually tuned transmitter-receiver groups and one of which uses an automatically tuned transmitter-receiver group. This radio set is highly mobile with erection and teardown times of less than an hour.

AN/TRC-97A Radio Set. The AN/TRC-97A is a tactical troposcatter radio set that uses dual space diversity and is designed to provide two-way voice, digital data, and teletype communications. It also can be used for line-of-sight (LOS) and diffraction propagation. The TRC-97A can reach optimum operation up to 100 nautical miles (nmi) in a single link configuration or up to 1,000 nmi when placed in tandem with other TRC-97As.

This radio set can multiplex up to 16 teletype channels onto any one of 24 VF channels. The system may employ either a horn antenna elevated to a height of up to 50 feet to clear obstacles, or, as seen in figure 1-15, a highly directional, high-gain, 8-foot parabolic dish antenna.

AN/TPS-43 Radar Set. The AN/TPS-43 is a highly mobile ground radar set designed for simultaneous long range search and height finding in a severe weather and/or jamming environment. The TPS-43 normally is found in the CRC/CRP or FACP configurations. Figure 1-16 shows the TPS-43 shelter and its stacked beam antenna.

406. 407L voice communications equipment

AN/TTC-30 Telephone Central Office. The AN/TTC-30 is the primary telephone switch used in the 407L system. It has two interconnected mobile communications modules that provide automatic switching of four-wire telephone circuits using dual-tone multifrequencies (DTMF) signaling. Computer programming techniques are used to assign telephone subscriber numbers and to program routing instructions.

Some of the special features of the AN/TTC-30 include direct area dialing, automatic altrouting (alternate routing) of calls over switched trunks, and preemption privileges for key people. This switch is compatible with AUTOVON, Army, commercial, and current manual switchboard systems.

SB-22/PT Field Switchboard. The SB-22/PT is just one of many manual switchboards in the 407L system. It is a portable, immersion-proof field telephone switchboard that interconnects local battery lines and line equipment used with teletype and remote control radio communications. This switchboard provides for the switching and signaling of up to 12 field telephones, teletype circuits or remote control radio circuits, or any combination of these.

TA-341 Telephone Set. The TA-341 is a transistorized telephone desk set with an AC/DC signaling scheme that provides compatibility with the AN/TTC-30 or similar electronic switching centers. This telephone can be used to originate and receive calls by way of an associated switching facility, or it can be connected "back-to-back" with another telephone set for point-to-point service. It is a four-wire

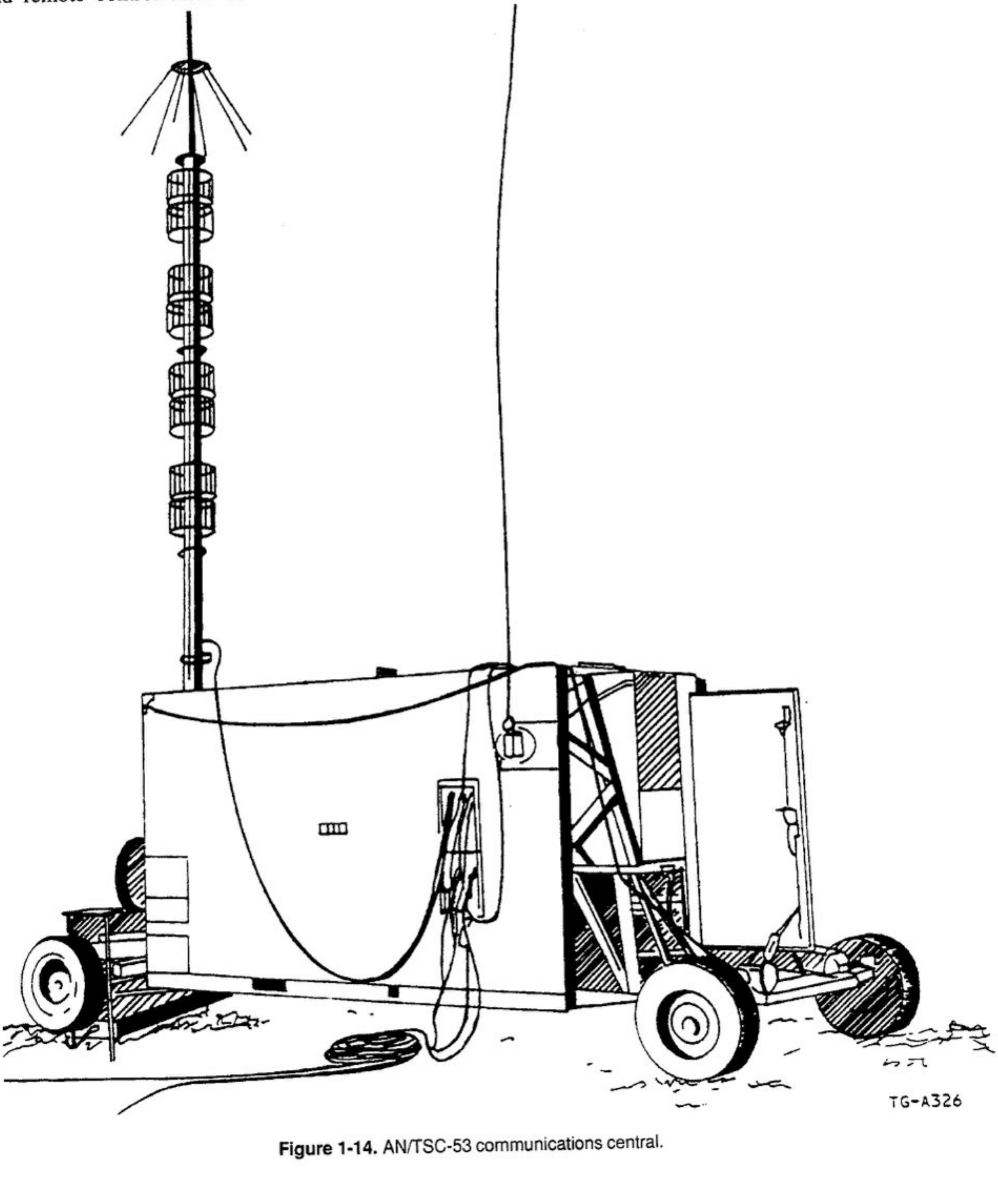


Figure 1-14. AN/TSC-53 communications central.

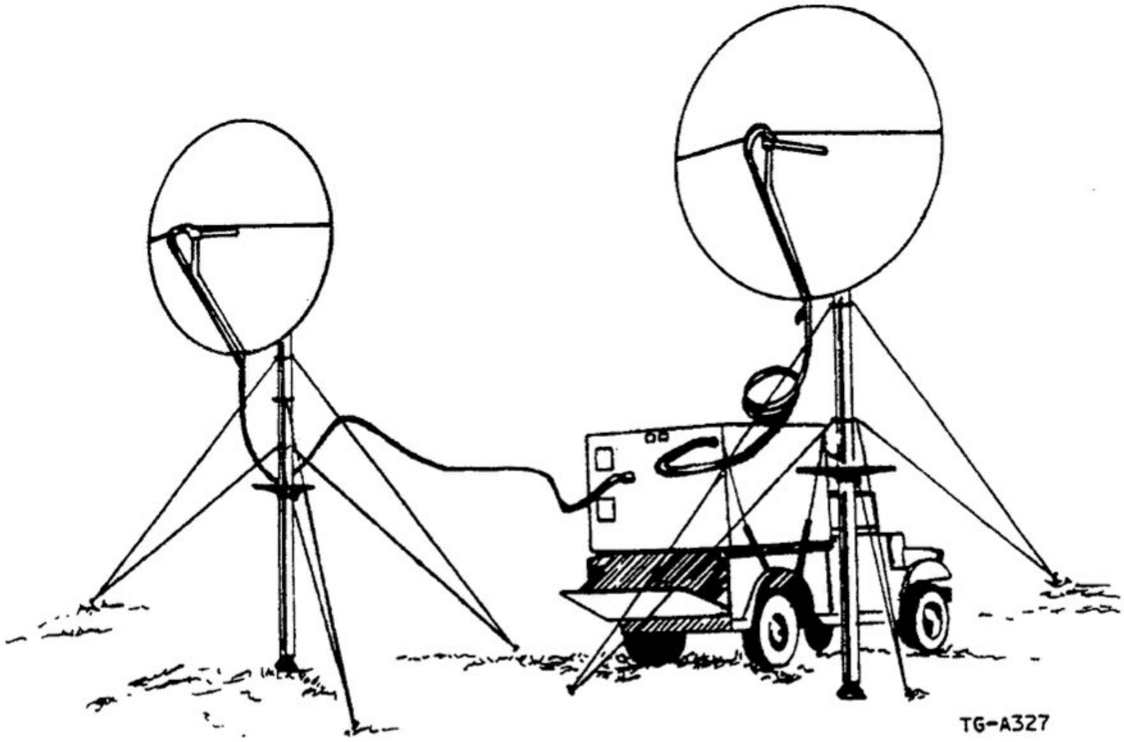


Figure 1-15. AN/TRRC-97A radio set.

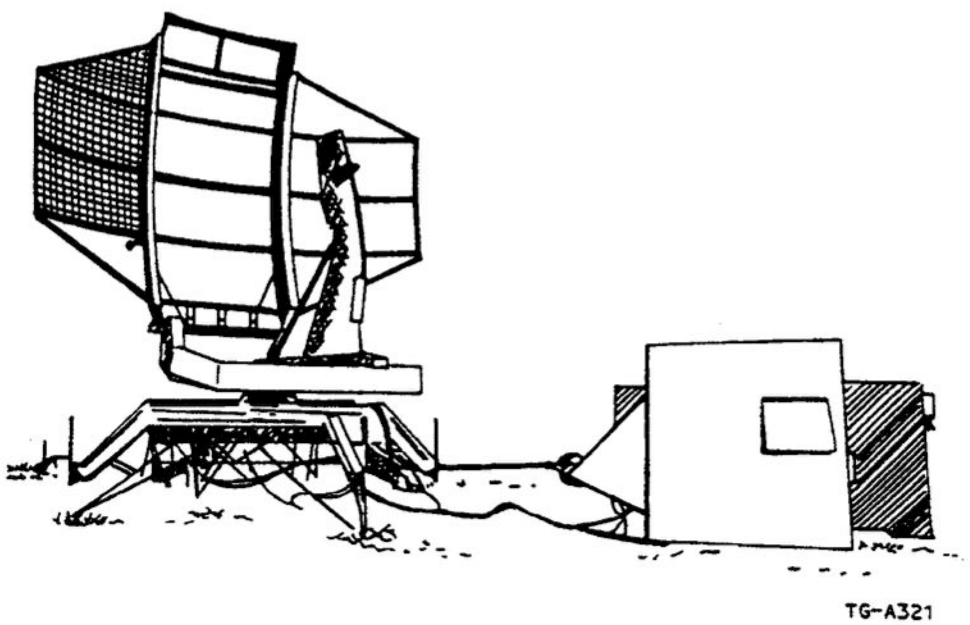


Figure 1-16. AN/NPS-43 radar set.

instrument that uses local battery power. VF tones are used for supervisory signaling to and from the AN/TTC-30.

The TA-341, figure 1-17, offers conference capability for up to four stations. Up to five of these instruments can be connected to one telephone circuit from the AN/TTC-30. As a technical controller assigned to a 407L element, you will spend many hours communicating over this type of telephone. It is worthy of mention that you are also the person your users will call when their TA-341 quits working. You must understand completely the signaling characteristics of this instrument.

TA-312/PT Field Telephone Set. The TA-312/PT (fig. 1-18) is a local battery manual telephone designed to work under all outdoor weather conditions, in groups of two or more, or with a switchboard. This crank-operated telephone emits a 20-Hz/90-volts ring. You can use it to control remotely operated radio equipment by using the press-to-talk switch on the handset.

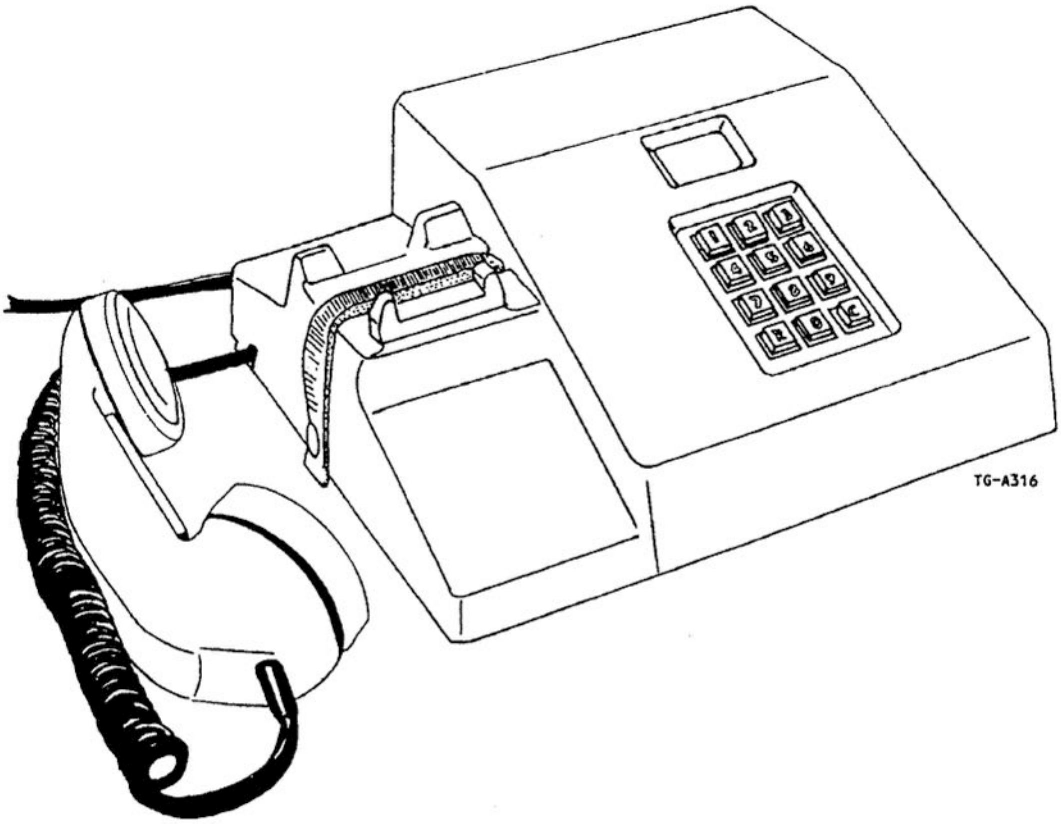


Figure 1-17. TA-341 telephone set.

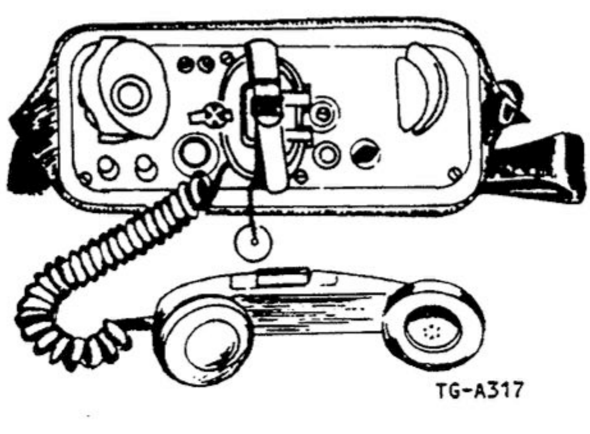


Figure 1-18. TA-312/PT field telephone set.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

402. 407L mobility support equipment

1. What happens if a -8 generator supplying power to your AN/TSC-62A van fails?

   Standby generator

2. What is the purpose of an A/E 32C-24 ECU?

   ECU that provides venting cooling heating for vans

403. The 407L operations centers

1. What operations center is used at CRCs and CRPs?

   AN/TSQ-91

2. What operations center is used at ASOCs?

   AN/TSQ-93

3. What van is used to process teletype traffic?

   AN/TSC-28

404. 407L communications central equipment

1. What communications central van is used in a FACP? AN/TSC 53

2. What communications capabilities does the AN/TSC-60 communications central provide?

   using 2 1KW HF/SSB radios, it provides voice, teletype, high speed data, multiplexed teletype, & speech plus teletype traffic.

3. What are the three major functions of the AN/TSC-62A communications central?

   ckt & radio channel quality
   restoring & rerouting ckts
   supervision.

405. 407L radio and radar equipment

1. What service does the AN/TRC-87 radio set provide? 4 channels using manually tuned TX/RX groups

2. Describe the particulars of engineering a radio link that must span a distance of 510 nmi. Include your suggestions for the type of antenna to be used for the originating station, which requires placement of the radio in such a way that a 30-foot tree must bee cleared, and for the terminal station, where the radio will be located on the edge of a barren field.
several AN/TSC-97A radio sets must be placed in tandem

3. What 407L equipment is designed for long-range search and height finding?
AN/TPS-43 Radar set

406. 407L voice communications equipment

1. What are the special features of the AN/TTC-30?
Direct dialing automatic rerouting + preempt capability

2. How many and what type of circuits may be interconnected using the SB-22/PT switchboard?
maximum of 12 teletype, field telephone, or remote control radio ckts

3. What is the conference capability of the TA-341?
4 stations

1-3. TRI-TAC Equipment

Modern tactical warfare demands innovative approaches to managing and controlling tactical communications. The rapid deployment capabilities of today's sophisticated weapons, coupled with increased troop mobility, require that commanders have instant and secure communication with their fighting forces.

The Department of Defense recognized the need to develop new communications equipment. Using the most modern technologies available, the DOD wanted to:

a. use the quickly-evolving digital communications technology.

b. integrate the new equipment with current analog equipment.

c. set standards for triservice compatibility.

The Joint Tactical Communications Office (TRI-TAC), an effort involving the Departments of the Army, Navy and Air Force, was created to design and implement this new system.

A key element of the TRI-TAC network architecture is the AN/TSQ-111 communications nodal control element (CNCE), a state-of-the-art communications system fully engineered by Martin-Marietta Orlando Aerospace. The CNCE manages communications resources throughout a node, monitors equipment and circuit quality, detects and isolates faults, and provides transmission and communications security (COMSEC) equipment needed for a responsive, flexible network.

It is also the first unit of its kind capable of controlling high-technology digital communications equipment and integrating both digital and analog communications in a single, easily transportable control function. The result is modern, integrated, processor-assisted nodal communications control for the combat commander.

Current tactical communications control facilities provide a limited manual capability only to monitor the technical parameters of analog equipment and to take corrective actions based on a combination of technical measurements and established procedures. The procedures are cumbersome, error-prone, and time-consuming. Additionally, the only capability to do resource allocation and reallocation is also manual and based on voice reporting and manual patch panels. These deficiencies are manifested in differing degrees in the services today, dependent on existing facilities and modes of operation.

A new generation of tactical communications equipment is required. This new equipment employs primarily digital techniques and provides improved communications security. As with the analog systems, the new digital systems require devices for monitoring the quality of signals, measuring equipment performance trends, and implementing the corrective measures required. The increasing amount of digital traffic and introduction of automatic analog and digital switching require a more rapid and efficient ability to analyze network performance and make adjustments as necessary.

In this section, you will study the function and certain characteristics of TRI-TAC equipment. You should bear in mind that although this new system is being phased into the TACS environment, some 407L equipment will stay in use at many TACS elements. As TRI-TAC was being designed, a complete 407L interface ability was taken into consideration. As you read descriptions of equipment in the following lessons, you may wish to refer to the illustrations of previous sections to see how these interrelate within the TACS elements.

407. TRI-TAC switching equipment

The switching assemblages are the heart of the TRI-TAC program. Basically two functional groups of switches are used: message and circuit. Message switches provide digital secure data communications between terminals and provide a forwarding service into the AUTODIN system. Circuit switches provide secure voice and data, digital nonsecure voice, and analog nonsecure voice communications between subscriber terminals. The TRI-TAC circuit switches are interoperable and are connected by digital secure or analog nonsecure trunks.

AN/TYC-39 Automatic Message Switching Central. The AN/TYC-39 is a 50-line, mobile store and forward message switch under microprocessor control with integral COMSEC and multiplexing equipment. It provides automatic secure switching of record and data traffic with multichannel LOS, FPTS, and satellite media. This switch in compatible with the DSN system and can work independently or jointly with an AN/TTC-39 circuit switch for the switching of data traffic. Figure 1-19 and 1-20 show the two primary shelters that make up the AN/TYC-39, the message processing, and communications interface shelters.

This message switch can process message traffic for up to 50 individual user inputs at data rates of 45.45 to 37,000 bps in either ITA #2 (Baudot) or ITA #5 (ASCII) codes. A maximum message length of 6,900 characters per

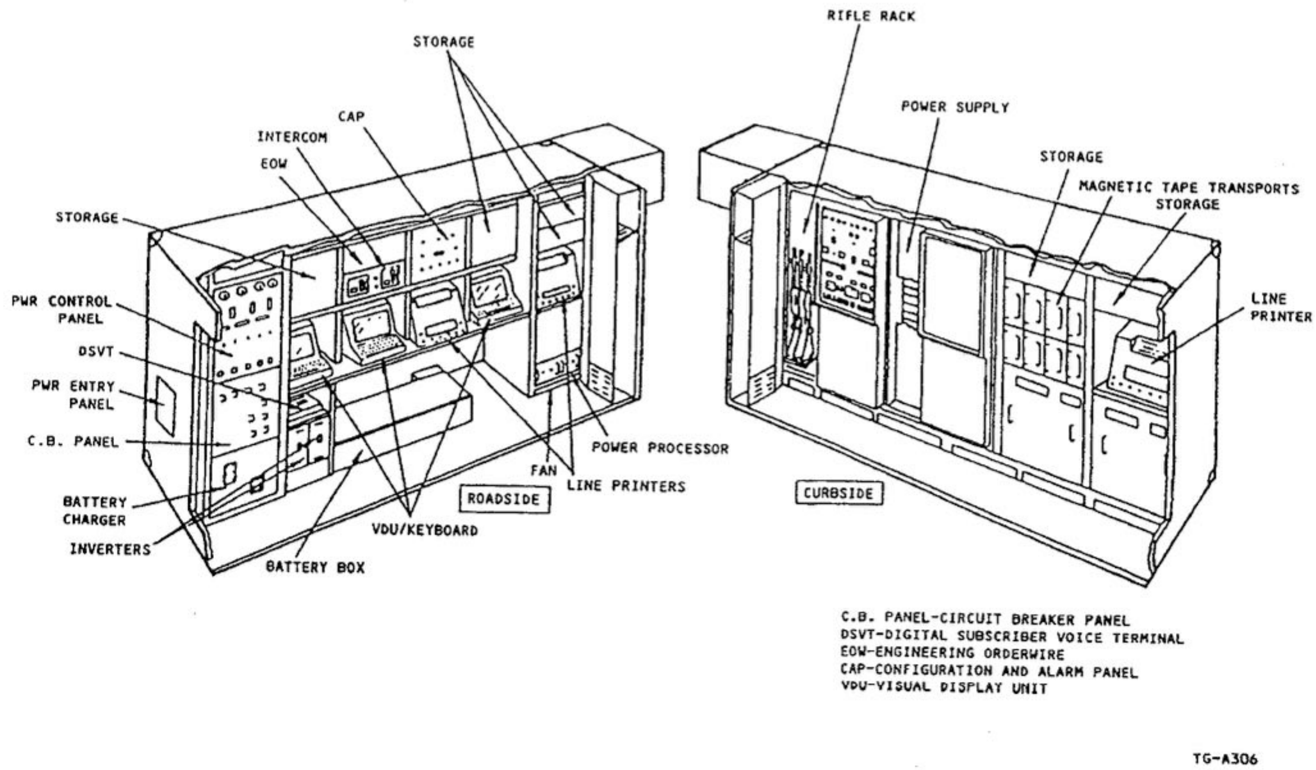


Figure 1-19. AN/TYC-39 message processing shelter.

message is accommodated with intransit storage for up to 2,500 messages. Accountability is done by creation of message control blocks having information on message entry and delivery.

The AN/TYC-39 stores message traffic for retrieval when needed. Traffic less than 24 hours old may be retrieved within 7 minutes for high priority messages. Traffic over 24 hours old may take up to 30 minutes to retrieve.

COMSEC may be provided internally or externally. Internal encryption is done by KG-81 crypto gear for trunk encryption and by KG-82s for individual user circuits and single channel trunks. An OX-54 coder/decoder group module may be colocated with the AN/TYC-39 to supply external encryption through the use of KW-7, KW-13 and KW-30 crypto devices.

The TYC-39 provides access for dedicated circuits and dial-up digital circuits through an AN/TTC-39 circuit switch. Magnetic tape is used for intercept storage if traffic is undeliverable due to circuit outage.

AN/GYC-7 Automatic Message Switching Set. The AN/GYC-7, commonly called a unit level message switch (ULMS), is a 12-line, ruggedized microprocessor based near real-time data switch with integral COMSEC equipment. It provides switching service for data traffic generated by a variety of connected terminals or by other AN/GYC-7 switches. This switch is team transportable for forward area use in an attended or unattended mode.

The GYC-7 can accommodate up to 12 individual user circuits (8 secure, 4 nonsecure) at data rates from 45.45 to 1,200 bps. The maximum message length is 160 characters with transmission rates up to 32 kbps. COMSEC is accomplished with KG-84 crypto devices for both individual circuits and single channel trunks. The AN/GYC-7 does not accommodate multichannel trunks.

AN/TTC-39 Automatic Telephone Central. The AN/TTC-39 is a 600-line mobile, microprocessor-based, modular circuit switch with integral COMSEC and multiplexing equipment. It switches secure and nonsecure voice and data traffic in DOD tactical systems, and it switches nonsecure voice traffic between those tactical systems and strategic and allied force systems. Figures 1-21 and 1-22 show the two primary shelters that make up the AN/TTC-39, the control and switching shelters.

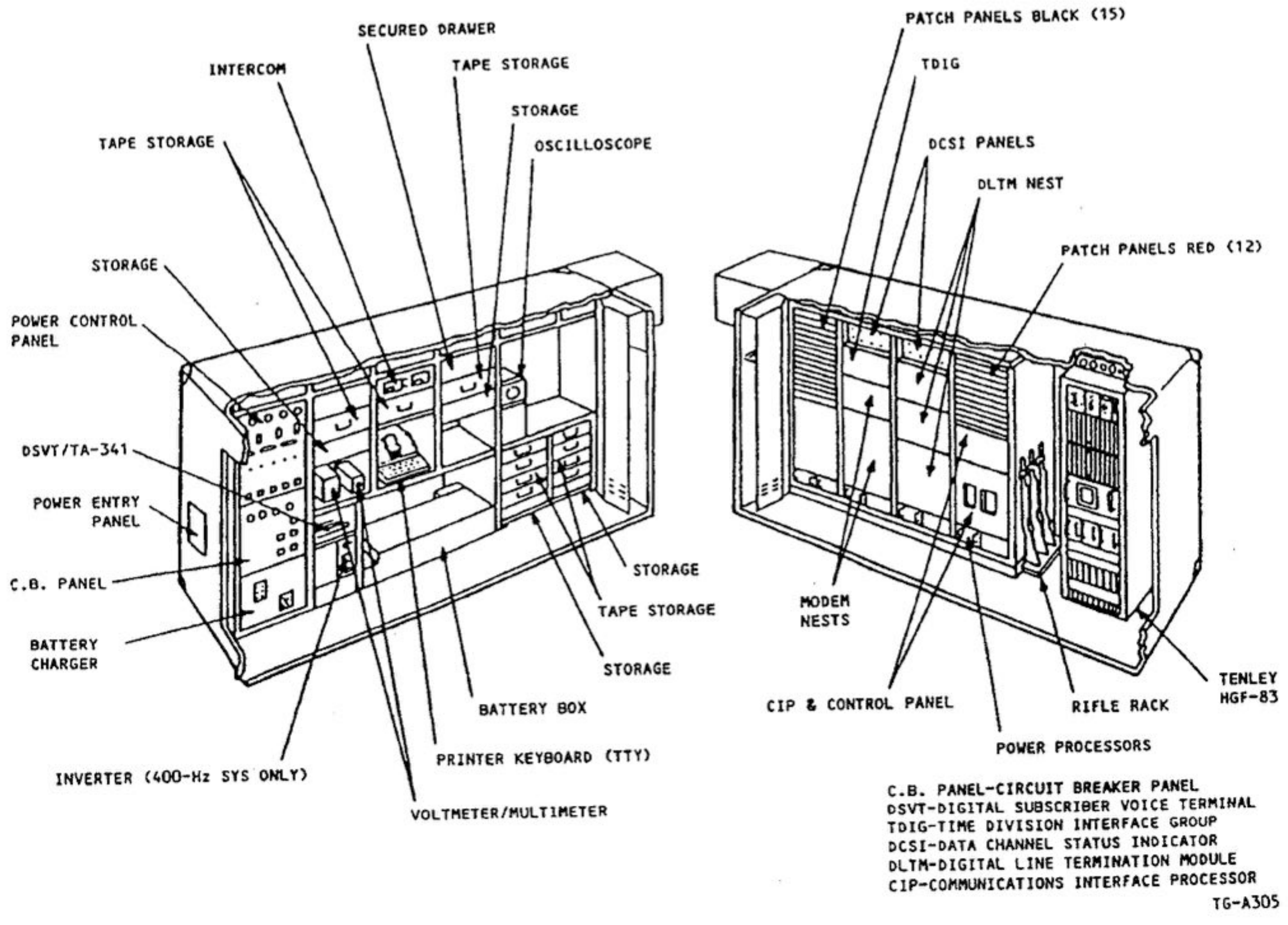


Figure 1-20. AN/TYC-39 communications interface shelter.

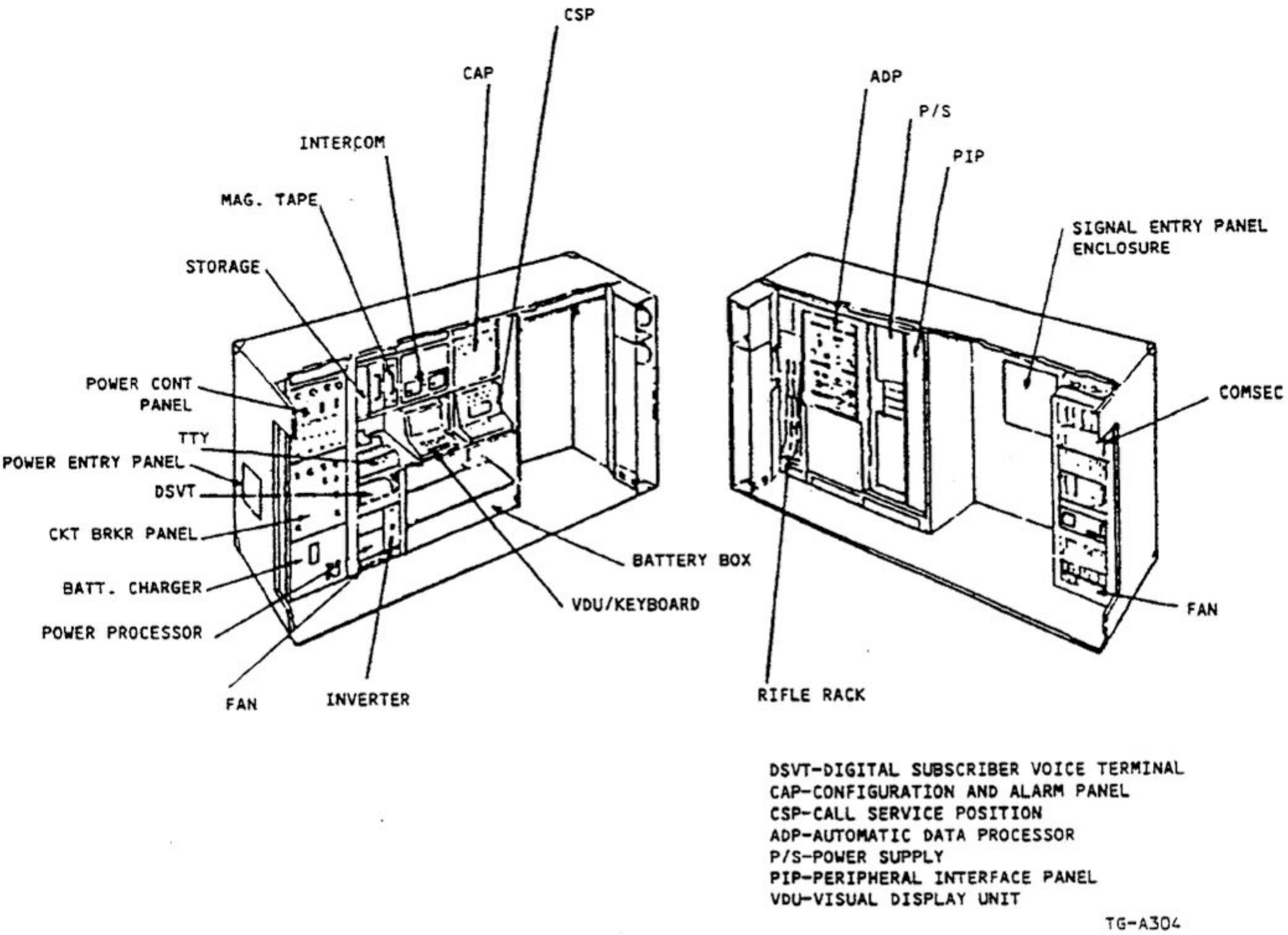


Figure 1-21. AN/TTC-39 control shelter.

This circuit switch can service 600 individual user circuits through three-analog and two-digital matrices. The AN/TTC-39 was designed with replaceable matrix modules. Hence, by replacing analog with digital matrices, the switch can increase its digital ability and make an orderly transition from present analog systems through a hybrid period to digital secure systems. The AN/TTC-39 circuit switch offers the following subscriber services:

Routing. One primary and five alternate routes.

5-level precedence. Flash override, flash immediate, priority, and routine.

Abbreviated dialing. Dial only last three or four digits for interconnection.

Compressed dialing. Allows interconnection with subscribers of different switch.

Call transfer. Incoming calls transferred to another number.

Call intercept. Recorded announcement.

Automatic line grouping. Lines can be grouped in sets of two to five so that incoming calls to a busy number are transferred to another number within that group.

Conference calls:

Progressive. Originator calls conferees in succession.

Pre-programmed. Originator keys number and all predetermined conferees called automatically.

Attendant access. Access by dialing "0".

Direct access. Point-to-point service for up to 60 two- or four-wire subscribers.

Information signals. A series of audible tones which give progress or disposition of calls.

Essential user bypass. An automated ability to connect up to 60 preselected essential digital subscribers to a distant AN/TTC-39 if both the primary and backup processors of the parent switch fail.

In addition to these dedicated user services, the AN/TTC-39 offers the following switch functions:

Parent switch. Controls call requests of subordinate SB-3865 circuit switch subscribers and analog interface trunks; provides those service features available to local subscribers to long loop subscribers; extends calls to subscribers served by subordinate SB-3865 circuit switches.

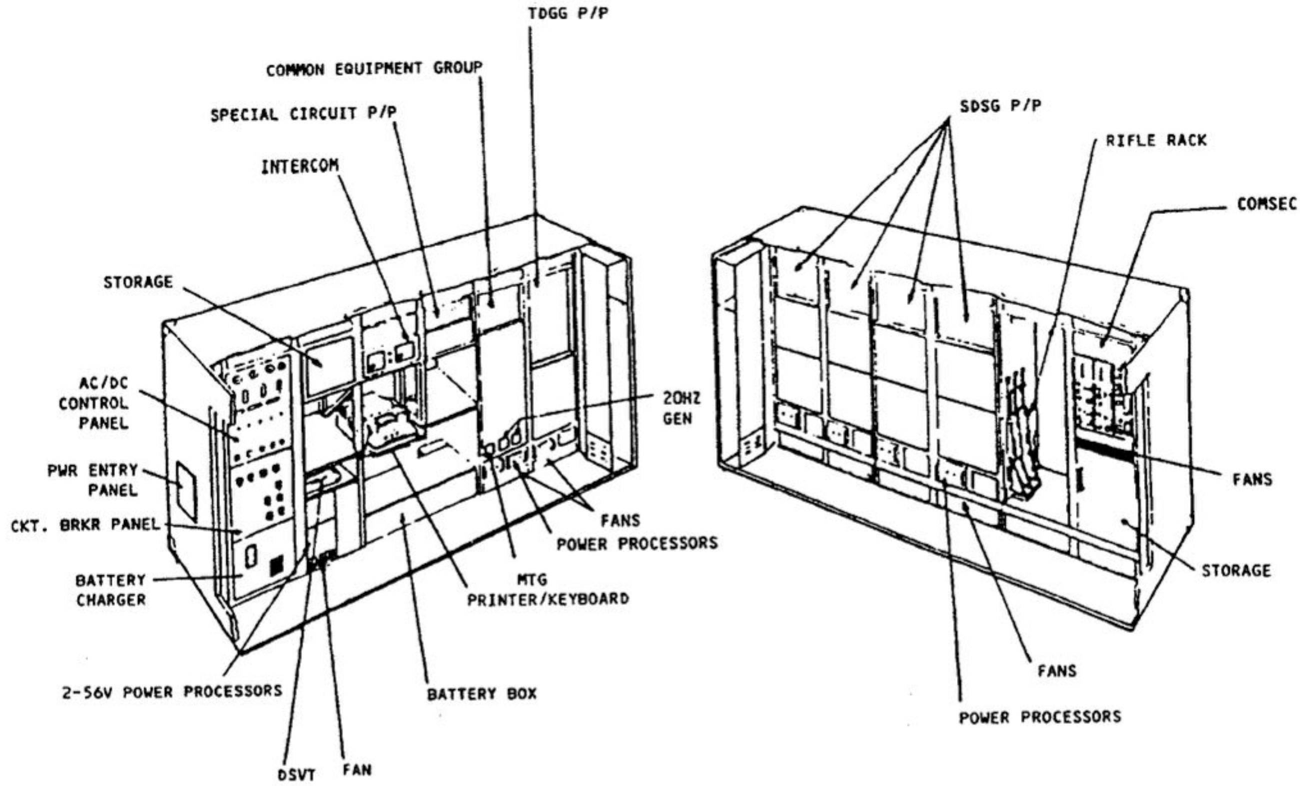


Figure 1-22. AN/TTC-39 switching shelter.

COMSEC. Equipment necessary to implement the COMSEC parent switch (CPS) functions of cryptovariable generation, automatic key distribution, encryption, and trunk encryption are integral to the switch shelter.

Digital loop group. The combination of several loop or access circuits into a single group for simplicity of transmission.

Digital trunk group. The combination of several trunks into a single group for simplicity of transmission.

Digital transmission group. The combination of digital trunk groups, digital groups and/or digital loops into a single group for simplicity of transmission.

SB-3865/TTC Automatic Telephone Switchboard. The SB-3865, commonly called a unit level circuit switch (ULCS), is a 30-line, team-transportable, microprocessor-based telephone switchboard that provides switching service and subscriber service functions to four-wire digital secure and nonsecure loop subscribers, four-wire digital trunks, and selected four-wire analog loops and trunks. Two or three switches may be interconnected to provide increased switching capabilities of 60 or 90 lines, respectively. It is designed to work in the attended or unattended mode. When placed in the unattended mode, calls to the call service queue are rerouted to another switch or subscriber terminal as designated in the data base. Consisting of a switch module, power module, COMSEC module, attendant's headset, technical manuals, grounding rod, and connecting cables, this unit takes only two people to transport.

408. The AN/TRC-170 digital troposcatter radio terminal set

The AN/TRC-170 is designed for LOS or troposcatter operation. Each facility accepts up to four digital groups with up to 15 channels on each, and it accepts up to 30 local digital subscriber loops using two TD-1235 loop group multiplexers (LGMs). Some or all of these digital loops can be replaced by dedicated four-wire analog subscriber loops.

The AN/TRC-170 works with an RF bandwidth of 3.5 to 7 megahertz (MHz). RF power output is 200 milliwatts (mW) in an LOS configuration, and 2 kilowatt (kW) in the troposcatter configuration. A nominal range of 100 miles is obtainable with the use of two 6-foot parabolic antennae (fig. 1-23).

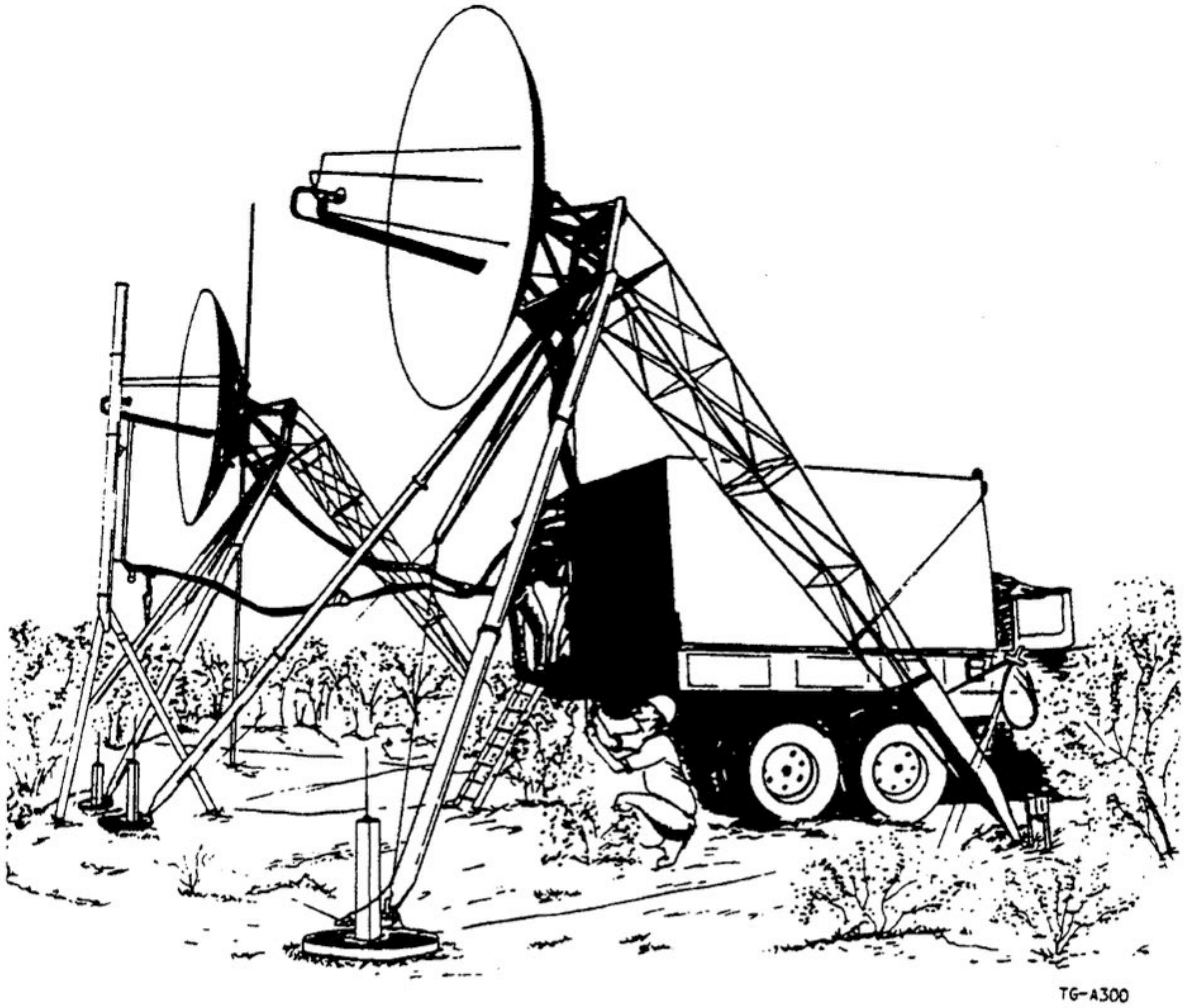


Figure 1-23. AN/TRC-170 digital troposcatter radio terminal set.

The following are the applications of the AN/TRC-170. Refer to figure 1-24 as you review each of these.

Internodal Trunking. Provides an ability to interconnect an AN/TTC-39 and/or unit level switch directly or via an AN/TSQ-111 (technical control) and/or short-range wideband radio (SRWBR) (see application "a" of fig. 1-24).

Multitrunking. Provides for the connection of up to four other radio terminal sets to a switch either directly or via an AN/TSQ-111 (see application "b").

Remote Subscriber Access. Provides an ability to connect 16 or 32 kbps digital voice or data subscribers to the AN/TTC-39 either directly or via an AN/TSQ-111 and/or SRWBR (see application "c").

Subscriber Access at a Relay. Provides an ability to connect 16 or 32 kbps digital voice or data subscribers at a relay (repeater) site to an AN/TTC-39 either directly or via an AN/TSQ-111 and/or SRWBR (see application "c").

Dedicated Trunking. Provides an ability for 16 or 32 kbps digital voice or data and four-wire analog (voice or quasi-analog) communications on a dedicated basis without passing through a circuit switch or AN/TSQ-111 (see application "d").

Drop and Insert at a Relay. Provides for the establishment of a trunk group from a relay site to either of two nodes without requiring additional terminal equipment or RF channels (see application "e").

409. TRI-TAC modems, restorers, and multiplexers

MD-1023 Low-Speed Cable Driver Modem (LSCDM). The LSCDM is a shelter-mounted modem that provides a signal and power interface for repeatered coaxial cable links. It accommodates transmission of analog voice, digital voice and data orderwires. The MD-1023 accepts multiplexer inputs from 72 to 2,048 kbps and provides a 2,304 kbps output.

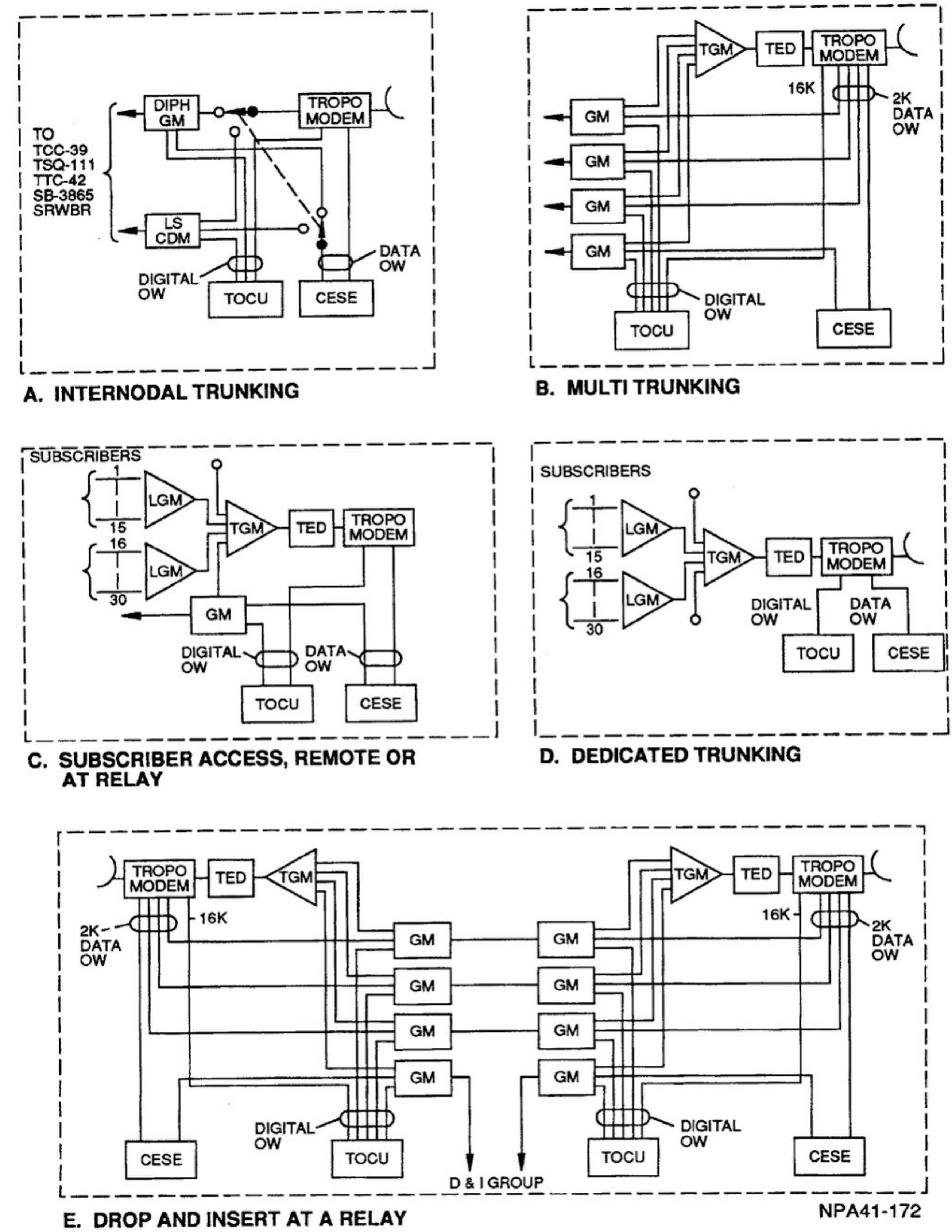


Figure 1-24. AN/TRC-170 applications.

TD-1218/G Low-Speed Pulse Restorer (LSPR). The LSPR is a field-exposed pulse restorer for use in TRI-TAC repeatered coaxial cable systems terminated with the MD-1023 LSCDM. It provides pulse regeneration for 2,304 kbps analog conditioned diphase signals, and it provides line loading for analog orderwire signals.

Multiplexers. As you study the multiplexers used in the TRI-TAC system, refer to figure 1-25 for clarification. At the time of this writing, the master group multiplexer (MGM) scheme is not in use.

TD-1233 remote loop group multiplexer (RLGM). The RLGM is a field-exposed unit that time division multiplexes up to four 16 or 32 kbps channels into a single group. With inputs of 16 and 32 kbps, the RLGM provides analog conditioned diphase 72 and 144 kbps outputs, respectively.

TD-1234 remote multiplexer combiner (RMC). The RMC is a field exposed unit that time division multiplexes up to eight 16 or 32 kbps user channels and/or a single loop group of 72 or 144 kbps. Its output is an analog conditioned diphase signal of 144, 288, or 576 kbps, depending on its inputs.

TD-1235 loop group multiplexer (LGM). The LGM is a shelter-mounted unit that time division multiplexes up to sixteen 16 or 32 kbps, four-wire full duplex loop circuits into a balanced nonreturn to zero (NRZ) group. Inputs are accepted in groups of 7, 8, 15, or 16 channels. There are outputs of 128 to 288 kbps if inputs are 16 kbps, and there are outputs of 256 to 576 kbps if inputs are 32 kbps inputs.

TD-1236 trunk group multiplexer (TGM). The TGM is a shelter-mounted unit that time division multiplexes 2, 3, or 4 trunk groups of 72 to 576 kbps into a supergroup. Its output is a balanced NRZ supergroup (with timing) of 144 kbps to 4,608 Mbps.

TD-1237 master group multiplexer. The MGM is a shelter-mounted unit that time division multiplexes up to 12 asynchronous groups or supergroups into a master group. It has two 16 kbps data orderwires as part of its overhead channel. The MGMs output is a balanced NRZ mastergroup (with timing) of 9.36 or 18.72 Mbps. This master group signal represents as many as 1,144 traffic channels.

The modems, pulse restorers, and multiplexers of the TRI-TAC system offer a great deal of flexibility to TACS elements. As a Technical Controller working with the TRI-TAC system, you must be totally familiar with the operational characteristics of each of these to ensure maximum system performance.

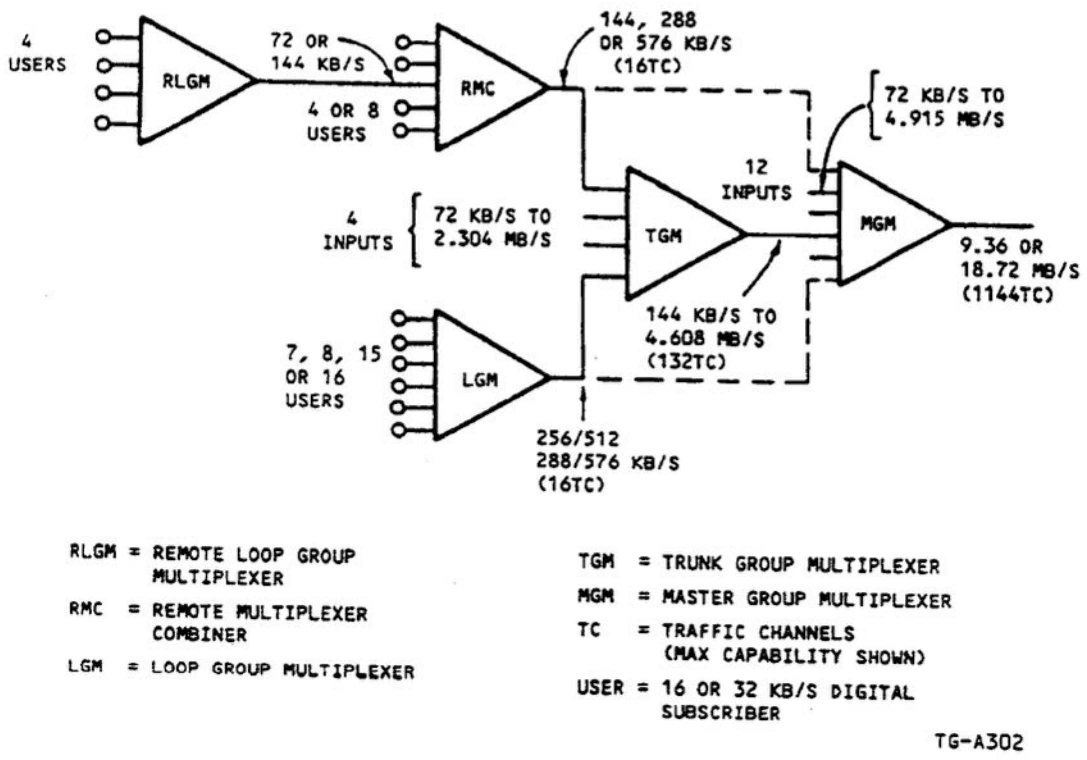


Figure 1-25. TRI-TAC multiplexer scheme.

410. The AN/TSQ-111 CNCE and TRI-TAC terminal equipment

AN/TSQ-111 Communications Nodal Control Element (CNCE). The CNCE, or technical control van, is the TRI-TAC system equal of the AN/TSC-62A communications central used in the 407L system. The CNCE incorporates a new concept for technical control application, a systems approach.

The CNCE provides centralized management and control of a communications node. It provides the interface for analog and digital nodal switches, common user and dedicated subscribers, and the internodal radio and cable transmission networks. The CNCE has a cesium beam (atomic clock) timing standard and acts as the nodal master clock for all digital circuits.

The CNCE is a highly versatile, system-oriented control element that offers the technical controller a variety of new challenges. We cover this van in depth in the closing section of this unit.

Subscriber Terminals. Many user terminals exist under the TRI-TAC program. They enhance the operations abilities of the TACS user and improve maintenance and systems control procedures. We will now discuss a few of the new terminals.

AN/UGC-137 single subscriber terminal (SST). The SST (fig. 1-26) is a ruggedized video display unit that has a 25-line plasma display panel, keyboard, controls, and indicators. The SST has a communications interface and equipment to interface with peripheral devices such as printers and optical character readers.

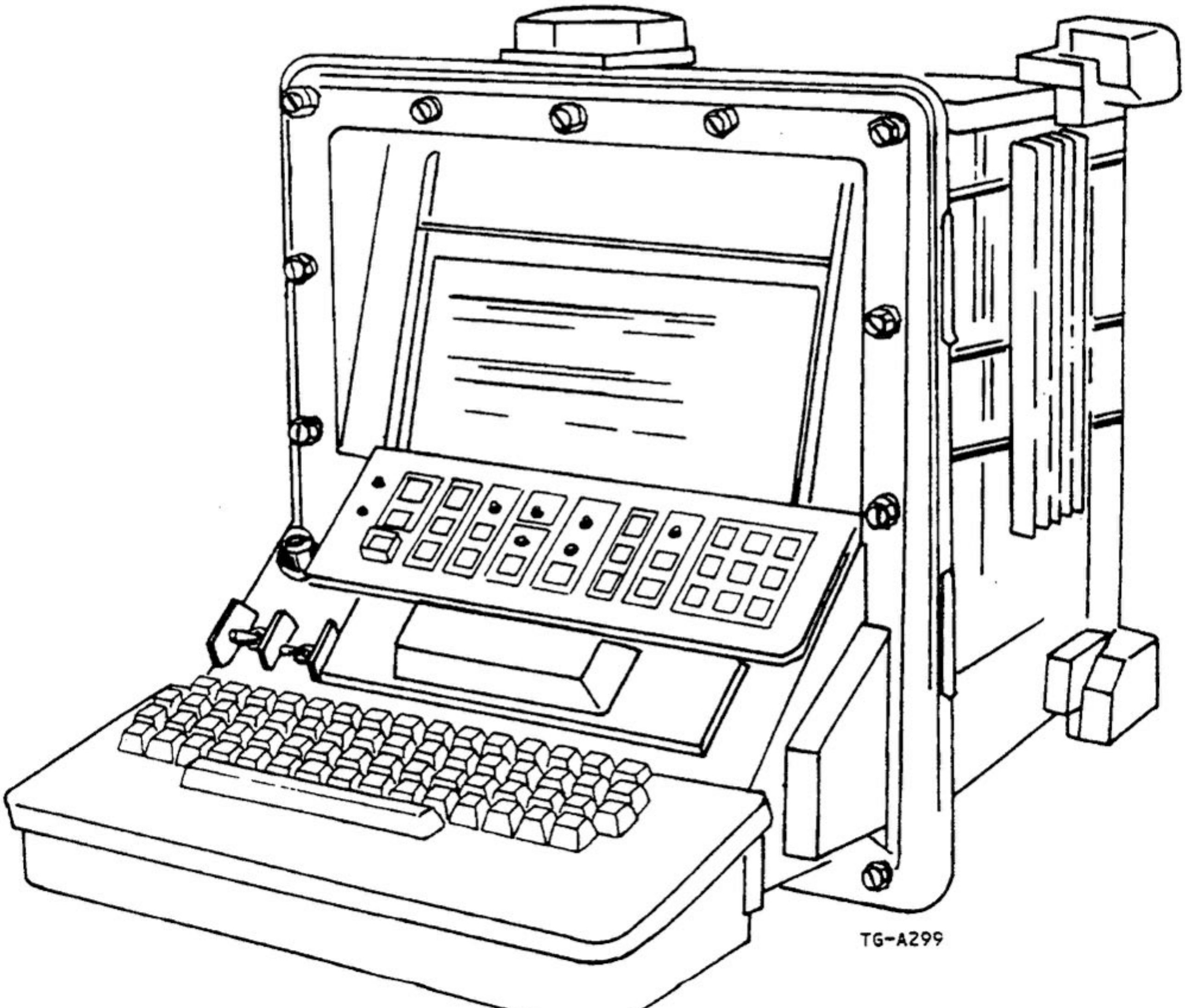


Figure 1-26. AN/UGC-137 single subscriber terminal.

This unit can compose, edit, store, display, refile, transmit, receive, and monitor record message traffic through operator prompting. It is used at all levels of the TACS.

Using both the Baudot and ASCII (synchronous and asynchronous) operating codes at rates from 45.5 baud to 16 kbps, the SST interfaces not only other tactical equipment, but the DCS AUTODIN modes I, II and V as well.

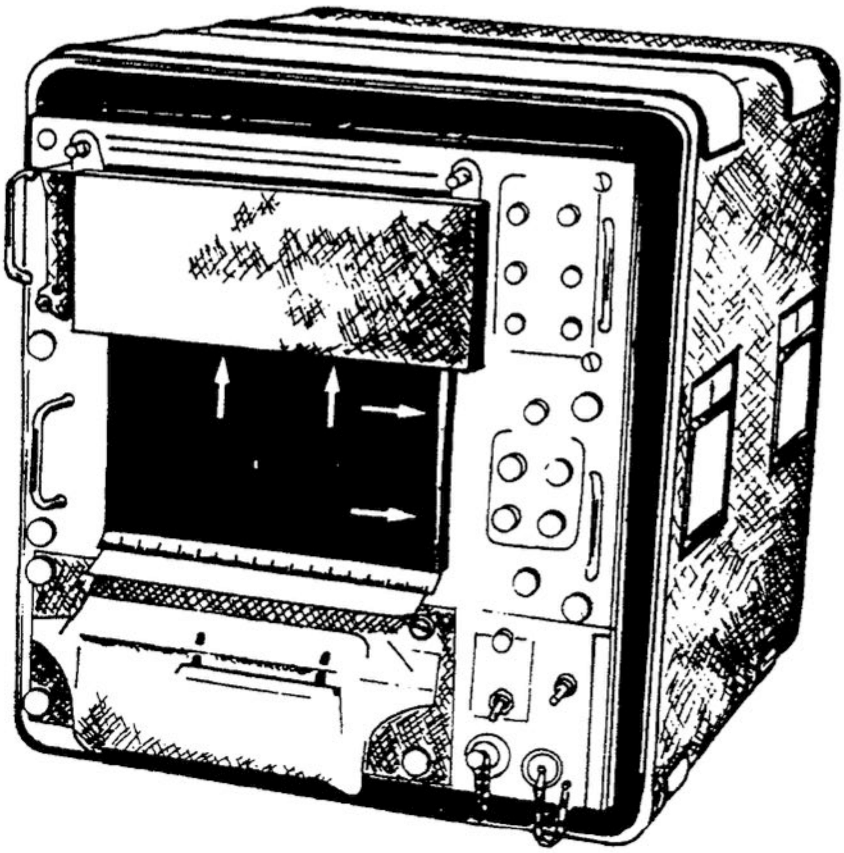
AN/UXC-4 tactical digital facsimile (TDF) terminal. Facsimile transmission has found a home in practically every aspect of military operations, and the tactical environment is no exception. The TDF (fig. 1-27) is a ruggedized unit capable of half- or full-duplex digital facsimile operation via wire or radio communication channels, and it reproduces copies locally.

This unit uses the gray scale, reproducing in 16 shades of gray, at data rates from 1.2 to 32 kbps. Built-in test equipment gives the capability to generate a series of diagnostic test charts and to identify failed replaceable units.

KY-68 digital subscriber voice terminal (DSVT). The DSVT is a ruggedized field terminal having the audio processing, signaling, and COMSEC functions necessary to give secure and nonsecure voice and secure data access to circuit-switched digital networks. It also provides secure access to a variety of nonswitched, sole-user digital networks.

The DSVT digitizes voice information using continuously variable slope delta modulation. It is capable of both half- and full-duplex operation at rates of 16 or 32 kbps.

TA-954 digital nonsecure voice terminal (DNVT). The DNVT is a ruggedized, four-wire, nonsecure telephone set that transmits and receives digital voice and loop signaling information to provide access to the TRI-TAC circuit switched network. It digitizes analog voice signals using continuously variable slope delta modulation at bit rates of 16 or 32 kbps.



TG-A318

Figure 1-27. AN/UXC-4 tactical digital facsimile.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

407. TRI-TAC switching equipment

1. What are the two functional groups of switching assemblages under the TRI-TAC program?
message & ckt switches

2. What is the primary message switch used in the TRI-TAC system? AN/TYC-39
auto switching

3. How many user inputs can the AN/TYC-39 service? What is the maximum user data rate?
50; up to 32 Kbps

4. What piece of equipment is referred to as the unit level message switch (ULMS)?
AN/GYC-7 automatic message switching set.

5. Explain the matrix module design of the AN/TTC-39 automatic telephone central. 600 user ckts may be served by 3 analog & 2 digital matrices

6. Explain the "essential user bypass" function of the AN/TTC-39 automatic telephone central. Automatic capability 60 preselected essential users.

408. The AN/TRC-170 digital troposcatter radio terminal set

1. What is the capacity of the AN/TRC-170 digital troposcatter radio terminal set? 4 digital groups with 15 channels.

2. What is the RF bandwidth of the AN/TRC-170?
3.5 to 7 MHz

3. Describe the "multitrunking" capability of the AN/TRC-170. provision for connecting upto 4 radio terminal sets

409. TRI-TAC modems, restorers, and multiplexers

1. What is the function of the MD-1023 LSCDM?
provides interface

2. What is the function of the TD-1218 LSPR?
provides pulse regeneration

3. What is the function of the TC-1233 RLGM?
muxes up to 16 or 32 kbps channels

4. What is the output of a TD-1236 TGM?
balanced NRZ 12/4 Kbps to 4608 Mbps
super-group

5. What does the output of the TD-1237 MGM represent? 1,144 trafic channels.

410. The AN/TSQ-111 CNCE and TRI-TAC terminal equipment

1. What new concept does the AN/TSQ-111, CNCE, incorporate in the tactical environment?
systems approach

2. What TRI-TAC equipment offers centralized management and control of a communications node?
AN/TSQ-111 CNCE

3. What are the capabilities of the AN/UGC-137 SST?
capable of composing editing storing displaying refiling TXing RXing & monitoring

4. What is the function of the AN/UXC-4 TDF?
provides tactical digital fax capability.

1-4. 407L and TRI-TAC Technical Control Centers

Technical control is the nerve center for all communications within the Tactical Air Control System. Under use in the 407L system for many years, the AN/TSC-62A communications central has served as the technical control van through which all vital communications systems and links are monitored and controlled. Under the TRI-TAC program, the AN/TSQ-111 CNCE serves as a technical control center that runs under the systems control concept.

In this section, we investigate the characteristics and capabilities of both. No matter what type of TCF you work in, you must become totally familiar with what your test equipment can do, with patching facilities, and the characteristics of the communications circuits and systems your facility services. In the tactical world, though, you must also become, almost literally, intimately familiar with the nuts and bolts that hold your technical control van together. This indepth knowledge of your van is necessary because of the nature of the tactical environment. We start our discussion with the AN/TSC-62A.

411. The AN/TSC-62A van

AN/TSC-62A Communications Central. The AN/TSC-62A has two major groups: the communications central group and the environmental control group. The communications central group (technical control shelter) has (1) the installed test and conditioning equipment and (2) the operations equipment (one 12-line switchboard and two teletypewriters, each used as orderwire circuitry). The environmental control group has a 50/60 or 400 hertz (Hz) air conditioning unit, two storage boxes, and two air duct containers.

The shelter has four lifting eyes for hoisting, one at each upper corner. Also, four towing eyes can sustain an 11,000 pound load in any direction, one at each lower corner. Three aluminum skids under the shelter are used for towing the shelter; their primary purpose is to provide a dampening effect should the shelter accidentally be dropped.

The shelter is watertight, up to 21 inches above the skids, and it can be immersed in water at this depth for up to 2 hours. There are four leveling indicators, one at each corner of the shelter. They are used with the leveling jacks. The watertight shelter roof can support an ice load of 40 lbs per square foot.

Power entrance panel. A power entrance panel to the left of the van door, on the outside, provides all the entrance connections for power cables (fig. 1-28). The power cable terminations are as follows:

POWER INPUT 120/208 VAC 3 PHASE, 50/60/400 Hz 20 kW connector	Connects AC cable from generator set to shelter.
UTILITY OUTLET 120 VAC 50/60/400 Hz, 1 kW connector	Provides single-phase power connection for external use.
ECU POWER OUTLET 120/208 VAC 30/50/60/400 Hz connector	Connects AC cable from shelter to remote ECU.

ECU REMOTE CONTROL connector	Connects 17-pin cable from remote ECU control in shelter to remote ECU platform assembly.
GROUND terminal	Provides ground connection for shelter power circuits.

Power distribution panel. A power distribution panel inside, to the left of the van door, provides monitoring facilities for voltage, current, and primary power frequency. The panel also houses the van equipment and ECU circuit breakers.

Lighting. The lighting circuitry has five light fixtures mounted in the shelter ceiling and an emergency light mounted on the rear wall. The lighting circuit has a door interlock switch that may be overridden by an auxiliary blackout switch during nonblackout conditions. The blackout override switch must be set to ON during normal situations. The shelter lights are then controlled by the LIGHTS switch.

Under blackout conditions, a door interlock switch automatically extinguishes shelter ceiling lights the instant the shelter door is opened. When the shelter door is closed, shelter lights are controlled by the LIGHTS switch.

The emergency light in ARM-CHARGE position, illuminates if normal light circuits fail. Also, when the emergency light is in this position, the internal battery is being charged. In the OFF position, the emergency light function is disabled. In the TEST position, emergency light functions are tested for proper operation.

External signal connector. The 62A has 60 external 407L cable hocks in the signal entrance panel, divided into four parts: panels 1, 2, 3, and 4. Each have 15 hocks hard-wired to terminal boards under patch panel racks 1A7 through 1A10. Twelve terminal boards are under each of the four racks, six on each side. The first five are wired to external hocks, the sixth being a "blind" (no patch panel appearance) terminal board hock.

412. Electrical equipment racks of the AN/TSC-62A van

The communications equipment of the AN/TSC-62A van is mounted in nine standard electrical equipment racks installed in bays along the roadside (left) and curbside (right) shelter walls. The racks are designated as rack assemblies 1A2 through 1A10. Rack assemblies 1A2 through 1A5 are

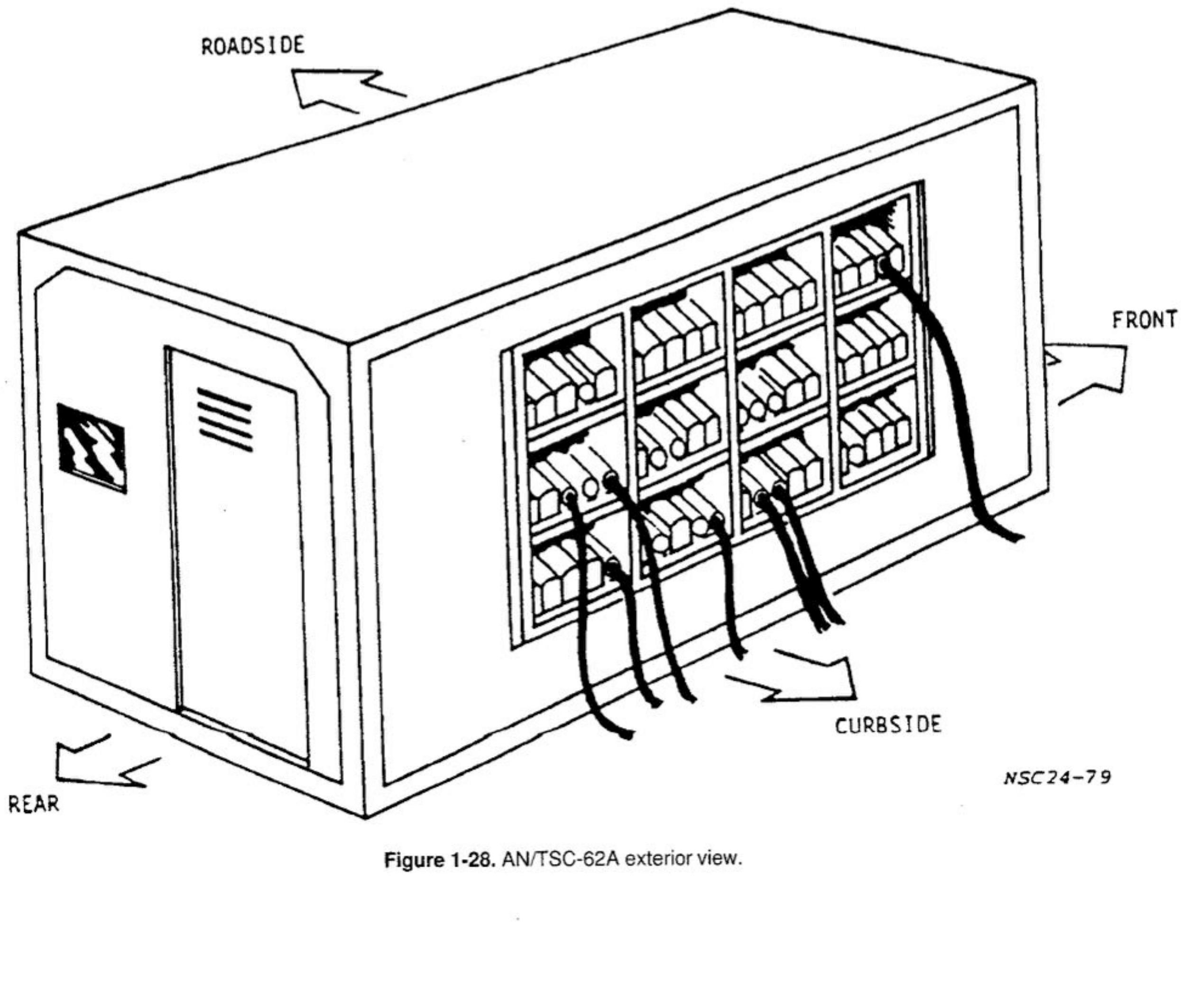


Figure 1-28. AN/TSC-62A exterior view.

along the roadside wall, and 1A6 through 1A10 along the curbside wall. As you study each rack assembly, refer to figures 1-29 and 1-30 for clarification.

Rack Assembly 1A2. This rack has space for remote monitoring units and auxiliary equipment. It also has a binding post assembly and order wire switchboard. Four spaces are provided for HF-ISB remote monitors (OK-145) and two spaces for tropospheric remote monitors. The binding post assembly provides 52 field wire binding posts for 26 line pairs. The binding posts are accessible for immediate connection to each remote monitoring unit mounted in the rack and are wired to the main distribution frame for connection to assigned circuits.

The auxiliary equipment space has three shelves spaced 8 inches apart. Each shelf space has a 24-pair terminal block wired to the combined distribution frame and power receptacles. The order-wire switchboard is part of the voice orderwire system providing access to 12 two-wire voice lines terminating at the technical control facility.

A telephone set (TA-312) is mounted on the side of rack assembly 1A2, where the operator at the coordinator's desk can reach it. The telephone is used with telephone order-wire circuit number one, which is one of two TA-312s used as voice order wires.

Rack Assembly 1A3. 1A3 has audio test equipment, three 48-volt power supplies, and a fuse panel. The following assemblies are also in rack assembly 1A3: strappable attenuators, TTY signal mixer and branching amplifiers, 2-wire/4-wire terminating sets, isolation and bridging transformers, amplifier/delay equalizers, a Hekimian 41-01 test set, and Hekimian 3901 communication test system. This equipment provides a centralized facility for doing routine testing and evaluation of the required facility power.

Rack Assembly 1A4. Rack assembly 1A4 has test equipment associated with testing DC teletype circuits and VF signal equipment. Included in this rack is a multimeter panel, signal converter and termination units (STU-1 and 5Ms), page printer keyboard, line amplifiers, and 4-way/4-wire bridges.

Rack Assembly 1A5. Rack assembly 1A5 has the HF radio monitor equipment, the VF tone keyer/converter equipment, a page printer keyboard, a speech plus teletype filter panel, and a storage drawer.

Rack Assembly 1A6. This assembly has a data analysis center (DAC-8), isolator bypass panel, DC series patch panel, miscellaneous patch panel, two line-isolator assemblies, 60-volt power supplies, and one storage drawer. These assemblies are a part of the DC patching facility that provides complete control of eight full duplex teletype circuits.

Rack Assembly 1A7. This assembly has a DC meter panel, two radio transceiver patch panels, a DC patch panel, a DC (VF) test and miscellaneous patch panel, a signal converter and miscellaneous patch panel, and distribution terminal blocks.

Rack Assembly 1A8. This assembly has seven patch panels and 12 distribution terminal blocks. The patch panels have line, equipment, and monitor jacks for 84 send-receive tropospheric tone circuits and 60 high-frequency radio circuits. There are patch panel jacks for inputs and outputs of the TTY mixing and branching amplifier, VF audio appearances, interbay trunks, miscellaneous equipment, and audio testing.

Rack Assembly 1A9. Rack assembly 1A9 has seven patch panels and 12 distribution terminal blocks. The patch panels have line, equipment and monitor jacks for 144 send-receive tropospheric voice circuits, jacks for 2w/4w signal converters (STU-1), line attenuators, telephone orderwire circuits, interbay trunks, miscellaneous equipment, and audio testing.

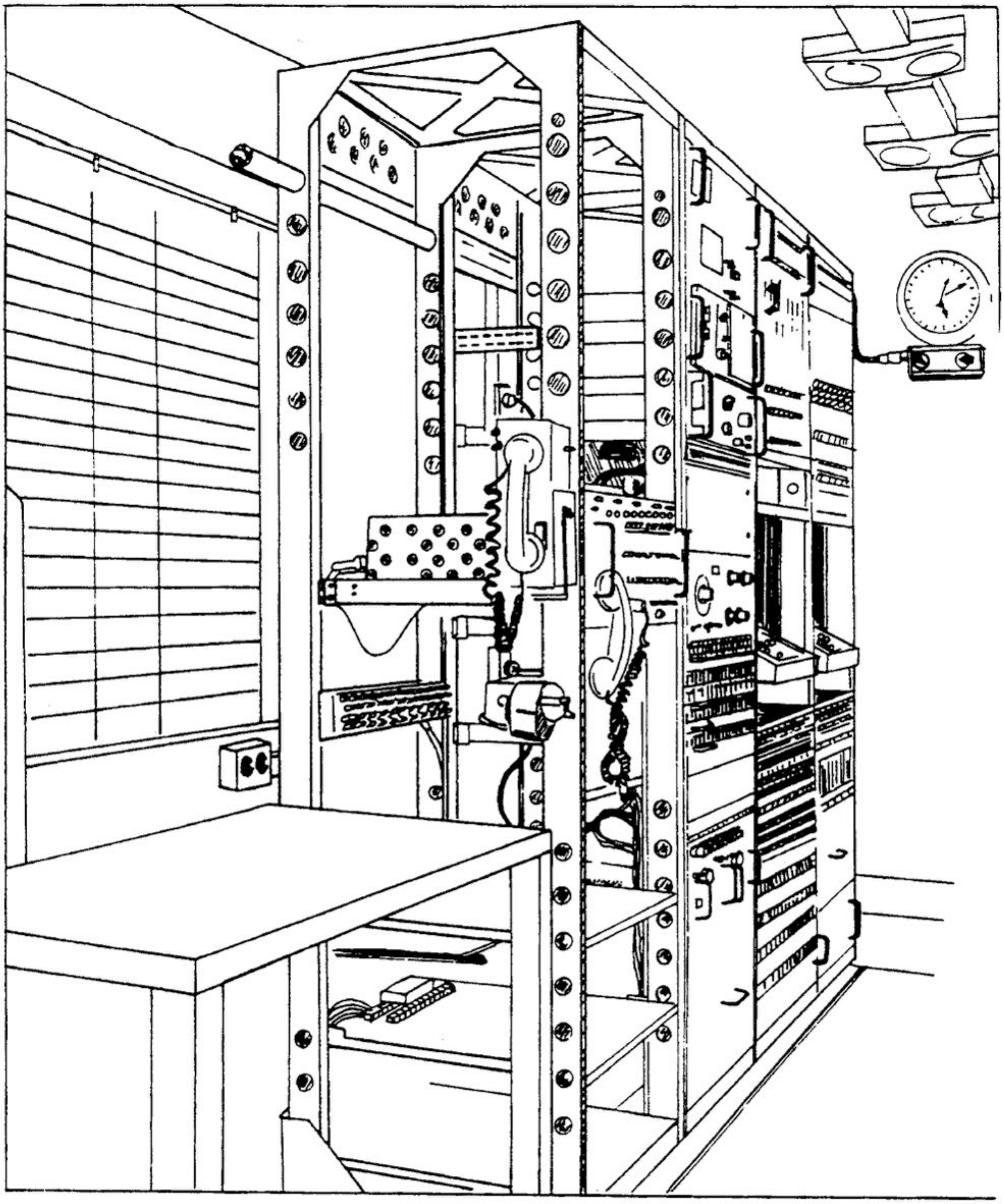
Rack Assembly 1A10. This last rack assembly has seven patch panels, a telephone set (TA-312), and 12 distribution terminal blocks. The patch panels have line, equipment, and monitor jacks for 24 send-receive tropospheric voice circuits and 108 high-frequency radio voice circuits, jacks for interbay trunks, miscellaneous equipment, audio testing, line amplifiers, and for STU-1 signal converters. A TA-312 is mounted on the side of the rack assembly and is used with the TCF order-wire circuit number 2.

From the preceding description of the rack assemblies of the AN/TSC-62A, you can see the tremendous technical control ability built into a very small van. The importance of becoming fully acquainted with the entire facility cannot be overemphasized.

413. Patching capabilities of the AN/TSC-62A van

Analog (VF Tone) Patch Jack Field. The analog (voice frequency tone) patch jack field provides a means for the control, routing, monitoring, and testing of 144 send and receive voice frequency tone lines. The jack fields have send and receive line and equipment jacks and send and receive line and equipment monitor jacks. The send and receive line and equipment jacks provide normal-through connection, via the distribution frames, between input and output signal entrance connectors.

Associated with the audio (VF tone) patch jack fields are jack fields for weather netting equipment, teletype, facsimile branching amplifiers, a VFTG audio system, and a filter system. The weather netting equipment includes a teletype signal mixer that accepts a teletype signal from any one of four distant terminals, retransmits the signal to distant terminals through a teletype branching amplifier, and provides an output to a local teletypewriter. The facsimile branching amplifier accepts a voice-frequency facsimile signal from a single source and simultaneously retransmits the signal to four local or distant terminals over separate transmission channels.



TG-A319

Figure 1-29. AN/TSC-62A left interior view.

The VFTG system has tone keyers and converters for 16 full-duplex teletype circuits. The filter system allows the use of any three of the 16 tone circuits to provide four-wire speech plus full-duplex telegraph operation.

Analog (Voice) Patch Jack Field. The analog (voice) patch jack field provides a means for the control, routing, monitoring, and testing of 276 send and receive voice lines. The jack field has send and receive line and equipment jacks and send and receive line and equipment monitor jacks. The send and receive line and equipment jacks provide normal-through connection, by the distribution frames, between input and output signal-entrance connectors.

A patch panel near the audio (voice) patch jack field has jacks for access to the inputs and outputs of the signal converter termination units, 4-way/4-wire bridges, equalizers, and telephone order wire equipment. The signal converter and termination units provide signal termination for 20 two- or four-wire circuits (4 STU-1s and 16 STU-5s). The telephone order-wire equipment has two TA-312 telephone sets and a two-wire/four-wire terminating set that allows use

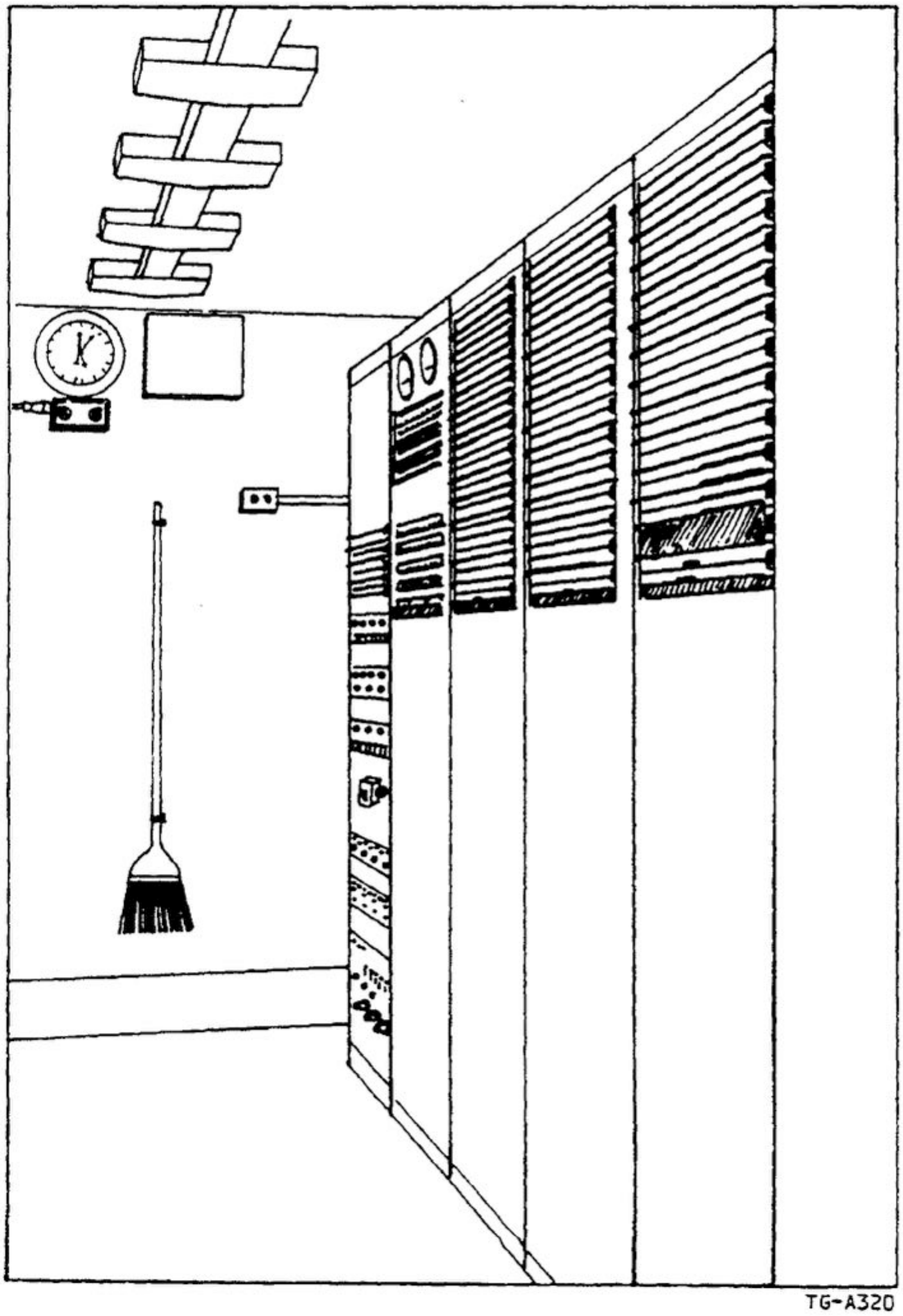


Figure 1-30. AN/TSC-62A right interior view.

of the telephone sets for either two- or four-wire circuits. Six 4-way/4-wire bridges offer a conference ability for four 2-way audio circuits.

Termination of line and equipment circuits is provided by 600 ohm terminating resistors in the line and equipment patch jacks. Thus, inserting a patch cord into a line jack automatically connects a terminating resistor across the equipment. Conversely, inserting a patch cord into an equipment jack connects a terminating resistor across the line circuit.

DC Patch Jack Field. The DC patch jack field provides a means for controlling, routing, monitoring, and testing the full-duplex teletype and data circuits serviced by the TCF. The jack field consists essentially of FDX LINE-ISOLATOR circuits.

Line isolator circuits isolate (removing common grounds) or convert incompatible DC teletype signals to those normally used by site equipment. Eight line-isolator assemblies in rack 1A6 can provide isolation for eight full-duplex teletype circuits. Associated with each full-duplex teletype circuit is a line-isolator that can be bypassed. There are 24 isolator bypass switches.

Miscellaneous Equipment Patch Jacks. An assortment of equipment patch jacks facilitate testing and conditioning of circuits in the AN/TSC-62A. The jacks and their locations in the van are discussed here.

Line termination circuits. Six 600-ohm line termination circuits are in the TCF. For convenience, two circuits are available at the miscellaneous 600-ohm jack strip on three patch panels at the VFTG and filter patch panel in rack 1A8 and at the miscellaneous trunk patch panel in rack 1A10. A 600-ohm resistor between the tip and ring contacts of each jack circuit provides the necessary terminating impedance during patching operations.

Audio mixing pad circuits. Two audio mixing pads mix VF signals. Each mixing pad accepts two VF signals and combines them into a single output. When connected to two 600-ohm signal sources, a 600-ohm impedance match is maintained at the output. Jack appearances for the mixing pad jack are in rack 1A9.

Fixed attenuator pad circuits. Ten fixed attenuator pads are in the audio patch facility: four 5-dB pads and two each 10, 15 and 20 dB pads. Each pad, when patched into a VF signal line, introduces an exact signal loss. The fixed attenuator pads have jack appearances in racks 1A9 and 1A10. Input and output impedance is maintained at approximately 600-ohm.

60-volt battery test jack circuits. Plus or minus 60-volts DC from a 60-volt power supply is available at jack appearances for DC testing purposes. Four test circuits are provided, each terminating at the 60-volt battery test jacks and the 2,500-ohm ground jack in rack 1A7. Cross-connections between jacks and the power supply circuit are made at terminal boards in rack 1A7.

Test trunk circuits. Eight normal-through test trunk channels facilitate equipment interconnections. Each channel has two parallel-connected jacks. One end of the eight channels terminates at the "test ckts-test trunk" jacks in rack 1A3. At the other end, two channels terminate at the miscellaneous test trunk jack in rack 1A8; three terminate at the miscellaneous trunk jacks in rack 1A9; and three terminate at the miscellaneous test trunk jacks in rack 1A10. A signal inserted into any one of the test trunk jacks at rack 1A8, 1A9, or 1A10 appears at the corresponding test jack in rack 1A3.

Interbay trunk circuits. Forty-eight interbay trunk jacks are in rack 1A8, 1A9 and 1A10. Jacks in rack 1A8 are connected in parallel to corresponding jacks in racks 1A9 and 1A10 for connectivity between the racks.

Multiple jack circuits. Seven multiple jack channels further facilitate equipment interconnections. Each channel has four parallel-connected jacks. Multiple jacks 1 through 3 are in rack 1A7, 4 through 6 in rack 1A9, and 7 in rack 1A10. A signal inserted in one multiple jack appears at the other three corresponding jacks.

External Connectors. Four signal entrance panels are on the curbside of the AN/TSC-62A van. Each panel has 15 (26 pair) cable connectors. Type 407L quick disconnect cables interconnect the van with its associated subscribers and link (radio) equipment.

Internal Wiring. Each cable connection on the outside of the van is wired internally to terminal blocks appearing in racks 1A7, 1A8, 1A9, and 1A10. All 60 cable connections are clearly labeled "j1" through "j60". To make patch panel cross-connects from patch panel to patch panel, wiring is done on the mainframe left block and equipment pins. The right terminal blocks are factory-wired to the side cable connectors.

414. Standard test equipment used in the AN/TSC-62A van

R-1555 Racal Receiver. This is a solid-state general-purpose receiver that can receive signals with amplitude modulation (AM), frequency modulation (EM), modulated continuous wave (MCW) and single-sideband (SSB), over a frequency range of 980 kHz to 30 MHz.

The receiver has a single, rack-mounted chassis with front panel controls for operating the unit's signal input and output appearances. A 16-VDC output and an antenna connection are on the rear of the AN/TSC-62A shelter.

The racal receiver is commonly used to monitor RF signals to ensure that local radios are transmitting or that distant end radio frequencies can be received. If absolutely necessary, it can be used to receive an HF/SSB duplex circuit.

SG-815 Standard Tone Generator. The SG-815 tone generator has audio test frequencies of 1,004 and 2,600 Hz at an output level of 0 or –4 dBm. It has 12 audio output appearances, six for 1004 Hz and six for 2,600 Hz outputs. The full 12 outputs appear on patch panel 1A3. Two associated patch jack appearances of each frequency appear on patch panels 1A8, 1A9, and 1A10 on the miscellaneous test trunk jacks.

VU Meter and Speaker Amplifier. The VU meter and speaker amplifier assembly has a VU meter, an audio amplifier, and a loudspeaker. The VU meter is used to measure audio signal volume levels in telephone transmission circuits and in other areas where precise monitoring over the audio range is required, The amplifier and speaker are used for monitoring audio circuits.

Hekimian 4101 Test Set. The 41-01 transmission test set measures levels, noise, and frequency. The set also transmits frequencies at different levels.

Hekimian 3901 Test System. The 3901 communication test system assembly is a complete transmission line test set. It measures frequency response, envelope delay, noise, phase jitter, nonlinear distortion, phase hits, gain hits and dropouts, and three levels of impulse noise. Outputs are provided for CRT, XY plotter, and an events counter.

Data Analysis Center (DAC-8). The DAC-8 is a four-section test unit that has a distortion analyzer, oscilloscope, time base generator, and test pattern generator. Except for the oscilloscope, jacks for the DAC-8 appear in racks 1A6 and 1A7. Connections for the oscilloscope are made internally from the inputs to the analyzer.

DC Meter Panel. The DC meter panel has a milliammeter and voltmeter. The milliammeter is wired to a jack in rack assembly 1A6 where it can be patched into the desired circuit. The voltmeter may be switched across the –48, +60, and –60 volt power supplies, or to a jack in rack assembly 1A7, by a front panel switch. The milliammeter is zero-centered with a full-scale sensitivity of 100 milliamperes. A button on the front panel allows selection of a high-sensitivity, full-scale deflection of 50 milliamperes. The voltmeter is zero-centered with a full-scale deflection of 150 volts. A button on the meter allows selection of a high-sensitivity, full-scale deflection of 15 volts.

The equipment we have discussed in this lesson makes up the primary test equipment available to you in the AN/TSC-62A TCF. Methods and procedures for use of test equipment in a 62 van are not too unlike those used in any other TCF. If your station's training program does not offer step-by-step instructions and detailed information on a particular piece of test equipment, consult the technical order (TO) for that piece of equipment.

415. Circuit conditioning equipment used in the AN/TSC-62A van

TU-1819 Line Isolation Unit (LIU). An LIU is used on DC teletype circuits to convert or to isolate the in-station from the out-station battery. All in-station user keying is :±60V 20 mA high level polar. The four modes of operation of the LIU make an incompatible out-station signal compatible with the in-station signal.

When LIUs are at each end of a communications link, they also can be used to key a radio from a distant location. The radio can be any variety, as long as it is set up for ground keying. The procedure involves converting the loop closure into a low-level polar signal in the LIU. The polar signal is then connected to a tone keyer, which converts the signal to an audio 1,275 narrowband FSK tone. The tones are then patched over a transmission system to the remote location, where the process is reversed.

Tone Keyers. The tone keyers provide tone sources for the send circuits of the 16 full-duplex teletype circuits. The DC inputs to the tone keyers appear at jacks in rack assembly 1A7. The audio outputs are in rack assembly 1A8.

Tone Converters. The tone converters provide tone conversion for the receive circuits of the 16 teletype circuits. Audio tone inputs appear at jacks in rack assembly 1A8. The DC outputs appear in rack assembly 1A7.

Stelma LA-1 Line Amplifier. The line amplifier assemblies permit adjusting VF channel levels to compensate for line, equipment, or transmission losses. Front panel monitor jacks and controls allow gain to be adjusted over a -10 to +35 dB range. Line amplifier jack appearances are in racks 1A7 and 1A10. Input and output impedances may be strapped for 600 or 900 ohms balanced.

Four-Way/Four-Wire Bridge. The four-way/four-wire bridge circuits provide the capability of interconnecting four each four-wire full-duplex voice frequency circuits. Each input provides an individual transmission path to all associated users. Each bridge circuit can disable side tones by a strap option. Jack appearances for the bridges are in rack 1A7.

As with the test equipment of the 62 van, its circuit conditioning equipment is similar to that found in most "fixed" TCFs. You may, though, find the circuit conditioning techniques used in the tactical environment to be somewhat different from those of the fixed facility.

An old TACS "war" story compares the acceptance QC procedures of a DCS AUTOVON technical controller with those of a deployed TACS technical controller. Having determined to accept a new voice circuit, the AUTOVON troop holds the QC order wire in one hand while studying the test results on the desk, presses the talk button, and softly says, "It looks like we're out at 2K by .1dB. But, I guess that's close enough for Government work. Let's call it good at this time."

The TACS troop, trying to make the same determination, picks up order wire, presses the talk button, whistles as loudly as possible, and screams at the top of his lungs, "H-e-e-e-e-y! Can you hear me?"

416. Operations equipment of the AN/TSC-62A van

SB-3260 Manual Telephone Switchboard. The SB-3260 is a rack-mounted, 12-line order-wire switchboard. It is a "cordless" unit for operator-controlled intercommunication between two-wire telephone circuits. A call indicator lamp lights and an audible alarm sounds when the SB-3260 detects an incoming ring. It connects calls through the use of toggle switches.

TT-588 Teletype Order Wire. The TT-588 teletype order wires are in racks 1A4 and 1A5. They are made up of three basic associated equipment parts: electrical service unit, page printer/keyboard, and frequency converter and motor control unit.

This order wire is commonly used for unsecure intra/intersite communications between technical control and servicing units. The TT-588 teletype order wire can be interfaced with a bridge for multiuser communications.

Electrical service unit (ESU) assembly. The ESU supplies AC power to the page printer/keyboard and to the frequency converter and motor control assembly. It provides current overload protection to these units, controls and operates mode of page printer/keyboard, interfaces the KSR-PTR and KSR-KBD jacks on patch panel 1A7, and connects the TTY polar signals developed by the keyboard generator contacts to the KSR-KBD jack and motor control unit.

Page printer/keyboard (KSR model 28). The appearances for the two KSR model 28s are on patch panel 1A7, with the jack labeling of KSR-KBD, KSR-PTR. The KSR-KBD jack provides an output connection for the keyboard generator contacts. The KSR-PTR jack provides a connection to the printer. The -60V DC power supply inputs high-level polar voltages to the keyboard generator contacts. These voltages develop into positive (mark) or negative (space) TTY signals. These signals have operational speeds of 45.45, 50, or 75 baud (65, 71, or 107 WPM).

Frequency converter and motor control unit. This unit has a frequency converter unit and a motor control unit. The motor of the page printer/keyboard stops automatically after a predetermined interval of 2 to 5 minutes idle. The motor starts again automatically after the receipt of a signal.

Modes of operation. The printer/keyboard can operate half-duplex (HDX) or full-duplex (FDX). This function is controlled by a mode switch on the front of the ESU. The TTY signals applied through this mode switch also are relayed through the frequency converter and motor control unit.

417. System applications and capabilities of the AN/TSQ-111 communications nodal control element (CNCE)

CNCE Applications. The AN/TSQ-111 is designed to coexist with current combat arena analog and digital switching and subscriber terminal facilities. The CNCE can be configured to receive, condition, and retransmit analog data; or the technical controller can convert the analog data to digital using continuous variable-slope delta (CVSD) encoders and transmit it to the user terminal for decoding back into analog.

The CNCE accommodates many variations of equipment needs. It can accept inventory Army Tactical Area Communications System (ATACS) 6-bit, pulse-code modulation (PCM) group data, comingle this data with TRI-TAC channels to form a TRI-TAC group, and send the combined group of channels over a TRI-TAC transmission system.

The CNCE also replaces, through attrition, large quantities of obsolete, out-of-production analog equipment still in active inventory, including:

a. AN/TSQ-84 analog technical control shelter.

b. AN/TCC-72 multiplexer shelter.

c. AN/TCC-65 multiplexer shelter.

d. AN/TCC-73 multiplexer shelter.

e. AN/TSC-62A analog technical control shelter.

f. AN/MSC-32 planning and engineering shelter.

g. AN/MSC-31 planning and engineering shelter.

The CNCE's compatibility with both analog and digital equipment helps ensure a smooth transition from the predominantly nonsecure, labor-intensive manual analog systems of the past to the digital systems of the future.

This increased compactness means that when a CNCE is deployed at a major node, the battlefield footprint for the technical control function is considerably reduced (fig. 1-31). The number of operations and maintenance people and their support requirements are correspondingly reduced.

System Capabilities. In the past, technical control equipment has been provided only for the critical nodes of a network. With limited capabilities for doing conventional technical control functions, controllers typically:

a. Depend primarily on user complaints for detection of faults.

b. Determine message quality by voice testing of circuits.

c. Troubleshoot circuits with manual test instruments.

d. Collect, via voice and TTY order-wire, the small amount of performance and status data obtained.

e. Have only limited methods of predicting pending failures.

f. Do all patching and rerouting with manual patch panels.

g. Keep all records and files on hard copy.

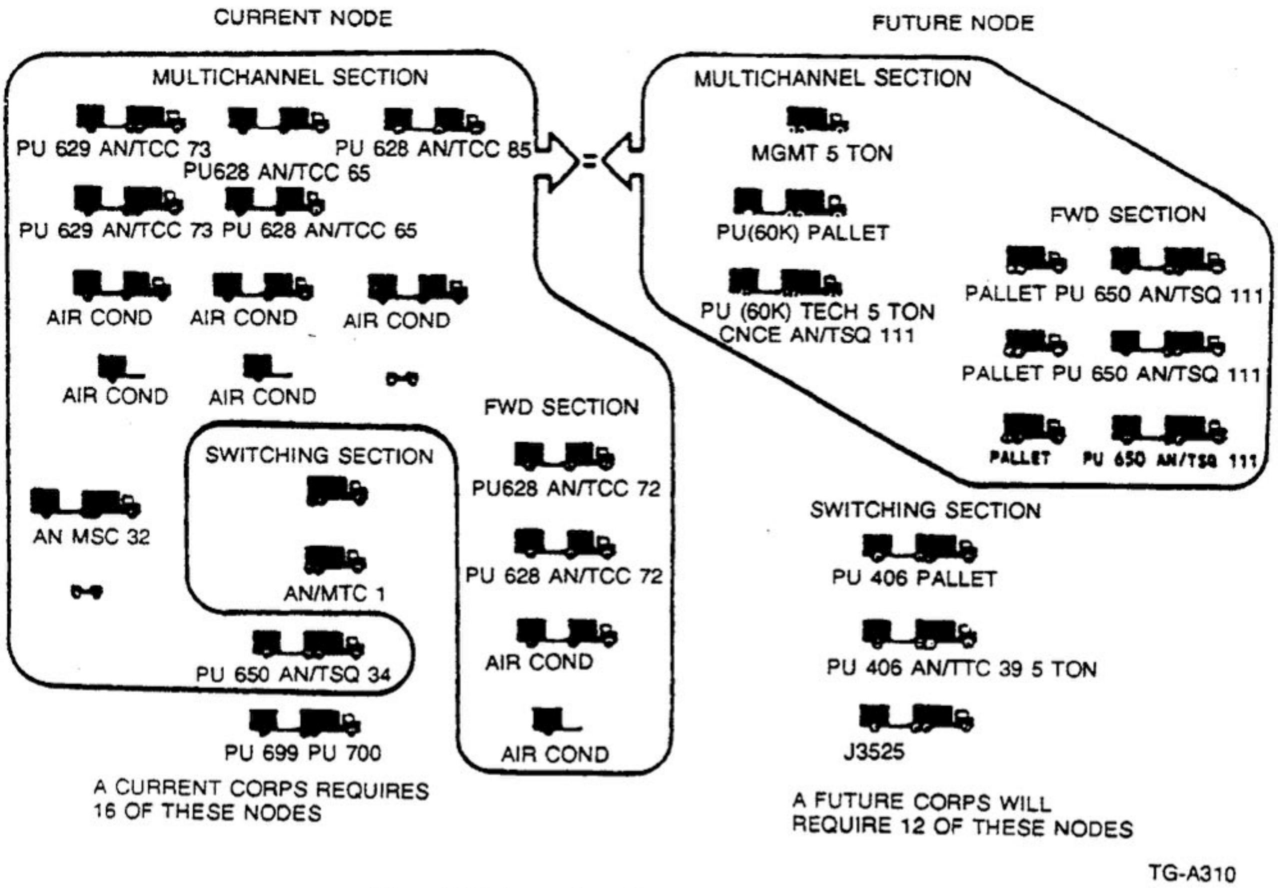


Figure 1-31. Comparison of current and future nodes.

As shown in Table 1-1, CNCE corrects these deficiencies while enhancing the overall communications system capabilities by providing:

a. Automatic fault detection and isolation.
b. End-to-end security.
c. Interoperability among hundreds of equipment types.
d. Improved data transmission,
e. Uninterrupted service.

418. Functional characteristics of the AN/TSQ-111 technical/management shelter

This shelter is configured for handling digital and analog transmissions (fig. 1-32). Power conditioning and environmental control equipment for the shelter are on an equipment pallet.

Technical Shelter. The CNCE provides the means to do the technical functions required of an analog and digital tactical communications facility. It has a console rack, processor rack, digital equipment rack (RED), COMSEC rack, analog patch facility, test and DGM rack, line conditioning rack, digital equipment rack (BLACK), DGM rack panel, signal entry panel, and power distribution panel (fig. 1-33).

Management Shelter. The AN/TSQ-111 CNCE is at the hub of a node's communications activity. Almost all of the nodal communications traffic either passes through and is processed by the CNCE or is acted on by the management functions of the CNCE. The CNCE's activities fall into two categories:

Functions that support nodal management and control. This group includes data-processing-assisted record-keeping, nodal health assessment, circuit and group testing, channel reassignment, internal fault isolation, and controller communications.

Functions directly related to communications traffic flow. These include all subsystems needed to handle communication transmissions through the network.

The CNCE is configured so that, if the processor or other support functions fail, traffic flow continues without interruption. It provides manual backup through control panel entry for such critical, processor-assisted functions as analog and digital testing, channel reassignment, and internal fault detection.

TABLE 1-1
COMPARISON-CNCE CAPABILITIES TO AN/TSC-62A

FUNCTION	AN/TSC-62A	CNCE AN/TSQ-111
LINE CONDITIONING	YES	YES
ANALOG CIRCUIT TEST	MANUAL	AUTOMATIC/MANUAL BACKUP
DIGITAL CIRCUIT TEST	NONE	AUTOMATIC/MANUAL BACKUP
ANALOG/DIGITAL INTERFACE	NONE	A/D - D/A CONVERSION
PATCHING		
ANALOG	MANUAL	MANUAL
DIGITAL	NONE	AUTOMATIC
MULTIPLEXING	NONE	DIGITAL, SUBCHANNEL, CHANNEL, GROUP, TELEMETRY
FAULT DETECTION/ISOLATION		
SHELTER	MANUAL	AUTOMATIC
NODAL	MANUAL	AUTOMATIC
NETWORK STATUS REPORTING	MANUAL	AUTOMATIC
DATA STORAGE & ACCESS	MANUAL	DISK, TAPE, VDU, HCP
RECORDS STORAGE & ACCESS	MANUAL	DISK, TAPE, VDU, HCP
SECURITY DEVICES	NONE	PARKHILL, VINSON, SEELEY

419. Major support and traffic functions of the AN/TSQ-111

The CNCE functions primarily to provide an interface between transmission facilities and users and to manage communication resources at a node. The CNCE support and traffic functions that interface with transmission and user nodal elements are shown in figure 1-34. The major support and traffic functions of the CNCE are to provide:

- Signal interface.
- Diagnostics ability.
- Channel reassignment.
- Command relationships.
- Equipment load ability.
- Reconfiguration ability.

Signal Interface. Controller communications are of paramount importance (fig. 1-34). Between the signal interfaces are the voice and data order-wire signals CNCE technical controllers use to determine network status and to coordinate activities. Other interface signals are traffic and test monitor signals. Traffic signals consist of loops, digital groups, and supergroups used for subscribers and transmission. The test and monitor signals provide circuit monitoring and fault isolation for the TACS.

Diagnostics Capability. The CNCE can automatically assess its own operational status and the operational status of its assigned nodal equipment and transmission links. Status information from transmission status messages, transmission link and circuit tests, fault monitoring and reporting, and manually-generated data are used in the assessment process. When the assessment process shows that system or equipment performance is in a degraded or failed mode, the status information provides enough information to permit fault isolation:

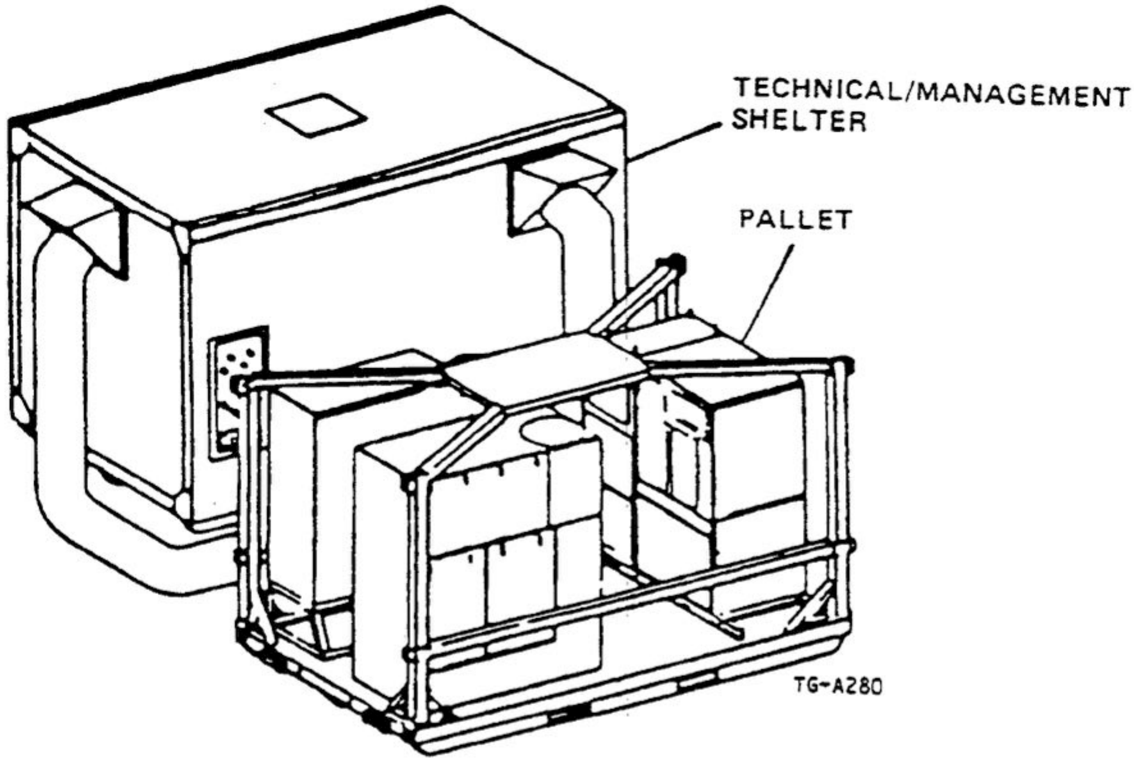


Figure 1-32. CNCE technical/management shelter (outside).

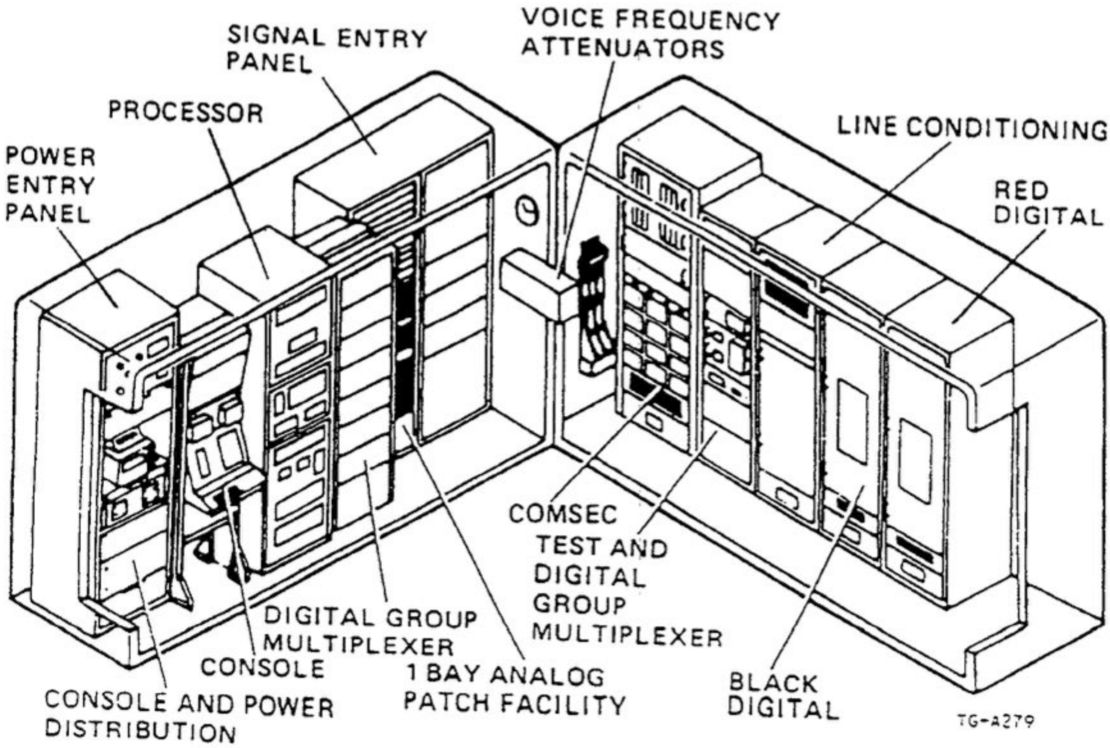


Figure 1-33. CNCE technical/management shelter (inside split view).

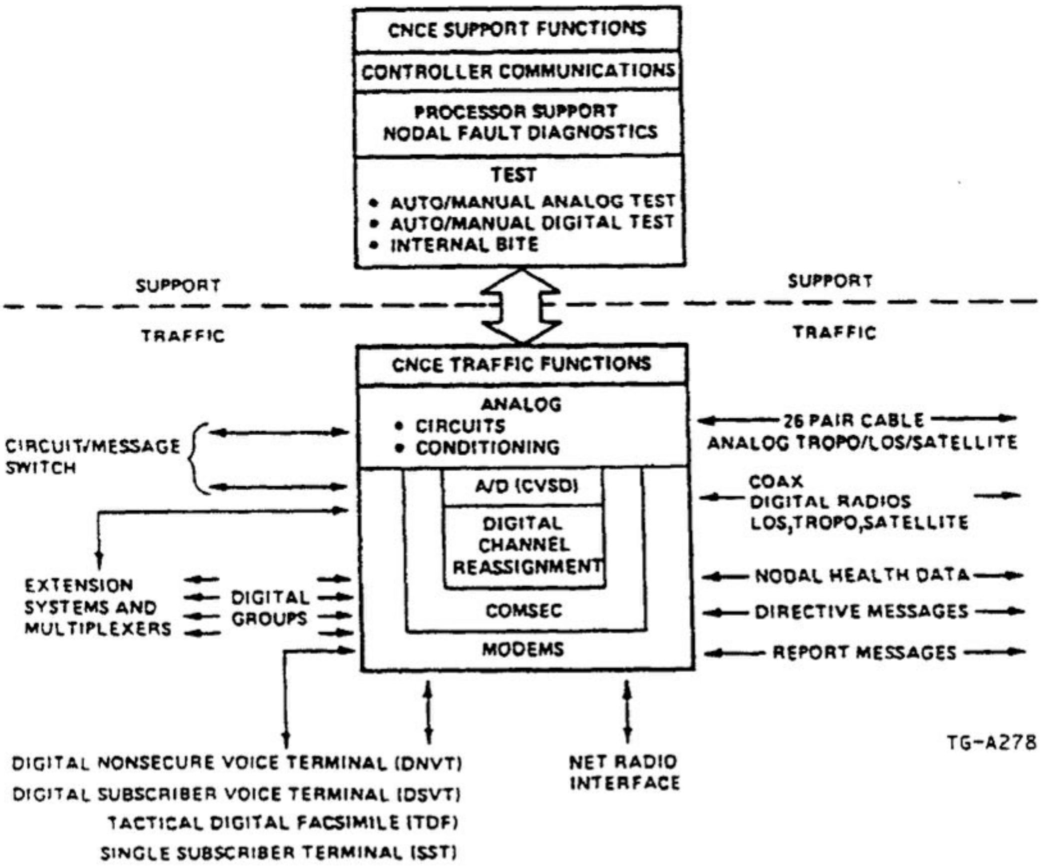


Figure 1-34. CNCE major functions.

a. In or beyond a radio frequency path.

b. At the radio park (the radio complex of transmission equipment).

c. In the transmission link between the radio park and the CNCE.

d. In the CNCE shelter.

e. In the cable between the CNCE and the switching center. To the switching center.

The CNCE status information, including information on CNCE equipment failures and transmission subsystem performance degradation, is summarized for display and reporting. Major and minor alarms signify the existence of a degraded or failed condition. Status displays on the VDU permit the CNCE operator to identify the problem and start further tests or corrective action. The CNCE allows the technical controller to conduct manual tests to augment the CNCE's automatic test ability. The manual capability is provided by standard manual test equipment furnished to the CNCE shelter and by either manual or semiautomatic operation or by automatic test equipment. The technical controller can access and monitor, for test purposes, each analog circuit and digital group routed through the CNCE. It is possible to monitor analog channels and digital groups at all conditioning equipment interfaces.

Channel Reassignment. The CNCE can process digital groups so that the bit positions occupied by specific channels or sets of channels in incoming data streams occupy specific bit positions in outgoing data streams, as determined by the operator. The channel reassignment function (CRF) accepts multiple groups at a dozen different rates and in single channels and subchannels for routing purposes. It can be configured to handle from 2 to 48 groups (hardware-expandable to 56 groups), 9 to 1,536 channels, and 8 to 1,536 subchannels.

In addition to routing channels and subchannels, the CRF establishes and maintains synchronization for each group. It also monitors the framing signal of each group for errors and the condition of its own buffers with a signal to the processor every 0.5 seconds. The digital groups are terminated at distribution frames within the CNCE, where they are available for possible connections to internal CNCE equipment or to external circuits.

Control of the CRF is managed through either of two modes: processor (automatic) or manual. Under processor control, the entire CRF, modular blocks, or single channel or subchannel memory locations can be loaded or read. Manual control is used to do single channel and subchannel routing.

Command Relationships. The CNCE exercises management and technical control over its associated subordinate activities and coordinates with other CNCEs. In the hierarchy of control levels, it functions as the nodal manager and the point of interface between the transmission subsystem and switching subsystem, interfaces users with the system, and has the physical, electrical, and workforce capabilities to do these functions.

The CNCE is the point of electrical interface between component, joint, and other communications systems. It is located at selected nodes based on density, complexity, and configuration requirements. A node is a communications complex characterized by the presence of one or more of the following functions: access switching (high subscriber density), trunk switching (low subscriber density), group breakout, back-to-back repeaters, or satellite terminal. It provides transmission system performance information and directs the appropriate subordinate activities to assure optimum system efficiency, continuity of service, and trouble correction.

Technical direction extends from the CNCE to its subordinate activities. Technical coordination must exist between adjacent CNCEs to assure effective system routing/rerouting implementation, fault isolation, and quality control monitoring and testing.

Equipment Load Capability. The number of nodal elements assigned to each CNCE is limited by the processor capability and its associated data bus controller (DBC). The processor subsystem can manage the inputs of up to four AN/TTC-39 message switches, one AN/TYC-39 store and forward (S&F) module, four nonprocessor-equipped type I CNCEs, and 40 telemetry reporting sources.

Reconfiguration Capability. The patch and test subsystem of the CNCE provides the capability to control, route, monitor, test, and patch all circuits serviced by the CNCE. This subsystem has two major facilities: the analog patch facility and the digital signal monitoring and processing facility.

The signal entry and distribution provision has a communications entry panel (CEP), a main distribution frame (MDF), a combined distribution frame (CDF), and an intermediate distribution frame (IDF). The MDF provides the means for terminating and interconnecting external circuits with CNCE equipment and patching facilities. The CDF provides the means for interconnecting analog and DC telegraph circuits on the MDF to circuit patching facilities, conditioning equipment, and other miscellaneous equipments within the CNCE. The IDF provides the means for interconnecting digital circuits.

All circuit identifiers, such as jack strips, test points, and panels, readily identify a circuit to the operator and are easily changeable. The patch facility is configured to prevent the inadvertent patching or cross-connecting of adjacent sides of colocated circuits. Each circuit can be monitored on both the line and equipment sides of the circuit. Circuits can be grouped by media, link, and multiplex location.

The configuration and locations of the distribution frames provide immediate access to all incoming and outgoing signals. The configuration and solderless connection (point-to-point) technique provides the capability to do all cross-connects needed to use the maximum circuit configuration capability of the shelter within 8 hours.

420. Major subsystems functions of the CNCE

Modular Design. The CNCE is modular to fit a wide variety of nodal equipment configurations. The major subsystems of the CNCE (fig. 1-35) are:

a. Analog patch and test subsystem.
b. Digital signal monitoring and processing subsystem.
c. Fault detection subsystem.
d. Processor subsystem.
e. Control subsystem.
f. Control communications subsystem.
g. Timing subsystem.
h. COMSEC subsystem.
i. Facilities subsystem.

A brief description of each subsystem is given here. More detail on the applications of these subsystems is in the sections that follow this overview.

Analog Patch and Test Subsystem. The analog patch and test equipment provides manual patching, line conditioning, automatic analog testing (AAT), manual testing, monitoring, and routing of all analog circuits.

Digital Signal Monitoring and Processing Subsystems. The digital signal monitoring and processing equipment provides line modems, manual patching, automatic patching (channel reassignment function (CRF), and automatic digital testing (ADT) of all digital circuits.

Fault Detection Subsystem. The processing of internal test equipment data, telemetry fault and performance data, switch status report data, AAT test results, ADT test results and channel reassignment status to detect and isolate faults in the CNCE, and other nodal equipment are provided by the fault detection subsystem.

Processor Subsystem. The processor subsystem processes and stores data; controls automatic testing, automatic patching, fault detection, and isolation functions; and provides processing for controller interface with the data base.

Control Subsystem. The control subsystem supplies the entry controls and display devices for the human/machine interface between the controller and the processor subsystem.

Control Communications Subsystem. The control communications subsystem provides intercom and analog voice, digital voice, teletype, and data order-wire facilities

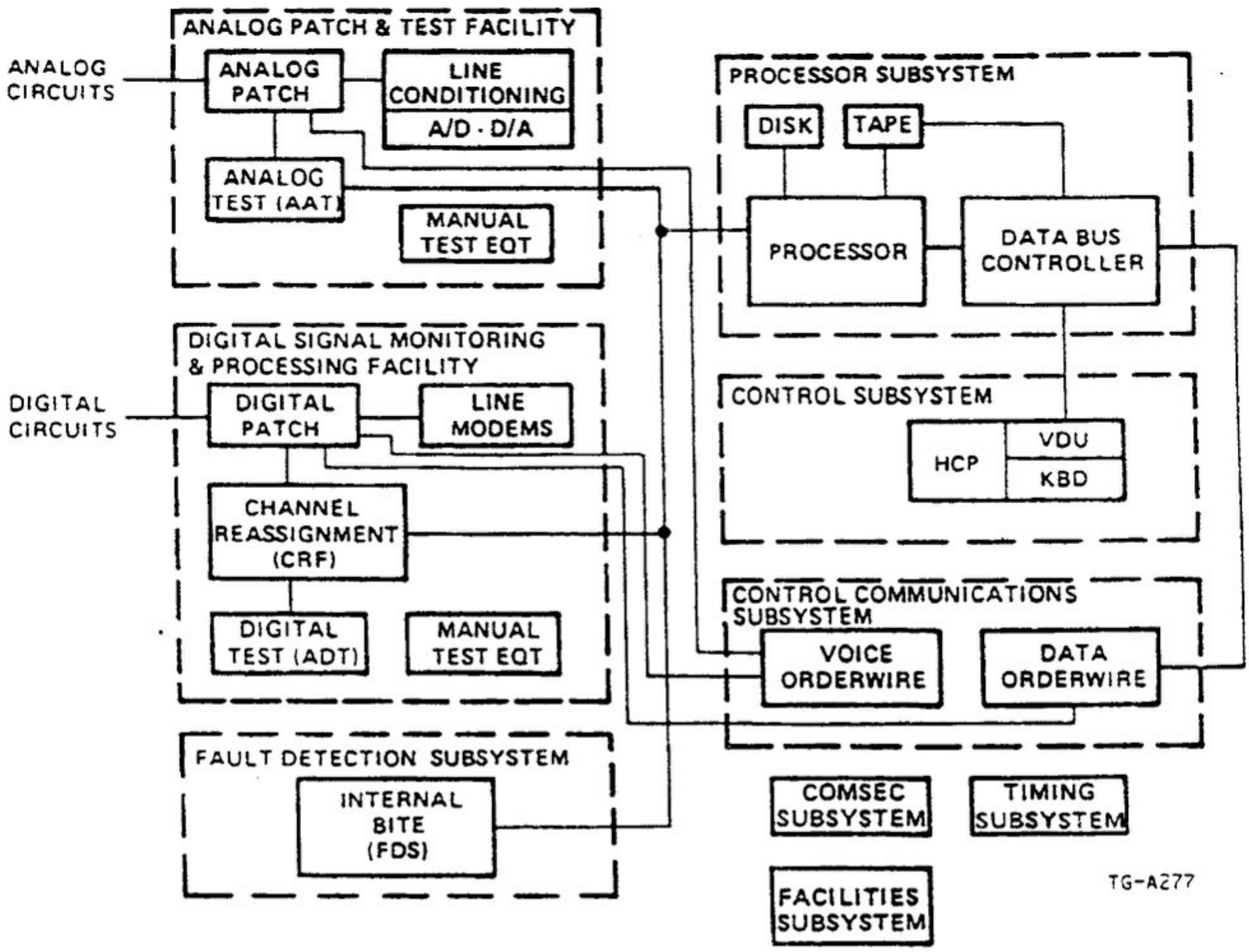


Figure 1-35. CNCE major subsystems.

between the CNCE and other nodal assemblages and between the CNCE and TACS equipment at other nodes.

Timing Subsystem. Timing provides the clock and synchronization functions necessary for maintaining bit integrity, framing, and COMSEC synchronization by the digital devices such as modems, multiplexers, and the CRF.

COMSEC Subsystem. COMSEC permits the encryption necessary for end-to-end secure communications.

Facilities Subsystem. This subsystem includes the electrical power, environmental control, external cabling, equipment racks, shelters, and storage necessary to support CNCE operations.

421. The analog patch and test subsystem

The major components of the analog patch and test subsystem are:

a. Main distribution frame (MDF).
b. Combined distribution frame (CDF).
c. Primary patch panel (PPP).
d. Equal level patch panel (ELPP).
e. Miscellaneous patch panel (MPP).
f. Line conditioning equipment.
g. Automatic analog tester (AAT).
h. Manual test equipment.

Distribution Frames. The MDF provides a termination for all analog circuits entering the CNCE and the interconnection of these circuits with the CNCE patching facilities.

The CDF provides a means for interconnecting the analog and TTY circuit appearances on the MDF with circuit patching and conditioning equipment.

Both MDF and CDF facilities include cross-connect panels to enable rapid connection of external circuit terminations with CNCE patching facilities. Space and weight requirements for these cross-connects are minimized by using cinch connectors instead of conventional wire-wrap techniques. These panels are at the most forward point in the shelter to minimize working space conflicts with other functions that must be done during equipment setup.

Patch Panels. The PPP permits convenient access to all 4 kHz voice frequency circuits and 50 kHz wideband circuits to and from user terminal and switching facilities.

The ELPP provides convenient access to all 4 kHz voice frequency circuits to and from radio multiplex facilities. The signal level of all circuit appearances is equalized to -4 dBr by line conditioning equipment.

The MPP uses jacks for patch access to manual test equipment and spare jacks for efficient tandem connection of line conditioning equipment.

The PPP, ELPP, and MPP use miniature bantam jacks and plugs. Both single and double plugs are provided to accommodate two-wire and four-wire circuits. Each circuit appearance is equipped with normal-through line and equipment jacks and a line side monitor jack.

Line Conditioning Equipment. Line conditioning capabilities are provided for termination, attenuation, amplification, delay equalization, echo suppression, two-wire/four-wire conversion, analog-to-digital conversion, supervisory signaling conversion, bridging, and TTY modulation rate conversion as required to establish compatibility between interfacing circuits. These devices may be patched into any analog circuit as required via the patch panels.

Automatic Analog Tester (AAT). This equipment automatically does a comprehensive range of both in-service and out-of-service tests for analog circuits. It does circuit scanning, signal adjustments, data processing, thresholding and display of alarms automatically, and display of test results following technical controller initiation via the VDU keyboard.

Manual Test Equipment. This equipment provides the capability for manual testing of analog circuits as a backup to the AAT.

422. The digital signal monitoring and processing subsystem

The functions of line conditioning, circuit distribution, patching, multiplexing/demultiplexing, routing, monitoring, and testing of all digital groups, channels, and subchannels are done by the CNCE digital signal monitoring and processing subsystem. The controller may direct selected or continuous testing of circuits and reassign (alternate route) circuits by the entry of simple command instructions at the console keyboard.

The major components of the digital signal monitoring and processing subsystem are:

a. Intermediate distribution frame (IDF).
b. Combined distribution frame (CDF).
c. Group modems.
d. Loop modems.
e. Channel reassignment function (CRF).
f. Automatic digital tester (ADT).
g. Manual test equipment.

Distribution Frames. The IDF provides termination, patching, and distribution for all digital groups that enter the CNCE. Patching on the line side of the modem is provided by miniature, snap-in coaxial connectors.

Digital loops entering the CNCE are terminated on the CDF where connections are made to loop modems. The equipment side of loop modems is connected directly to the CRF with cinch connectors using twisted pair wiring.

Modems. Group modems provide timing recovery, pulse restoration and separation of order-wire, and data stream signals on the receive side of digital groups entering the CNCE. The transmit side superimposes the order-wire and data stream signals for transmission on the cable. Modems are adaptable by plug-in units to accommodate diphase, dipulse, and bipolar signal formats.

The loop modems derive timing and do pulse restoration on the diphase signal received from the DSVT on the receive side. On the transmit side, it provides power for transmission of the diphase signal to the DSVT and supplies DC power for operation of the DSVT. The equipment side of the modem is hard-wired to the CRF.

Channel Reassignment Function (CRF). The CRF provides electronic patching for the interconnection and routing of all digital groups, channels, and subchannels entering the CNCE. It provides multiplex and demultiplex operations for all group rates from 72 kb to 4.608 Mb, enabling unrestricted flexibility for drop/insert and the formulation of transmission group sizes to optimize utilization of transmission equipment capacities. It also monitors sync status and framing bit error rate. Both automatic and manual modes of operation are provided to control routing assignments. The dotted lines in figure 1-36 show the ability of the CRF to reroute individual channels to groups, discrete channel ports, or the ADT.

Automatic Digital Tester (ADT). The ADT provides automatic, semiautomatic, and manual modes of operation for measuring the performance of digital groups, channels, and subchannels. It also provides a means for monitoring the status of remote digital group multiplexer (DGM) equipment, connections to the circuits to be measured are made via the CRF.

Manual Test Equipment. Standard manual test equipment is provided as a backup to automatic testing and fault isolation equipment.

423. The fault detection, processor subsystem, and data processing system

Fault Detection Subsystem. The integration of total system diagnostics into the CNCE processor software enables the CNCE to complete its primary mission of assuring the integrity of communications circuits in the tactical environment.

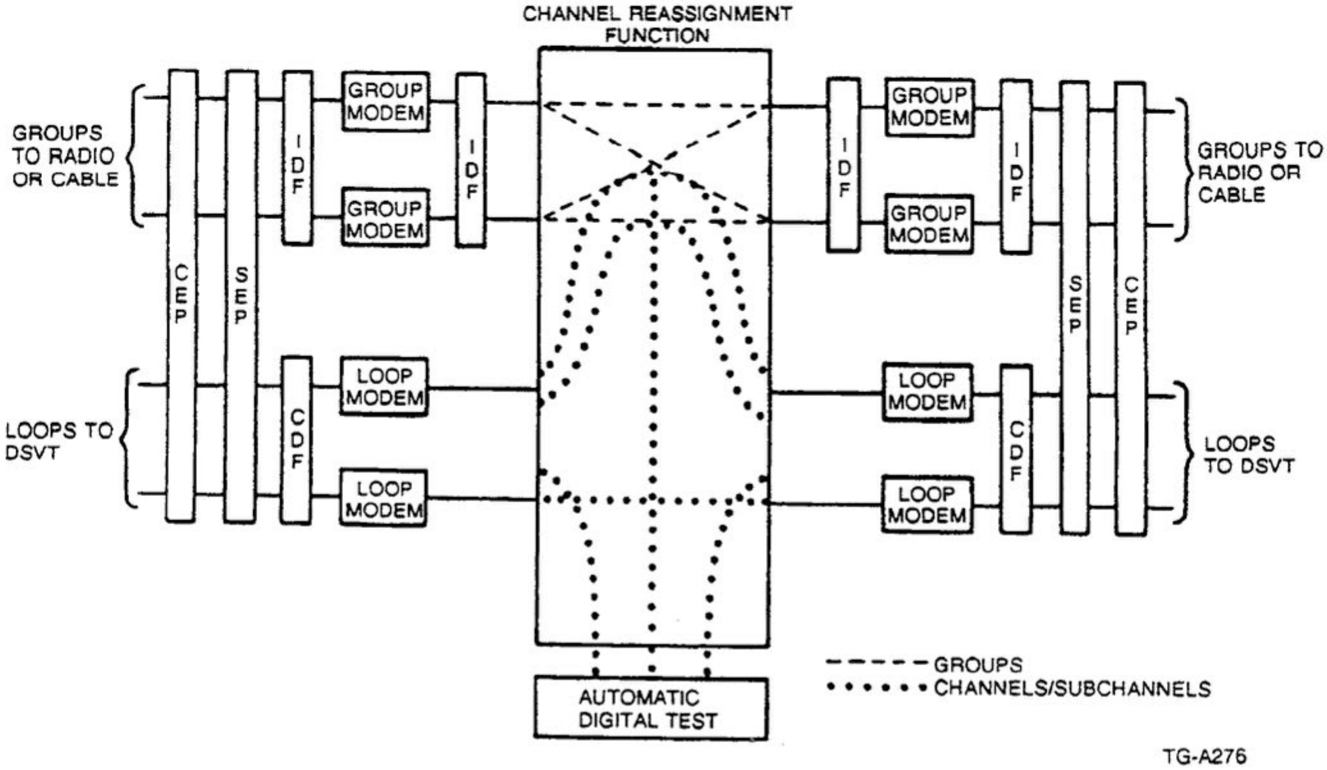


Figure 1-36. Channel reassignment function capabilities.

Total system diagnostics. To keep the integrity of communications circuits in the system, the CNCE is required to provide:

a. Near real-time fault detection.

b. Rapid fault isolation to the equipment level.

c. Recognition of transmission system degradation in time to permit corrective action before failure.

These requirements are satisfied in the CNCE by the implementation of a total system diagnostics concept that successfully integrates a combination of instrumentation methods including:

a. Equipment monitoring and reporting (internal and external to the CNCE).

b. Signal tracing within the CNCE.

c. End-to-end transmission signal parameter evaluation (bit error rate, group noise, timing, etc.).

As shown in figure 1-37, the transmission equipment within a CNCE and nodal equipment such as circuit switches, radio assemblages, and DGM family equipments have been heavily instrumented to report equipment failures or transmission performance degradation at once.

Fault detection and isolation. Reported fault or transmission status conditions are processed by the CNCE to generate audible and visual alarms to the controller. An important function provided by the total system diagnostics concept is the correlation of fault and status data to the geographic location of the failure. Faults within the CNCE are isolated to the card or module level. An alarm advisory identifies the fault location to the rack, the shelf, and even the card slot within the shelf. Nodal faults external to the CNCE are given the same degree of processing as internal faults. These equipment faults are isolated to the geographic location designated by their position in a transmission group. The faulty equipment and its transmission group also are identified by alarm advisories appearing on the VDU screen.

The total system diagnostic approach relieves the technical controller of the burden of recording fault events during the crucial period of a transmission failure. All major alarm advisories are recorded automatically in the chronological fault queue, in the CNCE master station log, and on a printout of the hard copy printer. Appropriate transmission performance displays are provided for conveying overall transmission group status to the technical controller.

Corrective action. Thus, the technical controller's burden during a fault event has been minimized so that this person's energies can be directed at once toward corrective action. On being informed of an alarm, the controller routinely:

a. Reads the advisory statement to find the nature and location of the problem.

b. Reviews the results of any additional processor analysis by accessing appropriate displays.

c. Does any additional tests or coordination that may be required.

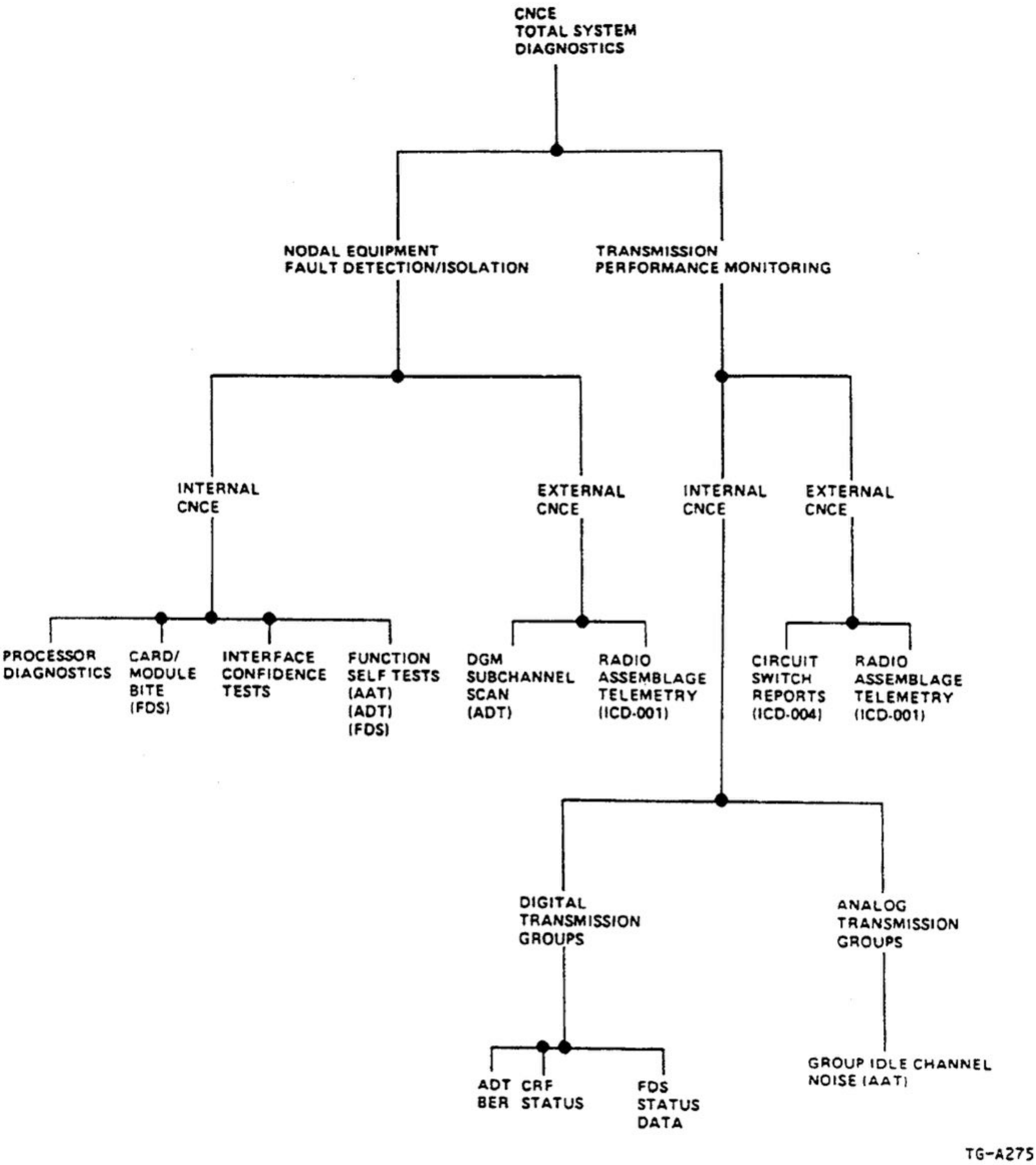


Figure 1-37. CNCE total system diagnostics.

d. Starts corrective action:

(1) Work orders generated via VDU/keyboard.

(2) Reroute/restoral via CRF displays.

(3) Card/module replacement in the CNCE.

Following corrective action, the technical controller manually updates the master station log and the fault queue.

Total system diagnostics summary. In summary, the technical controller is told of a fault condition, determines fault location and severity, verifies first results if necessary, starts corrective action to restore communications service, and updates all necessary records. In most cases, this process requires no more than 10 to 15 minutes.

Processor Subsystem. Automatic data processing and automatic equipment control capabilities do several hundred hours of work within milliseconds to support the real-time functions done by the CNCE.

Data Processing System (DPS). The DPS supports the normal operating mode of all major subsystems in the CNCE. Automation of these functions is the key to the rapid assessment and fast reaction capabilities of CNCE.

These CNCE functions show the greatest enhancements of processor control:

a. Routing and restoral.

b. Performance assessment and fault diagnostics.

c. Management and reporting.

d. Record keeping.

e. Displays and alarms.

f. Initialization and recovery.

Routing and restoral. Routing of digital channels takes about 5 seconds per channel. This time includes keyboard data entry and software control processing to complete a patch connection in the CRF.

Performance assessment and fault diagnostics. 288 four-wire analog circuits are tested every 3 hours. The test results are compared to threshold values, and group and route noise are calculated. Bit error rate tests are done on a channel in each of 48 transmission groups every 144 minutes. The results are compared to threshold values for alarm and display. A total of 64 DGM subchannels are monitored every 6 minutes. Synchronization status and framing pattern bit error rate are received from the CRF and processed once every half second for each of 48 transmission groups.

Radio assemblage telemetry data reporting transmission bit error rate and equipment status are received from up to 40 sources, totaling 1,800 messages per minute. This data is processed to determine equipment status and transmission quality. The technical controller is notified by alarm generation and status displays.

Fault status of CNCE internal equipment is determined by the processing of test equipment data from 491 monitor points each 6 seconds. Nodal fault diagnostics provide processing of status and fault data from all nodal sources to enable isolation of multiple fault indications to a single failure.

Management and reporting. Directive message processing and switch report message processing may reach peaks of about 100 messages in a 2.5-minute interval during stress conditions. Switch report data is processed to provide displays indicating traffic handling performance and circuit performance. Directives are sent to the message switch, and records are kept on the status of the action taken. Composition of work orders, trouble reports, technical service orders, and telecommunication service requests are assisted by automatic processing.

Record keeping. Processing, storage, and updating are provided for 5,000 pages of records that may be displayed on the VDU and printed on hard copy.

Displays and alarms. Data is collected and processed to provide 50 formatted VDU displays in addition to alarm advisories and textual message displays. Access time for 95 percent of the displays is less than 2 seconds each.

Initialization and recovery. System initialization or major system recovery using configuration data base and system program tapes can be done in 17 minutes. Partial recovery in cases where data stored on disk has not been disturbed, such as following a power failure, requires 9 minutes.

424. Characteristics of the control, control communications, timing, and COMSEC subsystems

Control Subsystem. In a command and control stress situation, it doesn't matter how much data is collected if it can't be processed and presented in time to aid the commander in decisions. This problem is handled by the CNCE, which receives all pertinent data on user requirements, connectivity between nodes, status of traffic requirements, and the health of all equipment installed within nodes.

After processing by the CNCE data processing subsystem, this information becomes part of the data base, which is organized into logical categories providing fingertip access to convenient displays of all required data. Figure 1-38 shows the CNCE I/O process.

In the past, this function has been done with manual techniques entailing the use of filing cabinets for storage of procedures, directives, and records. Because of inadequate access, information seldom was available quickly enough, resulting in frequent inefficient use of available communications and little chance of pinpointing faults in the system. Also, it took excessive numbers of people to run this cumbersome system.

The CNCE design eliminates these limits through human/machine interface facilities that provide automatic data processing, alarms, advisories, displays, software, an operator console, and equipment control panels human engineered for this specific application. These facilities provide fingertip access to data formatted for instant

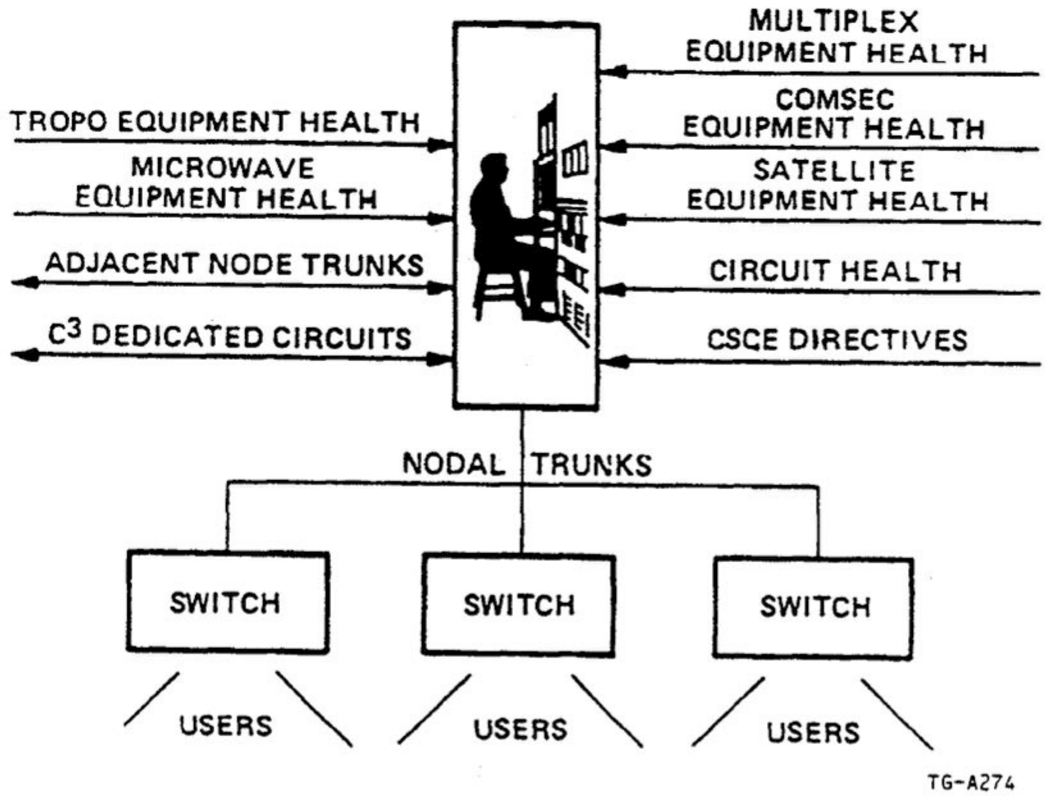


Figure 1-38. CNCE input/output.

interpretation, control mechanisms to minimize controller time and skill level requirements, and an electronic data base fed by automated data collection subsystems.

Control console. The CNCE technical controller is provided with a control console made up of a VDU, HCP, keyboard, and light pen as shown in figure 1-39. This console provides an orderly and rapid means to assign, monitor, and control nodal communications resources. Controller operating procedures are greatly enhanced by the simplicity of this human/machine interface.

Video display unit (VDU). The VDU uses a raster-scan pattern technique on a 12-inch (diagonal) cathode ray tube (CRT) to display up to 4,000 alphanumeric/graphic characters. The 4,000 characters are arranged in a 50-row by 80-column matrix. Either an alphanumeric or a graphic character may occupy one of the 4,000 character locations.

Negative character displays may be designated to highlight a character or field on the screen. A negative character has all dots in that character matrix illuminated, except for the dots representing that character.

Blinking character displays may be designated to attract attention to a particular display field on the screen. The fields selected to blink alternately display and remove the character at a rate of 3 Hz.

Summary of features. The control subsystem provides these important features:

a. 12-inch diagonal CRT.
b. 4,000 characters, 80 characters for each of 50 lines.
c. Refresh memory, character and graphics generator, light pen.
d. 63 ASCII character set per MIL-STD-188-100.
e. 3 Hz blink or reverse video for single characters or entire fields.
f. Light pen and cursor symbol.
g. Display and edit capability.
h. Hard copy printer.
i. Protected fields.

Control Communications Subsystem. The control communications subsystem includes the voice order wire and intercom patch panel, data order-wire patch panel, headsets, encryption devices, digital conference unit, and order-wire control unit. It furnishes voice intercom (nonencrypted), order wire (encrypted), and data order wire (usually encrypted) capabilities to the AN/TSQ-111 controller.

Timing Subsystem. The timing subsystem consists primarily of a cesium clock, a reference major components selection card, a clock synthesizer card, a timing control panel, and a timing distribution system. The timing subsystem selects one of three highly exact and stable signal sources as a reference, creates seven basic clock frequencies phase-locked to the reference, and distributes these throughout the CNCE. A block diagram of the timing subsystem is shown in figure 1-40.

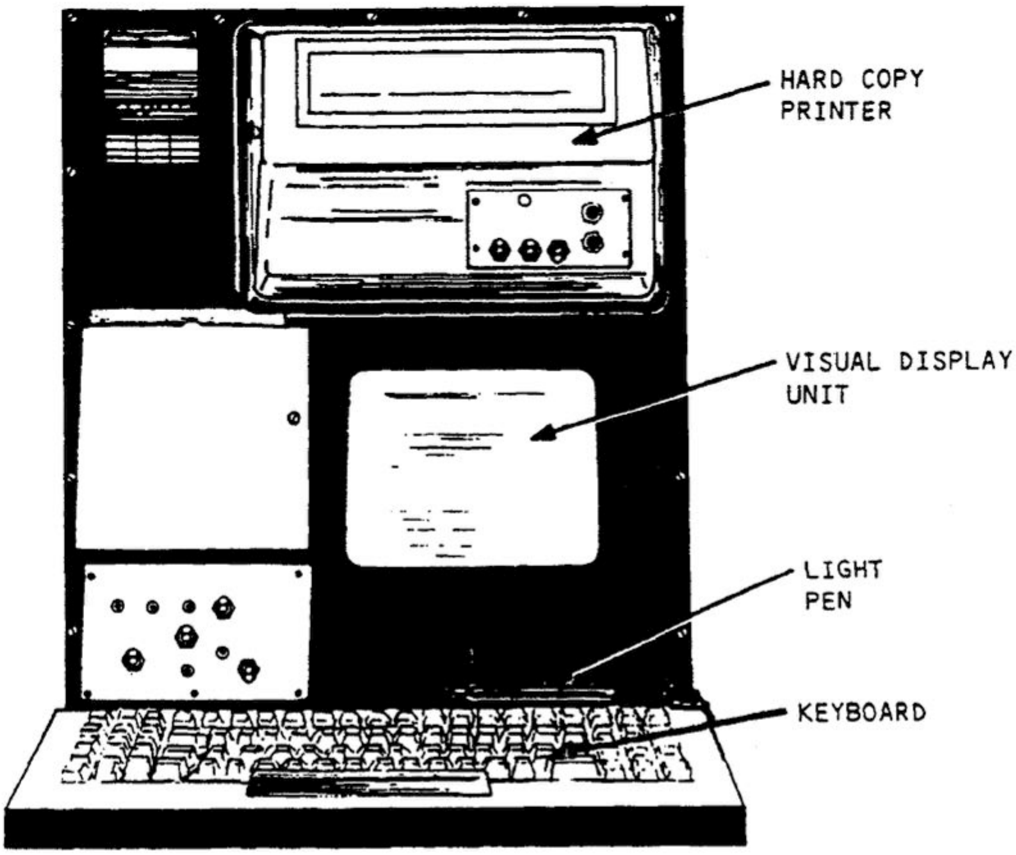


Figure 1-39. Technical controllers console.

COMSEC Subsystem. The COMSEC subsystem provides channel encryption, group encryption, and manual key distribution. Digital channels, group, and supergroups subjected to signal conditioning, monitoring, and processing are classified as RED or BLACK signal lines.

The COMSEC subsystem provides the encryption of orderwire circuits, digital channels, and digital groups; the generation and electronic distribution of keys; special-purpose COMSEC racks; and RED/BLACK signal separation and isolation.

A digital subscriber voice terminal (TSEC/KY-68) provides encryption for circuit switched or sole user digital voice circuits, doing an order-wire function for communications between the CNCEs and providing general communications entry for the CNCE into the tactical communications network. The VINSON (TSEC/KY-58) provides encrypted digital voice order wires at 16 kbps that are routed over TRI-TAC systems.

425. The AN/TSC-107 Transportable Communication Central

It takes time to organize an entire mobile communications unit from a logistical standpoint. Equipment, supplies and people must be loaded and organized to deploy by land or air, depending on the mission. In wartime, the mission simply can't wait. The Quick Reaction Package (QRP) can deploy to a specified location, set up communications quickly, and support command and control operations at a moment's notice (usually within 24 hours). Once this is done, the rest of the mobile communications people follow and set up the remaining components of the site. After communications is set up, the QRP deploys back to garrison or to a new location.

All of the major mobile communications units and most of the smaller ones have QRP. A typical QRP deployment is three tech controllers, 3 ground radio maintenance, 1 crypto maintenance, 1 power production, and another nine or ten

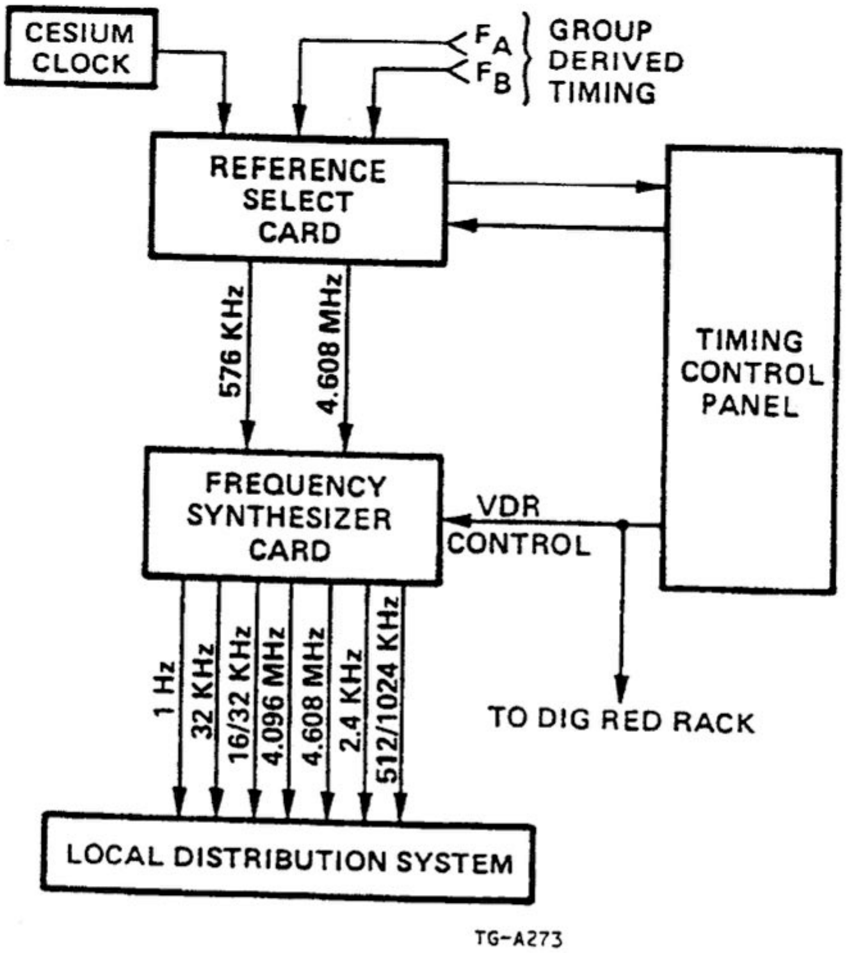


Figure 1-40. CNCE timing subsystem.

radio and teletype operators. Once these people arrive with their equipment, they usually can be on the air with limited communications within 15 minutes. This would be HF/SSB communications using a URC-92 radio and a whip type antenna. Full communications capability can be obtained in as little as three to four hours.

AN/TSC-107 Capabilities. The technical name for the QRP is the AN/TSC-107 Transportable Communication Central and has equipment for the transmission, reception, and processing of voice and data communications. This facility is designed for point-to-point and ground-to-air communications in a deployed tactical environment. It can terminate two secure full-duplex data circuits, two secure voice circuits, and three nonsecure Defense Switched Network (DSN) voice circuits extended into the DCS when deployed with Ground Mobile Forces (GMF) multichannel super high frequency (SHF) ground satellite terminals such as the AN/TSC-94. High frequency/independent sideband (HF/ISB) radio equipment in the facility provides for two secure full-duplex (FDX) data circuits (or one secure full-duplex data circuit and one securable voice circuit). A telephone switchboard with subscriber instruments provides telephone service to 25 on-site users. The facility has an HF radio for reception of Worldwide Meteorological Organization (WMO) broadcasts. Nonsecure voice, secure voice, and half-duplex secure teletype communication with airborne and ground stations is possible using the associated high frequency/single sideband (HF/SSB), VHF and UHF radios. These same modes are possible through a connected satellite terminal or landlines. The facility includes patching bays, built-in test equipment, message preparation equipment, and cryptographic devices. It also includes antenna structures and antenna couplers, trailer-mounted dual generators, skid-mounted environmental control units (ECU), and a utility support truck.

Components. The facility has a panel truck (stepvan) having the major items of equipment, a support vehicle, and a power unit. Each of these components is described below.

Stepvan. Primary communications equipment is in a C-30 stepvan. Figure 1-41 is a top view showing the floor layout of the AN/TSC-107. Access to the front operating compartment during operation is through a sliding door on the passenger side. Access to the rear operating compartment is through double doors at the rear of the stepvan. The left, or road, side of the stepvan (fig. 1-42) has external connections for 407L signal and electrical power cables, grounding strap connection, radio frequency (RF) connector, antenna coupler control cable connection, and antenna mounts. The right, or curb, side (fig. 1-43) has external RF and antenna connectors, antenna coupler control connections, and an antenna mount. The stepvan is the facility transport vehicle. A sliding access window with one-way glass is on the right side for message traffic pickup and delivery.

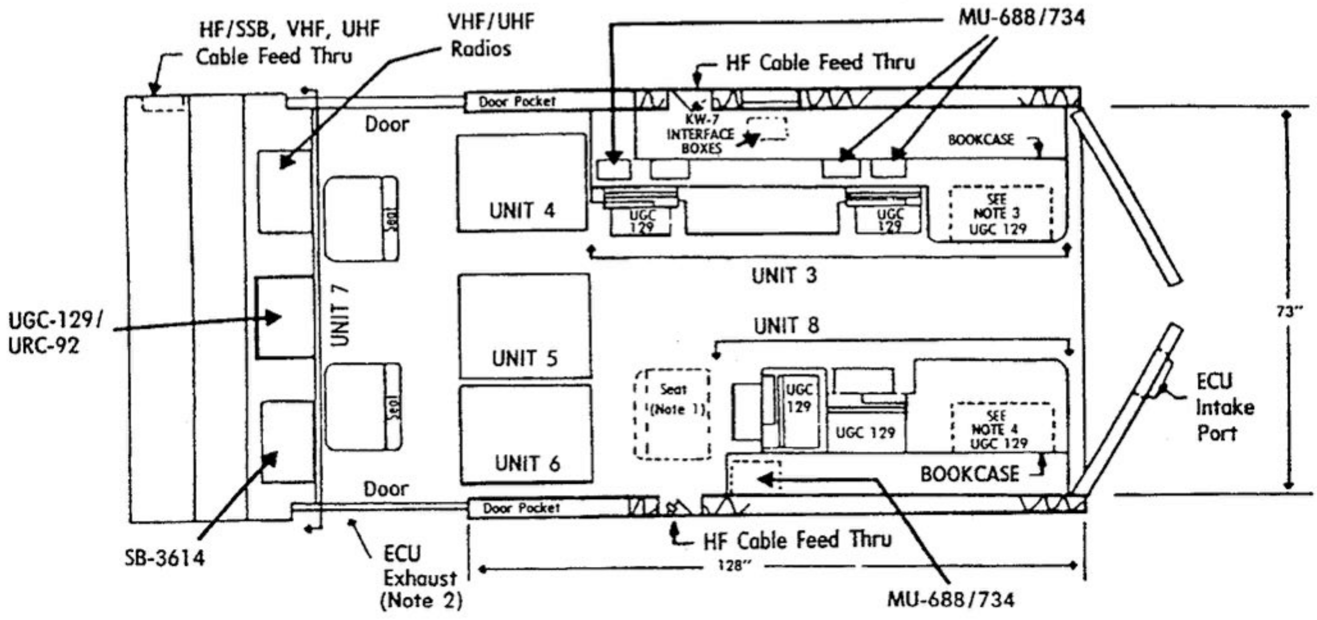
Support vehicle. A W-350 four-wheel drive support vehicle provides utility transportation and stores antenna, antenna support structures and cables, antenna couplers, collapsible fuel bladder, power cables, and War Readiness Spares Kits (WRSK). This vehicle carries basically everything maintenance needs to maintain the QRP including tools and spare parts.

Power unit. A modified M-103 military trailer serves as the mount and transporter for two MEP-003 power generators. The power output is adjustable but usually is set for 220 VAC.

Transport Mode. In the transport mode, the three major facility components described above can be airlifted in one C-130 aircraft or driven over improved roads. All antenna hardware is stowed during transport in the W-350 support vehicle. A canvas cover (tarpaulin) protects the stored items. Telephone instruments, the telephone switchboard, and connecting cables are stowed in the stepvan for transport.

Operating Mode. When the communication central is in operating position (fig. 1-44) the power unit, skid-mounted ECU, fuel bladder, and tactical HF antennas are close to the stepvan. A power cable from the power unit meets an external connector on the left rear quarter of the stepvan. The collapsible fuel bladder is deployed at least 50 feet from the power unit and is connected to provide a continuous fuel supply. VHF, UHF, and whip antennas mount directly on hardware attached to the stepvan. When the long-haul tactical HF antennas are used, they are erected on two AB-577 antenna structures. The ECU is on skids behind the stepvan and flexible air ducts attach to openings in one rear stepvan door and the road side window.

It is important to know that the technical controllers deployed in the QRP have a demanding job to do with tremendous responsibility. Once the equipment is set up, it is your job to make it all work together. Like the conductor of an orchestra, you must make sweet music with the instruments at hand. Often, one of the instruments does not work properly—that's when the maintenance people come into play. If you work *with* them, you will find that your job often is easier and less demanding.



NOTES:

1. During employment, passenger seat is removed and installed in rear as shown.
2. ECU exhaust is via front door window. An adapter plate is required and provided.
3. AN/UGC 129 position for WX intercept during transport.
4. Optional position number 5 for AN/UGC 129 operation. (See Figures 1-5 & 1-9).

Figure 1-41. AN/TSC-107 equipment layout.

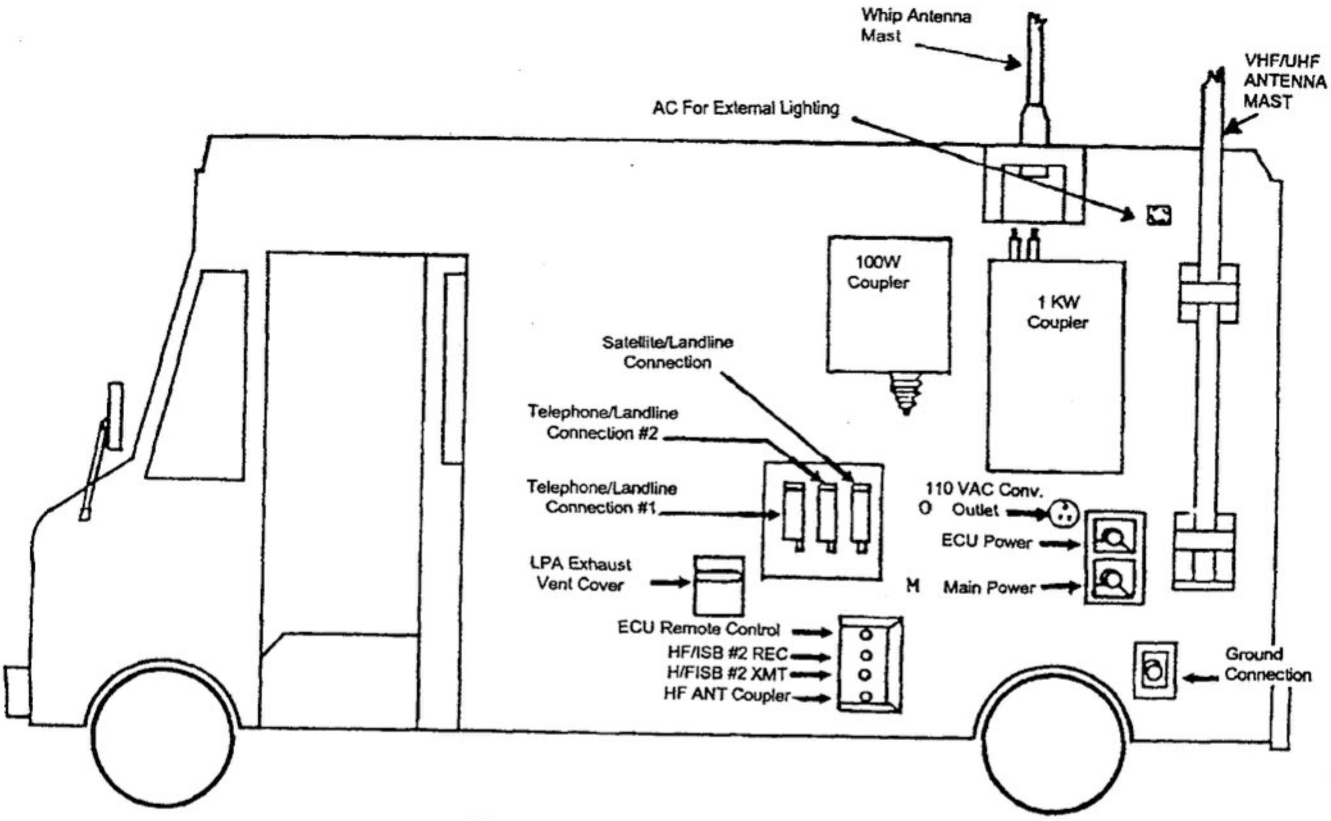
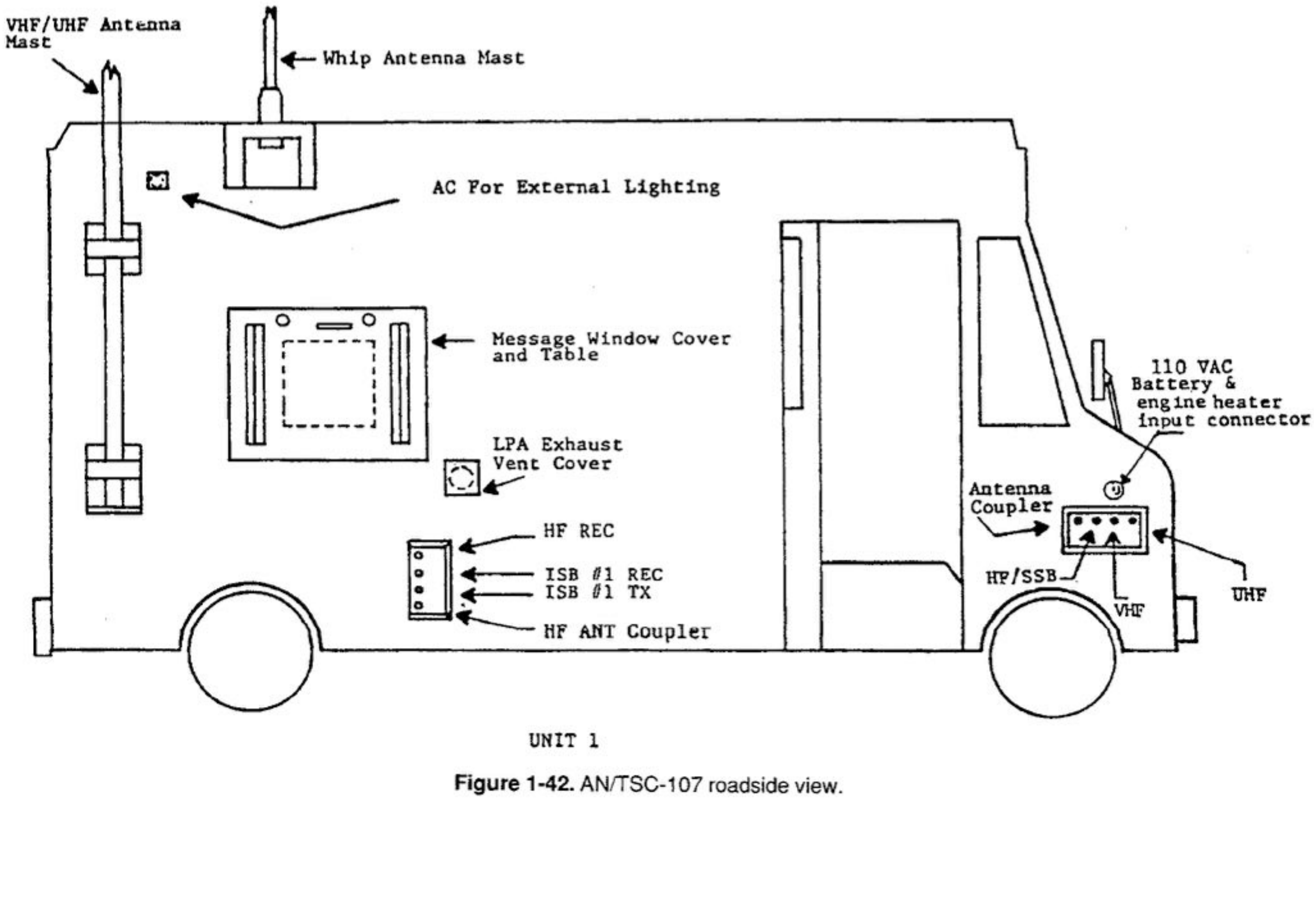


Figure 1-42. AN/TSC-107 roadside view.



UNIT 1

Figure 1-42. AN/TSC-107 roadside view.

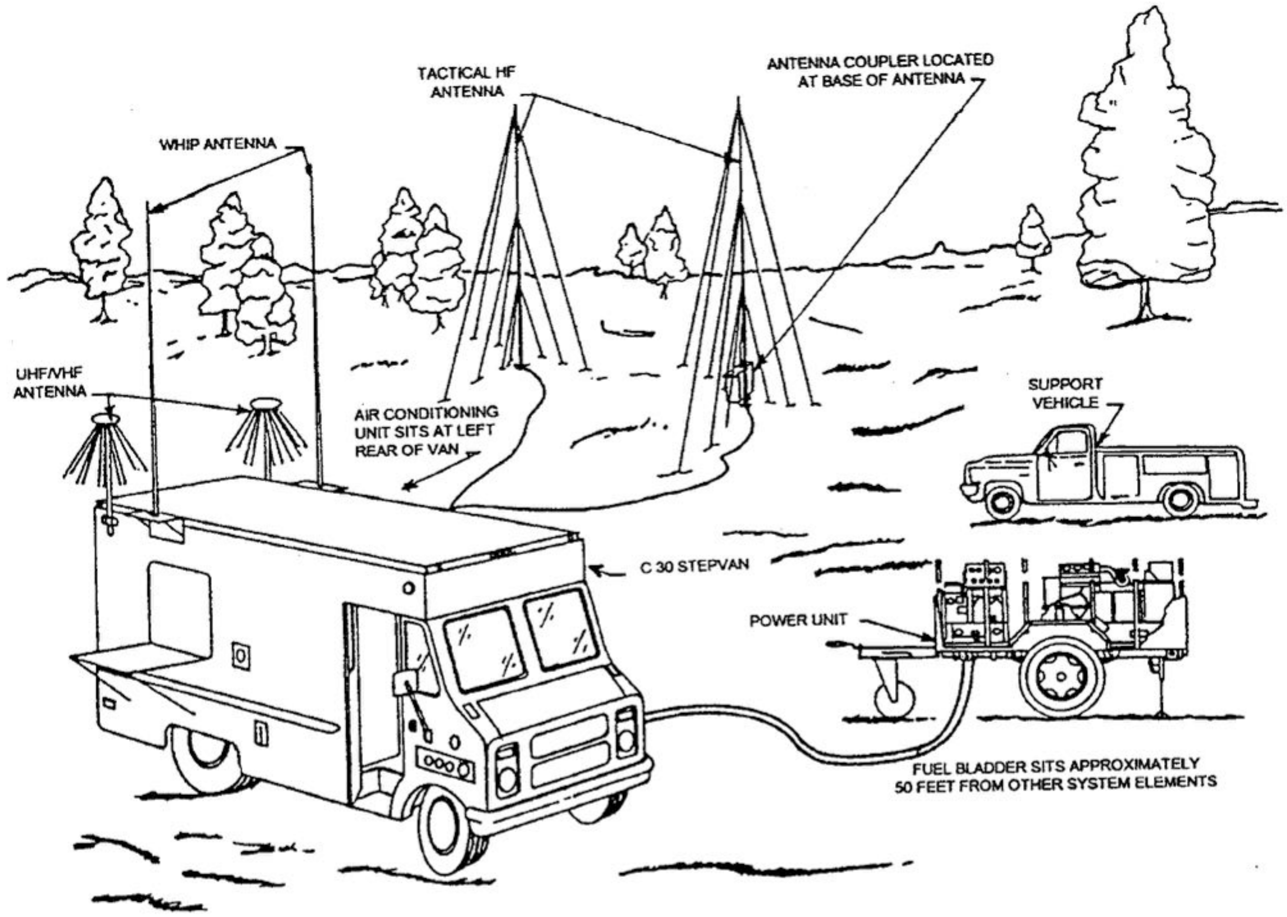


Figure 1-44. AN/TSC-107 in operation.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

411. The AN/TSC-62A van

1. What are the two major groups of the AN/TSC-62A?
   communications central & environmental control groups

2. What comprises the communications central group?
   Test & conditioning equipt.

3. Where are circuit breakers for van equipment and the ECU located? power distribution panel

4. How do signals enter and leave the AN/TSC-62A?
   60 external 407L cable hooks

412. Electrical equipment racks of the AN/TSC-62A van

1. How many standard electrical equipment racks are there in the AN/TSC-62A van? How are they numbered? 9 Racks 1A2 through 1A5

2. What are the three major equipment assemblies located in rack 1A3? Audio test equipt -48 volt power supply.

3. Where is the DC patch panel located? Rack assembly 1A7

413. Patching capabilities of the AN/TSC-62A van

1. How many full duplex teletype circuits will the VFTG system of the analog (VF tone) patch jack field facilitate? What components does it use to do so? 16 Don [illegible]

2. How many and what type circuits may be controlled, routed, monitored, and tested through the analog (voice) patch jack field? 276 TX + RX analog

3. Essentially, what type circuits are serviced through the DC patch jack field? Test jacks on Rack corresponding 1A3

4. If a signal is inserted in a test trunk jack at rack 1A9, where will it appear? FDX line isolators

5. What is wired to the right terminal blocks of racks 1A7, 1A8, 1A9, and 1A10? Factory wiring to side cable connectors

414. Standard test equipment used in the AN/TSC-62A van

1. What are the monitoring capabilities of the R-1555 racal receiver? Can RX AM FM MCW + SSB from 980 KHZ - 30 MHZ

2. What are the frequencies and level of output for the SG-815 standard tone generator? 1004 2600 or -4dbm

3. What circuit measurements are made with the Hekimian 3901 test system? Freq response delay, noise, phase jitter nonlinear distortion, phase hits, gain hits + dropouts

4. What should you do if you are unsure of the operating procedures for the SG-815 generator and your trainer can't help you? check to

415. Circuit conditioning equipment used in the AN/TSC-62A van

1. What is the purpose of a TU-1819 LIU?
used on teletype ckt.

2. What is the adjustable range of the Stelma LA-1 line amplifier? -10 to 35 dB

3. What is the purpose of the 4-way/4-wire bridge?
capability of connecting 4 four wire full duplex ckts.

416. Operations equipment of the AN/TSC-62A van

1. How are incoming calls detected by the SB-3260 manual telephone switchboard?
lamp + alarm sound

2. What are the three basic equipment parts of the TT-588 teletype order wire?
ESU printer keyboard

417. System applications and capabilities of the AN/TSQ-111 communications nodal control element (CNCE)

1. How can a technical controller convert an analog signal to digital data in the AN/TSQ-111?
CVSD

2. What feature of the CNCE eliminates the tendency to rely on user complaints for detection of faults?
Auto fault detection + isolation

3. How has the AN/TSQ-111 improved communications security?
end to end encryption

418. Functional characteristics of the AN/TSQ-111 technical/management shelter

1. Name three features that enable the AN/TSQ-111 to perform its technical functions. Console rack processor rack + digital equipt rack

2. Into what two categories do the CNCE's activities fall? support nodal management + control functions

419. Major support and traffic functions of the AN/TSQ-111

1. What major support and traffic functions are provided by the CNCE? signal interface, diagnostics capability, channel reassignment, command relationship to DBC

2. What automatic diagnostics capabilities does the CNCE have? automatically assess its own capabilities & those of its assigned nodal equipment & TX links.

3. What limits the number of nodal elements that can be assigned to a CNCE? processor resources

4. What does the signal entry and distribution provision of the CNCE consist of? comm. entry panel, MDF, CDF, + IDF

420. Major subsystems functions of the CNCE

1. What functions are provided by the analog patch and test subsystem? Manual patching, line conditioning, AAT, testing, monitoring & routing

2. What functions are provided by the digital signal monitoring and processing subsystem? line modems, patching & rout of digital ckts.

3. Which subsystem provides intercom and analog voice, digital voice, teletype, and data order-wire facilities? control comm. subsystem

421. The analog patch and test subsystem

1. What provides a termination point for all analog circuits entering the CNCE? MDF

2. What type circuits can be accessed from the primary patch panel (PPP)? 4 KHz + 50Khz wideband ckts

3. What two types of tests are performed by the AAT? In & out of service for analog ckts

422. The digital signal monitoring and processing subsystem

1. What provides a termination point for all digital groups entering the CNCE? IDC

2. What do the group modems provide on the receive side of digital groups entering the CNCE?
Timing recovery, pulse restoration & separation of orderwire

3. Can the CRF reroute individual channels? If so, to where? Yes groups ports on ADT

423. The fault detection and processor subsystem

1. What has enabled the CNCE to assure the integrity of communications circuits in the tactical environment? integration of total system

2. How is the technical controller alerted of faults and transmission status condition in the AN/TSQ-111?
alarms

3. Where are major alarm advisories automatically recorded? chronological fault queue

4. In total system diagnostics, what does the technical controller do after being advised of a fault condition?
Determines fault location

5. Approximately how long does the rerouting of digital channels take? 5 sec/channel

6. What are the display and alarm capabilities of the video display unit (VDU)? 50 formatted displays, alarm advisories & message displays

424. Characteristics of the control, control communications, timing, and COMSEC subsystems

1. What are the major components that comprise the technical controllers console?
VDU HDC Keyboard & lightpen

2. What feature may be selected to draw the technical controller's attention to a particular display field at the controllers console? Blinking character displays

3. What services does the COMSEC subsystem provide? channel & group encryption & key distribution

425. The AN/TSC-107 Transportable Communication Central

1. How long does it take to obtain full communications once at the deployed location?

   3-4 hours

2. What are the three main components of the AN/TSC-107? step van, support vehicle + power unit

3. Which component of the AN/TSC-107 carries the maintenance equipment.

   support vehicle

4. How many MEP-003 power generators are deployed with the QRP?

   2

ANSWERS TO SELF-TEST QUESTIONS

400

1. The combined forces of Army, Navy, and Air Force units
2. Air defense, interdiction, air support, airlift, and reconnaissance.
3. The Tactical Air Force Headquarters (TAFH).

401

1. The organization, along with its equipment, that plans, directs, and controls all tactical air operations and ensures they are properly integrated with other forces of the JTF.
2. (1) c; (2) i; (3) b; (4) j; (5) g; (6) a; (7) f; (8) e; (9) h.

402

1. The standby generator automatically starts.
2. It is an environmental control unit that provides ventilation, cooling, heating, pressurization, filtering, and dehumidification for mobile vans.

403

1. The AN/TSQ-91 operations central.
2. The AN/TSQ-93 operations central.
3. The AN/TGC-28 communication center.

404

1. An AN/TSC-53 communications central.
2. Using two 1-kW HF/SSB radios, it provides voice, teletype, high-speed data, multiplexed teletype, and speech-plus-teletype traffic.
3. Performing circuit and radio channel quality control, restoring and rerouting circuits, and providing continuous supervision of communications facilities.

405

1. Four channels using manually tuned transmitter-receiver groups and one channel using an automatically tuned transmitter-receiver group.
2. Several AN/TSC-97A radio sets must be placed in tandem. The originating station must use a horn antenna to clear the obstruction, while the terminating station can use a parabolic dish.
3. The AN/TPS-43 radar set.

406

1. Direct area dialing, automatic altrouting over switched trunks, and a preemption capability.
2. A maximum of 12 teletype, field telephone, or remote control radio circuits in any combination.
3. Up to four stations.

407

1. Message and circuit switches.
2. The AN/TYC-39 automatic message switching central.
3. 50; up to 37 kbps.
4. The AN/GYC-7 automatic message switching set.
5. Up to 600 individual user circuits may be served by three analog and two digital matrices. The matrices are replaceable to accommodate transition from analog to digital matrix modules.
6. This is an automated capability that connects up to 60 preselected essential digital users to a distant AN/TTC-39 in the event the parent switch fails.

408

1. The AN/TRC-170 accepts up to four digital groups with up to 15 channels on each and up to 30 local digital subscriber loops.
2. 3.5 to 7 MHz.
3. The provision for connecting up to four other radio terminal sets to a switch either directly or via an AN/TSQ-111.

409

1. It provides a signal and power interface for repeatered coaxial cable links.
2. It provides pulse regeneration for 2,304 kbps analog conditioned diphase signals and line loading for analog orderwire signals.
3. It time division multiplexes up to four 16 or 32 kbps channels into a single analog conditioned diphase 72 or 144 kbps group.
4. A balance NRZ 144 kbps to 4,608 Mbps supergroup with timing.
5. As many as 1,144 traffic channels.

410

1. The systems approach.
2. The AN/TSQ-111 communications nodal control element CNCE.
3. It is capable of composing, editing, storing, displaying, refiling, transmitting, receiving, and monitoring record message traffic of both the tactical and DCS AUTODIN communities.
4. It provides a tactical digital facsimile capability.

411

1. The communications central and environmental control groups.
2. Test and conditioning equipment and the operations equipment (one 12-line switchboard and two teletypewriters).
3. In the power distribution panel.
4. Through 60 external 407L cable hocks in the signal entrance panel.

412

1. Nine. Racks 1A2 through 1A5 are located along the roadside wall; 1A6 through 1A10 are on the curbside wall.
2. Audio test equipment, –48 volt power supplies, and a fuse panel.
3. Rack assembly 1A7.

413

1. 16; tone keyers and converters.
2. 276 send-receive voice circuits.
3. FDX line isolator circuits.
4. At the corresponding test jack in rack 1A3.
5. Factory wiring to the side cable connectors.

414

1. It can receive AM, FM, MCW, and SSB radio signals from 980 kHz to 30 MHz.
2. 1,004 and 2,600 Hz at 0 or –4 dBm.
3. Frequency response, envelope delay, noise, phase jitter, non-linear distortion, phase hits, gain hits and dropouts, and three levels of impulse noise.
4. Check the appropriate TO.

415

1. It is used on DC teletype circuits either to convert or to isolate in-station from out-station batteries.
2. –10 to +35 dB.
3. It provides the capability of interconnecting four four-wire, full-duplex VF circuits.

416

1. A call indicator lamp lights and an audible alarm sounds.
2. The electrical service unit (ESU), page printer/keyboard, and frequency converter and motor control unit.

417

1. By using continuous variable-slope delta (CVSD) encoders.
2. Automatic fault detection and isolation.
3. Through end-to-end security using Parkhill, Vinson, and Seeley encryption devices.

418

1. A console rack, a processor rack, and digital equipment rack (RED), a COMSEC rack, and analog patch facility, a test and DGM rack, a line conditioning rack, a digital equipment rack (BLACK), a DGM rack panel, a signal entry panel, and a power distribution panel.
2. Functions that support nodal management and control and functions directly related to communications traffic flow.

419

1. Signal interface, diagnostics capability, channel reassignment, command relationships, an equipment load capability, and a reconfiguration capability.
2. It can automatically assess its own operational capabilities and those of its assigned nodal equipment and transmission links.
3. The capabilities of its processor and associated data bus controller (DBC).
4. A communications entry panel, an MDF, a CDF, and an IDF.

420

1. Manual patching, line conditioning, AAT, manual testing, monitoring, and routing of analog circuits.
2. Line modems, manual patching, automatic patching (CRF), and ADT of digital circuits.
3. The control communications subsystem.

421

1. The MDF.
2. 4 kHz VF and 50 kHz wideband circuits.
3. In-service and out-of-service for analog circuits.

422

1. The IDF.
2. Timing recovery, pulse restoration and separation of orderwire, and data stream signals.
3. Yes. To groups, discrete channel ports, or the ADT.

423

1. The integration of total system diagnostics.
2. By audible and visual alarms.
3. In the chronological fault queue, in the CNCE MSL, and on printout by the hard copy printer.
4. Determines fault location and severity, verifies initial results, initiates corrective action, and updates records.
5. 5 seconds per channel.
6. 50 formatted displays, alarm advisories, and textual message displays.

424

1. A VDU, HCP, keyboard, and light pen.
2. Blinking character displays.
3. Channel and group encryption and manual key distribution.

425

1. 3 to 4 hours.
2. The stepvan, support vehicle and power unit.
3. The support vehicle.
4. Two.

Do the Unit Review Exercises (URE) before going to the next unit. →

UNIT REVIEW EXERCISES

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to ECI Form 34, Field Scoring Answer Sheet. **DO NOT RETURN YOUR ANSWER SHEET TO ECI.**

1. (400) From what location is the air portion of a battle directed?
   a. The Tactical Air Base (TAB).
   b. The Tactical Air Control Center (TACC).
   c. The Tactical Air Force Headquarters (TAFH).
   d. The Joint Tactical Force (JTF) Headquarters.

2. (401) The TACS element that serves as a base of operations for the air resources of a Tactical Air Force (TAF) is
   a. a Tactical Air Base (TAB).
   b. a Tactical Air Control Center (TACC).
   c. an Air Support operations Center (ASOC).
   d. the Tactical Air Force Headquarters (TAFH).

3. (401) The TACS element from which the Tactical Air Force Commander has centralized the functions of planning, directing, and controlling tactical air resources is
   a. a Tactical Air Control Center (TACC).
   b. an Air Support Operations Center (ASOC).
   c. a Tactical Air Force Headquarters (TAFH).
   d. an Airborne Battlefield Command and Control Center (ABCCC).

4. (402) Power for 407L equipment in the deployed configuration is supplied by
   a. an M-720.
   b. an A/E 24U-8.
   c. an A/E 32C-24.
   d. an AN/TSC-62A.

5. (402) What is the cooling capacity of an A/E 32C-24 ECU?
   a. 24,000 BTU/HR.
   b. 32,000 BTU/HR.
   c. 36,000 BTU/HR.
   d. 40,000 BTU/HR.

6. (403) The operations van used in a control and reporting post (CRP) is
   a. AN/TSQ-93.
   b. AN/TGC-28.
   c. AN/TSQ-91.
   d. AN/TSC-62A.

7. (404) The Communications Central which normally deploys with a forward air control post (FACP) and provides both HF voice and VHF/UHF air-to-ground communications is the
   a. AN/TGC-28.
   b. AN/TSC-53.
   c. AN/TSC-60.
   d. AN/TSC-62A.

8. (404) Which of the following is *not* a function of technical controller in an AN/TSC-62A Communications Central?
   a. Performs circuit and channel quality control.
   b. Establishes subscriber communications circuit requirements.
   c. Restores and reroutes telephone, teletype, and digital communications circuits.
   d. Continually supervises the operating condition of communications facilities.

9. (405) Which 407L equipment can multiplex up to 16 teletype channels onto any of 24 VF channels?
   a. AN/TSC-53.
   b. AN/TRC-87.
   c. AN/TPS-43.
   d. AN/TRC-97A.

10. (405) Which of the following equipment is a highly mobile ground radar set?
    a. AN/TRC-87.
    b. AN/TPS-43.
    c. AN/TSC-53.
    d. AN/TRC-97A.

11. (406) What type of subscriber signaling does the AN/TTC-30 use?

a. 20 Hz/90 volts.
b. Local battery.
c. Dual-tone multifrequencies (DTMF).
d. E&M.

12. (407) What are the two functional groups of switches used in the TRI-TAC program?

a. Digital and analog switches.
b. Digital and circuit switches.
c. Message and circuit switches.
d. Message and analog switches.

13. (407) What switch provides automatic secure switching of record and data traffic for up to 50 individual users within the TRI-TAC system?

a. The AN/TTC-39 Automatic Telephone Central.
b. The AN/GYC-7 Automatic Message Switching Set.
c. The SB-3865/TTC Automatic Telephone Switchboard.
d. The AN/TYC-39 Automatic Message Switching Central.

14. (407) What are the user capabilities of the AN/GYC-7 Automatic Message Switching Set?

a. Up to 30 users with data rates of 45.45 to 1,200 bps.
b. Up to 12 users with data rates of 45.45 to 1,200 bps.
c. Up to 50 users with data rates of 45.45 to 37,000 bps.
d. Up to 600 users with data rates of 45.45 to 37,000 bps.

15. (408) How many digital groups and local digital subscriber loops can the AN/TRC-170 Digital Troposcatter Radio Terminal Set accept?

a. Up to 4 and 15 respectively.
b. Up to 4 and 30 respectively.
c. Up to 15 and 30 respectively.
d. Up to 30 and 15 respectively.

16. (408) What is the RF bandwidth of the AN/TRC 170 Digital Troposcatter Radio Terminal Set?

a. 2 to 200 MHz.
b. 3.5 to 7 MHz.
c. 35 to 70 MHz.
d. 20 to 200 MHz.

17. (408) Which of the following is *not* a trunking application of the AN/TRC-170?

a. Multitrunking.
b. Internodal trunking.
c. Intranodal trunking.
d. Drop and insert at a relay.

18. (409) Which piece of TRI-TAC equipment provides a power and signal interface for repeatered coaxial cables?

a. TD-1234 RMC.
b. TD-1237 MGM.
c. TD-1218 LSPR.
d. MD-1023 LSCDM.

19. (409) With inputs of 16 kbps, the output range of the TD-1235 Loop Group Multiplexer (LGM) a balanced NRZ group of

a. 128 to 576 kb/s.
b. 128 to 288 kb/s.
c. 256 to 288 kb/s.
d. 256 to 576 kb/s.

20. (410) What TRI-TAC facility provides centralized management and control of a communications node?

a. The TA-954.
b. The AN/UXC-4.
c. The AN/TSQ-111.
d. The AN/UGC-137.

21. (410) The function of the AN/UGC-137 Single Subscriber Terminal (SST) is to provide

a. a digital facsimile capability for TACS users.
b. centralized management and control of a communications node.
c. a transmit and receive capability of record message traffic.
d. secure, nonsecure voice and secure data access to circuit switched digital networks.

22. (411) External signals enter the AN/TSC-62A Communications Central through

a. 40 external 407L cable hocks on six entrance panels.
b. 60 external 407L cable hocks on six entrance panels.
c. 40 external 407L cable hocks on four entrance panels.
d. 60 external 407L cable hocks on four entrance panels.

23. (412) The communications equipment of the AN/TSC-62A van is arranged in

a. ten equipment racks numbered Al through A10.
b. nine equipment racks numbered A2 through A10.
c. ten equipment racks numbered 1A1 through 1A10.
d. nine equipment racks numbered 1A2 through 1A10.

24. (412) How many TA-312s are used as voice orderwires in the AN/TSC-62A?

a. 2.
b. 3.
c. 4.
d. 5.

25. (412) How many 48-volt power supplies are located in rack assembly 1A3 of the AN/TSC-62A?

a. 1.
b. 2.
c. 3.
d. 4.

26. (413) The analog (VF tone) patch jack field of the AN/TSC-62A can accommodate

a. 8 full duplex circuits.
b. 24 full duplex circuits.
c. 276 send and receive lines.
d. 144 send and receive lines.

27. (413) A signal inserted at a test trunk jack of rack 1A8, 1A9, or 1A10 of the AN/TSC-62A appear on a corresponding

a. test trunk jack of rack 1A3.
b. test trunk jack of rack 1A5.
c. interbay trunk jack of rack 1A3.
d. interbay trunk jack of rack 1A5.

28. (414) In the AN/TSC-62A van, what test tone capabilities are provided by the SG-815 Standard Tone Generator?

a. 300 to 3 kHz outputs at 0 or –4 dBm.
b. 300 to 3 kHz outputs from 0 to –4 dBm.
c. 1,004 or 2,600 Hz outputs at 0 or –4 dBm.
d. 1,004 or 2,600 Hz outputs from 0 to –4 dBm.

29. (415) What equipment in the AN/TSC-62A van is used to convert out-station battery levels to be compatible with the levels of in-station users?

a. Tone keyers.
b. Tone converters.
c. Line isolation units.
d. Four-way/four-wire bridges.

30. (416) What equipment in the AN/TSC-62A van provides intercommunication between two-wire users?

a. TA-341 Telephone Sets.
b. TT-588 Teletype Orderwire.
c. TA-312/PT Field Telephone Sets.
d. SB-3260 Manual Telephone Switchboard.

31. (416) What is the purpose of the electrical service unit (ESU) assembly of the AN/TSC-62A van?

a. It distributes power to the various equipment throughout the van.
b. It provides a current and voltage monitoring capability for van power.
c. It distributes the outputs of the +60 volt and -48 volt power supplies.
d. It supplies power to the page printer/keyboard of the TT-588 teletypes.

32. (417) Primarily, how are user circuit faults detected by the technical controller in the communications nodal control element (CNCE)?

a. By manual fault detection and isolation.
b. By automatic fault detection and isolation.
c. By manually scanning user circuits periodically.
d. By periodic individual user line service checks.

33. (418) What effect does a processor failure in the AN/TSQ-111 Technical/Management Shelter have on traffic flow?

a. It continues without interruption.
b. It is interrupted until the fault is corrected.
c. Message traffic is held in queue until the fault is cleared.
d. Message traffic must be retransmitted when the fault is cleared.

34. (419) How many telemetry reporting sources can the TSQ-111 van support?

a. 4.
b. 10.
c. 25.
d. 40.

35. (419) What provides the means for interconnecting digital circuits in the CNCE?

a. The main distribution frame (MDF).
b. The combined distribution frame (CDF).
c. The communications entry panels (CEPs).
d. The intermediate distribution frame (IDF).

36. (420) The digital signal monitoring and processing subsystem of the AN/TSQ-111 Technical/ Management Shelter provides

a. digital voice, teletype, and data order wires.
b. automatic patching, fault detection, and isolation.
c. manual patching, line conditioning, and automatic analog testing.
d. manual patching, line modems, and channel reassignment function (CRF).

37. (420) The processing of internal telemetry fault and performance data in the AN/TSQ-111 Technical/ Management Shelter is a function of the

a. control subsystem.
b. processor subsystem.
c. fault detection subsystem.
d. communications control subsystem.

38. (420) The entry controls and display devices which interface the controller to the processor subsystem in the communications nodal control element (CNCE) are a part of the

a. control subsystem.
b. facilities subsystem.
c. fault detection subsystem.
d. communications control subsystem.

39. (421) What provides a termination for all analog circuits entering the CNCE?

a. The main distribution frame (MDF).
b. The equal level patch panel (ELPP).
c. The combined distribution frame (CDF).
d. The intermediate distribution frame (IDF).

40. (421) What kind of tests does the automatic analog tester (AAT) of the CNCE make?

a. inservice.
b. out-of-service.
c. end-to-end quality.
d. inservice and out-of-service.

41. (422) What provides termination, patching, and distribution for all digital groups that enter the CNCE?

a. The main distribution frame (MDF).
b. The equal level patch panel (ELPP).
c. The combined distribution frame (CDF).
d. The intermediate distribution frame (IDF).

42. (422) The major components of the digital signal monitoring and processing subsystem in the CNCE include all of these *except* the

a. main distribution frame (MDF).
b. automatic digital tester (ADT).
c. combined distribution frame (CDF).
d. intermediate distribution frame (IDF).

43. (423) Internal equipment faults of the AN/TSQ-11 technical/management shelter are automatically detected and isolated to the

a. system level.
b. circuit level.
c. subsystem level.
d. card/module level.

44. (423) Including keyboard data entry and software control processing, how long does the automatic routing and restoral of digital channels in the AN/TSQ-111 take?

a. 3 seconds per channel.
b. 5 seconds per channel.
c. 15 seconds per channel.
d. 45 seconds per channel.

45. (423) What is the record keeping capacity of the CNCE?

a. Up to 1,500 pages.
b. Up to 3,000 pages.
c. Up to 5,000 pages.
d. Up to 15,000 pages.

46. (424) Which subsystem provides the CNCE with voice and data order wires and voice intercom?

    a. The control subsystem.
    b. The processor subsystem.
    c. The control communications subsystem.
    d. The digital monitoring and processing subsystem.

47. (424) In the timing subsystem of the AN/TSQ-111, how many basic clock frequencies are phase-locked to the reference frequency?

    a. 7.
    b. 8.
    c. 9.
    d. 10.

48. (425) Approximately how long does it take to set up limited communications using an AN/TSC-107 once equipment has arrived at the deployment site?

    a. Ten minutes.
    b. Fifteen minutes.
    c. Thirty minutes.
    d. One hour.

49. (425) When the AN/TSC-107 is in the operational mode, at *least* how far from the power unit must the fuel bladder be deployed for safe operation?

    a. 10 feet.
    b. 20 feet.
    c. 50 feet.
    d. 100 feet.

Please read the topic page for Unit 2 and continue. ➡

STUDENT WORK SPACE

FIXED TECHNICAL CONTROL FACILITIES

Page

Now that you have been introduced to the mobile side of our career field, let's discuss the fixed facility that most people encounter. Very seldom will you find two facilities exactly alike in the Air Force. By now you know that some fixed controls are large, with perhaps hundreds of circuits passing through them and others are small, with relatively few circuits. Some are modern facilities, while others are older. Regardless of whether control facilities are large or small, new or old, they all have many things in common. It is these common characteristics that we discuss in this unit.

2-1. Systems Control Operation

Systems control is the function that ensures user-to-user service is kept on a real-time basis under changing traffic conditions, user requirements, stresses, disturbances, and equipment disruptions.

426. Components and objectives of systems control

Components. The systems control theory is designed to support DCA and the MilDeps in management, operation, and maintenance activities. The systems control theory builds on the inherent monitoring and control features of the DCS and non-DCS facilities to help execute related management activities. This control must be exercised at the lowest level consistent with authority and resources. Systems control must be able to react and to supply guidance to these responses:

a. For a predetermined course of action in response to a specific condition. These instructions could change the configuration of the system, the network, or their associated facilities. The changes would be based on a variety of engineering factors, operational performances, user demands on the existing system for service, or traffic analysis indicators that may be monitored during system, network, or facility operations.

b. For an improvised course of action in response to an unanticipated event such as natural disturbances or equipment failures, circuit outages or degradations, or unusual traffic demands.

Facility surveillance. Provides real-time equipment, transmission network, and terminal trend data on the status of the system, network and facilities, and their near-term performance over a period of time. Where "real-time" is the time it takes to react to a situation, "near-term" is a longer period of time in which analysis and more permanent corrective actions are started. It also includes associated near-term data reduction and analysis to support the near-term network and technical control. It provides data to support mid- and long-range systems management, engineering, operation, and maintenance.

Traffic surveillance. Provides real-time data on systems and network loading, data processing queue status, message backlog, buffer-fill-rate data, and other measures to describe system, network and facility congestion, and traffic load. It also includes associated near-term data reduction and analysis to support traffic control. It provides data to support mid- and long-range systems management engineering, operation, and maintenance.

Network control. Provides real-time and near-term control of switched or special networks and their associated transmission circuitry. It also has the authority to reconfigure its system back to a previously known configuration if circumstances deem it necessary. Other functions available to the network controller are circuit and system restorals, extension of supervision, control of the satellite system, and payload and allocation of resources.

Traffic control. Provides real-time and near-term control of traffic flow routing, such as code cancellation, code blocking, alternate route cancellation, line load control, and user prioritization.

Technical control. Provides real-time transmission system configuration control, quality assurance, and quality control. Technical control also handles alternate routing, patching, testing, directing, educating the users, coordinating, restoring, and reporting functions necessary for effective maintenance of transmission paths and facilities. (Technical controls are discussed in greater detail later in this unit.)

Objectives. Significant changes will occur during the next decade in the technology and facilities that make up the DCS. The primary objectives for systems control throughout this evolution are to:

a. Keep critical subscriber and system connectivity without excessive use of available system or network mission capacity.

b. Incorporate a level of control and systems management survivability consistent with the survivability of the user.

c. React quickly and flexibly to assure sustained quality user service through timely and effective monitoring, analysis, and control execution in both normal and stressed environments.

d. Interoperate with control systems associated with other communications systems - such as tactical, allied and commercial carriers - to allow maximum flexibility in restoring user service.

e. Maximize system efficiency through effective control action.

f. Improve management visibility of status, quality of service, and performance of systems through an integrated reporting and management information system.

g. Aid in the effective use of limited operation and maintenance manpower at DCS stations.

h. Minimize manpower resources required for control and for the provision of support information.

i. Provide information to support systems management, engineering, operation, and maintenance.

The description and objectives of systems control listed above are written for a system that provides end-to-end user service. They can be applied to both DCS and non-DCS requirements. The responsibilities for systems control of non-DCS facilities, networks, and systems must be fulfilled according to military department or other operating agency directives.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

426. Components and objectives of systems control

1. At what level of authority is the inherent monitoring of systems control executed? lowest level consistant with authority & resources

2. To what type of responses must systems control react? determine course of action & improvise an unexpected event

3. What are five interrelated functions that make up systems control? Facility & traffic surveillance, network traffic & tech. control

2-2. Technical Control Operation

The technical control picture would be incomplete without spending some time discussing the associated facilities with which you must work. Technical control can be effective only when it is wholeheartedly supported by its associated support facilities and when it receives full support in reporting from its subscribers. Technical control exercises operational control over its support facilities. To get the fullest cooperation from the support facilities, you must keep them fully informed on all factors affecting their operation. You will find that using tact and diplomacy greatly simplifies your job-coordinating with other sections. In this section, we discuss the jobs and duties of your support facilities and how they work with you for more effective communications. Keep in mind that the support facilities at your station depend on the mission of your facility.

427. Support facilities

Transmitter Site. A transmitter site shares the responsibility with its technical control facility (TCF) for proper frequency use and is specifically responsible for staying within prescribed tolerances for frequency, modulation, distortion, bandwidth, radiated power, and transmission levels. The transmitter site people not only depend on you for directions about frequency changes, but they also rely on you to certify the quality of the transmitted signal. The certification of proper tuning of each transmit frequency used is your responsibility. Each time a new frequency is brought up, you must check to see that the emission is on frequency, that spurious and harmonic radiations are below maximum allowed levels, that frequency shift is correct, and that signals are in the correct path.

Receiver Site. A receiver site is responsible for making measurements to see that frequencies, signal levels, and signal-to-noise ratios are within prescribed tolerances. It also is responsible for helping the TCF identify harmful interference. As technical controller, you will serve as a receiver attendant at many installations. Much coordinating goes on between the receiver site and the technical control. The facility at the receiver site is considered a patch and test facility, in that it has responsibilities like those of a TCF, but it is subordinate to the TCF.

Both the receiver site and the previously discussed transmitter site are placed away from heavily populated areas, industrial areas, and other communications installations. These sites normally are within 10 to 20 miles of the on base relay facility and are separated by 15 to 30 miles to ensure minimum local and intersite interference.

Maintenance Activities. When trouble occurs with the facilities or equipment associated with your TCF, it becomes necessary for you to coordinate with maintenance. Our mission is to provide high-quality, reliable communications to our subscribers and other facilities, and maintenance must support us in this mission. To support the mission, nearly every command uses a workload control or job control center to centralize maintenance efforts. The job control center has relieved you of contacting each maintenance activity individually. Once you identify the problem and restore service via equipment substitution or circuit reroute, contact job control to initiate a work order for repair action. Job control then notifies the proper maintenance activity in the case of equipment failure. It is also necessary to coordinate periodically with a maintenance activity on the status of equipment repair. For this reason, we will look at a few of these maintenance activities.

NCMO. The Air Force Communications Command (AFCC) established the navigational aids communications management office (NCMO) to serve as a liaison between maintenance and technical control. The NCMO is designed as a centralized office of reporting and management. It is built into the command structure from squadron level through region, area, and command headquarters. Daily standup briefings are conducted for the commander and the commander's staff to make them aware of any problem in operations, maintenance, or logistics within their area of responsibility. Technical control people are now being used in NCMOs.

Wideband communications. The wideband communications specialists, formerly known as radio relay maintenance specialists, maintain all wideband radios, such as fixed and mobile troposphere and microwave radios. They also maintain all voice and data multiplex equipment, telephone terminals and ringing equipment, and the circuit conditioning equipment.

The Air Force specialty code for wideband communications specialists is 304X0. They work very closely with technical control in troubleshooting system outages and determining trouble locations. The wideband communications specialist maintains the TCF; at some sites where the communications facility is not large enough to justify staffing by technical controllers, they are tasked with the operation of a patch and test facility. Of all the maintenance specialists you will work with, the wideband communications specialist is probably the closest.

Ground radio. The 304X4, ground radio maintenance specialist, installs and maintains fixed and transportable low-frequency, high-frequency, very-high-frequency and ultra-high-frequency transmitters, receivers, and transceivers. Ground radio people are assigned to remote transmitter and receiver sites, where they are responsible for changing frequencies on equipment at the direction of the controlling technical control facility. Ground radio people also maintain the high-frequency receiver located in some technical controls that is used to monitor the transmit traffic. In the case of air-to-ground communications, the transceivers are maintained by ground radio. They must be capable of changing preset frequencies on the request of users or technical control.

Teletype maintenance. This career field, 306X2, maintains and repairs all teletypewriter equipment, which includes the card reader, card punch, tape reader, and tape punch. When technical control resolves a problem of an equipment failure, teletype maintenance responds to correct that failure. Teletype maintenance makes sure technical control teletypewriter equipment works within specifications.

Cryptographic maintenance. Crypto maintenance, 306X0 and 306X1, is responsible for the security and maintenance of cryptographic equipment. The cryptographic section enables the many subscribers of the worldwide communications system to send and receive both analog and digital traffic in a secure manner. The ultimate aim of communications security is the elimination of any delay factors directly attributable to the use of communications security equipment during the passage of information from message originator to addressee. This requires the use of automatic, online, synchronous equipment, operating at the speed of the communications system for all modes, including teletype, voice, facsimile, and data.

The digital method of encryption used is known as link encryption. It is nothing more than the protection of the transmission path from relay station to relay station and from relay station to tributary station. This method is the most widespread way to secure digital traffic. It provides transmission security for all message traffic and increases the speed and reliability with which classified messages are handled.

In a terminal TCF, crypto maintenance coordinates with technical control for all online maintenance and secure key changes. High-speed data circuits and composite data links are being designed for link encryption.

The analog method of encryption is a way to encrypt a normal voice circuit. The equipment is at the subscriber's terminal, and the subscriber alone exercises the option to use the encryption device when necessary. As controller, you coordinate outages incurred on these voice circuits in the same way as on any voice circuit. Any failures occurring with the encryption devices, however, are reportable to the cryptographic section. Because of the sophistication of encryption devices, all lines and paths must be conditioned for maximum circuit reliability.

Inside/outside plant. The primary duty of inside plant maintenance is to maintain distribution frames, switchboards, and in-house cabling. Your on-base subscribers, unless they are colocated with the technical control facility, transverse over the base cable. Sometimes it becomes necessary to coordinate and troubleshoot problems with inside plant maintenance. If, however, problems arise on the aerial or buried cable, outside plant maintenance is called for troubleshooting or repair action.

PMEL. Another support facility we rely on is the precision measurement equipment laboratory (PMEL). PMEL calibrates all of our test equipment. Most test equipment requires calibration every 180 days. If test equipment is not operating correctly, technical control sends the test equipment to PMEL for repair. They are responsible for such equipment as oscillators, oscilloscopes, noise- and level-measuring sets, envelope delay-sets, frequency-selective voltmeters, and frequency counters.

Power Production. All communications equipment requires power from an alternating- or a direct-current source. Equipment performance depends on stable power supplies that prevent abnormalities such as short-time transients and power surges. Power system reliability has a direct effect on the reliability of communications. Whenever it is necessary to change a power source, the TCF is notified. Technical control then tells the proper individuals of a power change and stands by in case of a failure. The TCF may deem it necessary to defer the power change if it will substantially degrade the mission.

In the event of any failure, the power facility is responsible for providing the TCF with an alternate power source. The three basic sources of power are the primary, the no-break, and the auxiliary power.

Primary power. The primary power source is commercial power bought from a local utility company or power generated by a base power plant.

No-break power. The no-break power supply provides a continuous, reliable source of power to critical equipment. The no-break, or uninterrupted power supply (UPS), generally falls into two classes: rotating mass stored energy systems using flywheels for energy storage, and rectifier-battery-inverter systems in which the energy is stored in fully charged batteries.

Auxiliary power. The auxiliary power source is available if the primary power source fails. It has at least one standby diesel driving an alternating current (AC) generator. It must be started and brought up to speed before being switched on line. The emergency unit is connected to the system by a transfer switch and can supply the system with a reliable source of power within 15 minutes of the loss of the primary power source.

AC power is available in many forms, such as voltage, phase, and frequency. The type of power required by your particular station is determined by the equipment installed at the station.

All AC-powered communications equipment made in the United States is available in models that require an input frequency of 60 Hz. Some equipment is also available in models that can run on AC power supplied at a frequency of 50 Hz. Most foreign-made equipment is designed to run only on 50 Hz power sources. Since most of the equipment at any DCS station is made in the United States, the primary AC source at your station should be 60 Hz. To run equipment designed for other frequencies, a rotary or solid-state static converter is used to change the frequency of the primary power.

Most communications and test equipment we use works on 120 volts single phase. But equipment that requires large amounts of power, such as a high-powered radio transmitter, generally works on 240 or 480 volts, three-phase power. These are nominal voltages, and a variation of 5 percent usually can be tolerated.

Equipment that requires 120-volt input power generally is designed for single-phase power, and most equipment that requires 240-volt input power is designed for three-phase power. Three-phase power is generated by three separate induction coils in the generator. The method of connecting these three coils results in various configurations and may be arranged to give different voltages in the range of 208 to 480 volts. The three coils, and the individual phases they produce, are separated by 120° so that there is equality between the three phases. The high powered generating plants normally produce the three-phase power. Most DCS station equipment uses only single-phase power. Distribution of primary power within the station is important; therefore, disparity between loads on individual phases creates problems and should be balanced within reasonable limits.

Power distribution within a DCS station begins at the main power panel and extends to the operating equipment. Subpanels, transformers, and circuit breakers may be included in the distribution circuits. Communications equipment in the station may be divided into two or more major groups. Each major group of equipment is connected to the main power panel. Radio transmitting stations have the largest and most complex power installation of the DCS. The output voltage and the configuration of engine-generator units determine whether the distribution from their generators is connected to transformers or directly to the bus bars on the main switchboard. Distribution lines from the power panel to operating equipment are installed in floor trenches, in ducts, or on cable racks.

Commercial Communications Facilities. Military policy is to lease commercial facilities for communications within the CONUS except when unusual security or operational conditions prohibit their use. In both peace and war, these facilities have proven to be operationally reliable and fully responsive to military requirements. This means that the military services stay largely dependent on the commercial communications systems of the nation. Hence, the military services have a vital interest in any changes that may adversely affect the capacity and operational efficiency of commercial systems. You should understand the nature of the services provided by these sources because they are the people most often contacted at the working level.

When a circuit is leased, it goes from one terminal to another terminal. We are not directly responsible for troubleshooting the leased part of the communications link. If we find that the Government-furnished equipment (GFE) at either end is satisfactory, we turn the problem over to the proper commercial activity. This could be RCA, AT&T, Western Union, ITT, and many more. Channels provided by these organizations send communications via cable, HF radio, satellite, and microwave systems throughout the United States and in many foreign countries. The undersea cable system, for instance, reaches all parts of the world through interconnection with a variety of foreign systems. Regardless of the media used, if the parameters are not met, the circuit may be logged out, and this time is chargeable to the commercial agency until the problem is fixed. But, if the problem is turned over to the commercial carrier and it becomes a GFE problem, the commercial carrier is allowed to charge the Government. As long as the DCA parameters for the circuit are met, the carrier company may change the media it transverses daily.

In some cases, the Government has found it to be more convenient to lease equipment with maintenance supplied or to contact maintenance for Government equipment. The most cost-effective condition is the one chosen. For instance, Honeywell has a Government contract to provide computers and terminals. They are also responsible for maintaining the equipment. Rather than have the DOD buy equipment and then train people to maintain and repair it, it is cost-effective to lease. This way, if a computer needs expanding or replacing, it is covered under the contract.

Sometimes, when a facility has special equipment, a commercial maintenance worker is assigned to maintain the equipment, such as CODEX, Philco Ford, and Telesig equipment. The maintenance on this equipment is critical to maintain quality communications.

Distant Control Facilities. In the course of your duties, you will test, monitor, and watch outgoing and incoming circuits to ensure proper operation. You must coordinate with local users and with distant stations to isolate and correct troubles. The distant control facility is not aware of your problems until you tell someone there. And, only then, if your communication is clear and concise, will it help clear up the problem.

When coordinating with distant controls or with associated facilities, be sure your instructions are accurate and complete. Proper terminology enhances your operation. Exercising tact is of prime importance when coordinating and more than repays you in improved relations and increased cooperation.

In the preceding paragraphs, we have discussed support facilities. As you probably can see, support facilities provide long-haul communications. This communications business is a team effort. Remember, one weak link weakens the entire chain. Don't let that weak link be the technical control facility because this would result in poor service to our subscribers, and, as you know, our primary purpose is to provide the best possible service to our subscribers.

You, no doubt, remember the continued emphasis during your resident training on service to our subscribers. You also have noticed that throughout this course we mention our subscribers or "users." In the next section, we discuss some of our subscriber facilities primarily to refresh your memory. We do not go into great detail because of the extensive training you already have received on the subject.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

427. Support facilities

1. Match each definition concerning maintenance activities in column A with the appropriate term in column B.

Column A	*Column B*
F (1) Maintains distribution frames, switchboards, and in-house cabling.	a. Outside plant
B (2) Maintains and repairs card readers and tape readers.	b. Teletype maintenance.
D (3) Calibrates all test equipment such as oscillators and oscilloscopes.	c. Power facility.
E (4) Repairs multiplexing equipment and circuit conditioning equipment.	d. PMEL.
A (5) Implements and maintains all on-base cables.	e. Wideband communications facility.
G (6) Maintains and repairs all HF radio equipment.	f. Inside plant.
H (7) Provides secure communications.	g. Ground radio.
C (8) Provides three basic sources of power.	h. Crypto maintenance.

2. Why is it so important that you notify the distant end TCF when you have a problem?
Its often their own means of knowing

2-3. Alarm and Fault Indicator Systems

Fault isolation is the process of finding the location of a trouble within a circuit or within the transmission media that carries the circuit. The trouble could be in any of the transmitting facilities of one station, the receiving facilities of the adjacent station, the media connecting them, or the user's equipment that terminates the circuit. After the general area of a trouble has been isolated (for example, media, user equipment, access lines, etc.), a decision can be made to provide the quickest method of restoral. Fault isolation is not a finger-pointing or blame-fixing exercise. Its basic purpose is to find the source of a trouble and get it fixed, regardless of where it is or which piece of equipment is at fault. When the same problem recurs at frequency intervals, it becomes a prime concern of both DCA and O&M agencies, and corrective measures must be taken.

The first step in fault isolation is to recognize that a problem exists. On the surface, fault recognition may seem to be a trite phrase, but most DCS problems are the result of failing to see trouble signs. Trouble recognition may be a result of quality control testing equipment sensors and alarms, customer complaint, or any combination of these. The main point is that when trouble signs appear, regardless of how or from whom, coordinated actions to identify the location of the problem must be started at once by the person recognizing the trouble.

The present-day DCS is an exceedingly complex system that demands utmost competence and attention to technical details by all operations, control, and maintenance people. In a system as sophisticated as the DCS, there is little room for error, for even a small error can easily be compounded into a series of errors that can render a circuit, system, or service unusable. Every station and link in the system was originally tested and accepted as meeting a specified level of performance. If the system is to continue operating at that level, each electrical standard must be kept within the established parameters. The day of "it's only off a couple of dB" has long gone by the board.

The DCS is made up of many types of equipment that do the same work but do not have the same electrical characteristics. For example, not all of the VF channel multiplex equipment in the DCS are designed for a –16 dBm transmission level point (TLP) input to the VF channel modulator. Because of the detailed differences that exist, no cut-and-dried test-point fault isolation procedures exist that cover all possible installations. Certain functional areas are common to all systems, regardless of the installed equipment. The procedures in this unit, therefore, are addressed to functional areas rather than to specific signal and test-tone levels at the equipment. We begin this section with information about fault isolation aids.

428. Fault isolation

It is often difficult to find the trouble in a circuit or transmission medium, even for the experienced controller. Successful controllers know the circuits and systems with which they work, and they use established procedures and other aids. We suggest 10 fault isolation aids to you:

(1) Written procedures.
(2) Ready reference charts and placards.
(3) Equipment/subsystem block diagrams.
(4) System/network configuration plans.
(5) Circuit/trunk records.
(6) Plant cabling cross-reference files.
(7) Intercommunications.
(8) Operational adjustments.
(9) Test facilities.
(10) Alarms and indicators.

We exclude "customer complaints" from this list. Although complaints are fault indicators, and information from customers can be helpful, we don't list them because we do not want to imply that you should rely on them.

Written Procedures. Each station (fixed or transportable) should write local fault-isolation procedures based on the particular type of equipment installed in that station, the design capability of each link or system, the types of patch panels and other test points, and the available test equipment. The procedures should include diagrams showing test-tone levels, impedances, and calculated noise levels for each test point throughout the station.

Effective fault isolation requires the complete coordination and cooperation of operation and maintenance people working as a team. For this reason, the station's written procedures should clearly identify which tasks you normally should do and which tasks maintainers should do. If this information is not included, it can lead to arguments between maintainers and controllers.

Maintainers often may be apprehensive about letting you make equipment adjustments, especially internal ones. But, cooperation on these matters can be easily had. All you have to do is talk to the head maintainer and come to an agreement, in writing. You may find that you will be allowed to make some adjustments that you never thought you would. Before leaving this subject, we should tell you how DCA feels about controllers making adjustments. We quote from DCAC 310-70-1, as follows:

> Equipment adjustments made by technical control personnel will normally be limited to operational controls which are necessary for proper circuit operation; i.e., line current levels, composite audio levels, mode changes, channel reduction, or paralleling (twinning). They will not normally adjust, or attempt to adjust, any of the controls used for equipment alignment.

Ready Reference Charts and Placards. Each station should have ready reference charts or placards at or near each patch panel and other test points. Such references should show test-tone levels, signal and noise levels, and allowable tolerances. They may take the form of labels affixed to patch panels or equipment panels. They include receiver quieting curves, AGC graphs, and block diagrams.

System Plans. System and network configuration plans are valuable to you. Plans of this type show transmission facilities, such as trunks, links, and VFCTs. They are useful in circuit-rerouting and fault-isolation because they show routing, composition, and capacity.

In tactical communications, planning people prepare *system trunking plans* that show, in line diagram form, a layout of system channel requirements and termination locations. Due to the nature of tactical communications, several preplanned configurations may be on hand to take care of mission requirements. These may be modified when actual deployment takes place.

The DCA prepares several configuration plans to cover networks or systems within each DCA area. For example, DCA European Area Headquarters people draw, print, and distribute plans of weather facsimile networks, VFCT trunking networks, major transmission routes, and voice channel multiplex configurations.

Some DCA plans may seem complex and perplexing when one first looks at them. For instance, the multiplex plan for the European area also shows the wideband link layout. It takes several sheets of paper to cover the whole area.

Cabling Files. Cabling records and distribution frame wiring files are useful during fault isolation. Inside plant wire maintenance people usually maintain such records at fixed stations. Similar records are available for tactical communications facilities.

429. Alarms and alarm systems

As a technical controller, you are the technical manager of systems and you are responsible for monitoring the circuits traversing those systems. If equipment failures occur and disrupt parts of a system, you must learn of these failures at once so that you can assess the situation and start action to alleviate the impaired service of the users by rerouting or substituting equipment. For this reason, most alarm systems on communications equipment are extended or remoted to a master alarm panel in the TCF. The number and type of alarms appearing in a TCF vary, but they must be sufficient to give you an adequate indication of the status of the station and communications equipment used there. The alarms are divided into two levels, which indicate the degree of impairment of the total capability of the facility. Major alarms indicate a loss of more than 10 percent of the capacity of the cross section, while minor alarms indicate the loss of less than 10 percent.

Master Alarm. All vital circuits in the multiplexers are connected to an extensive alarm system that provides a visual alarm (lamp) whenever a failure occurs. Two types of alarm conditions are established—major and minor. A major alarm condition occurs when a circuit failure causes a loss in service, if any one of the five incoming pilots is not received or is received improperly by the group pilot alarm, or if the synchronization pilot is lost. A minor alarm condition occurs when a circuit failure does not cause a loss of service. The following assemblies are monitored by the failure alarm system:

- Master frequency generator assembly.
- Channel carrier generator.
- Channel carrier supply,
- Channel carrier amplifier.
- Group carrier generator.
- Group carrier supply.
- Group carrier amplifier.
- Supergroup carrier generator.
- Supergroup carrier supply.
- Supergroup carrier amplifier.
- Power supply assembly.
- Supergroup demodulator.
- Supergroup modulator.
- Pilot generator.
- Group pilot alarm (major alarm only).
- Group regulator (major alarm only).
- Fuse panels (minor alarm only).

Minor and major alarm lamps and alarm cutoff switches and lamps are installed on the front panel of the assemblies connected to the alarm system. Any alarm condition lights the appropriate alarm lamp on the front panel of the defective assembly and on the front of the master alarm panel. The alarm cutoff switches are used to restore the failure alarm system to normal after an alarm condition has occurred. When an alarm cutoff switch is thrown to the CUTOFF position, the master alarm panel lamp goes off, and the alarm cutoff lamp on the assembly panel lights up. When the faulty circuit is repaired or replaced, the alarm lamps go off.

The master alarm panel has its own independent power supply, which operates from the primary AC power source. This power supply furnishes the operating current for all alarm lamps in the alarm system. An external alarm circuit allows the failure alarm system to be monitored from a remote position.

Group Pilot Alarm. A pilot is inserted into the group pilot injection networks of each 12-channel group, 20 dB below the signal transmission level. Group pilot alarms pilots are used at the receiving terminal to monitor the 60- to 108-kHz group signals from the group multiplexer shelf. If any one of these incoming pilots is lost or is degraded ±5 dB, an alarm condition is shown by the group pilot alarm lamp on the assembly's front panel. At the same time, a major alarm condition is shown on the master alarm panel. The pilot is supplied by the pilot generator through the group pilot distribution panel.

Station Alarm. Station alarms monitor power and building conditions in the technical control element. They provide both visual and audible alarms and are capable of being paralleled with remote alarm panels installed in locations within the building complex.

Radio Alarm. Radio alarms provide status information from unattended intermediate repeater stations. They provide both major and minor conditions. Typical alarms transmitted to the alarm center include:

- Low-transmitter output.
- Low-receiver input.
- High-received noise on the radio channel.
- Failure of standby equipment.
- Failure of power-generating equipment (high- or low-voltage).
- Fuse operation.
- Low-fuel supply for generators.
- Open door or window (at unattended stations).
- Change of waveguide air supply.

Multiplex Alarms. Multiplex terminal equipment alarms include:

- High- or low-level pilot frequencies.
- Failure of standby equipment.
- Failure to transfer between operational and standby equipment due to lockout or equipment malfunction.
- Fuse operation.
- Failure of carrier supply.

Telegraph and Digital Equipment Alarms. Telegraph and digital terminal equipment, including telegraph multiplex and modem alarms include:

- Telegraph distortion exceeding allowable limits on the order wire.
- Failure of telegraph carrier supplies.
- No transition alarms.
- Fuse operation.

Voice Frequency Terminal Equipment Alarms. These alarms include failure of signaling supply and fuse operation.

Other Alarms. Other alarms include the following:

- Power supply failure/malfunctions.
- Antenna tower light failure.
- Station intrusion and environmental alarms (as required).

All of the alarms mentioned should be connected to the station alarm panel, which should be in the technical control facility, as needed,

430. Characteristics of fault alarm and status reporting and transmission control (TRAMCON) systems

Fault Alarm and Status Reporting (FASR). FASR is the key to the new concept of fault isolation and control of digital equipment for technical control. It provides the alarm conditions to you by a control and status alarm panel and/or by cathode ray tube (CRT) displays. It also provides the means for switching some transmission equipment automatically or manually. The main function of FASR is to help you to isolate a failure or degradation to a location and item of equipment. Service is restored manually or automatically by use of redundant equipment.

Equipment design, modular construction, and built-in test equipment enable rapid detection and replacement of failed equipment. In most digital PCM/TDM equipment, the power supplies and common wiring are the only sections not restorable by module replacement. Since repair of these modules is not generally an onsite function, they are bench stocked. This design makes replacement of equipment almost as rapid and effect as patching. Spare equipment, except for radios, is also available for restoration and fault isolation using the classical method of substitution. Conditioning, terminal and FDM equipment fault isolation, and restoration procedures are not affected by the interface with digital systems.

The functions that may be monitored and alarmed by the FASR are as follows:

BASIC FUNCTIONS:

- AC power failure.
- General "A" or "B" operation and failure.
- Rectifier "A" or "B" operation and failure.
- "A" and "B" radio: Online/offline, TWT failure, transmitter failure, or receiver failure.
- RSL fade.
- Power supply in use and failure.
- Radio: phase lock and synchronization and bulk encryption failure.
- TDM: normal or standby failure, transmit-receive standby online and offline, and normal and standby T-1 fault (port failure), normal and standby framing errors.
- PCM: (digroup) failure and radio mission bit stream (MBS) loss or failure.
- Telemetry.
- No answer from polled station.
- Decoding.
- Parity error.
- Transmit data.
- Receive data.
- Carrier failure.
- Power.

OPTIONAL FUNCTIONS:

- Radio "A" or "B" disable.
- Receiver "A" or "B" online.
- Generator start.
- Generator reset.
- Primary or standby rectifier online.
- TDM transmitter normal or standby online,
- TDM receiver normal or standby online.
- FASR test.

Transmission Control (TRAMCON) Procedures. The purpose of the TRAMCON subsystem is to provide a major systems control facility, such as an FCO, with the capability to supervise subordinate digital terrestrial transmission media and facilities. The TRAMCON subsystem supports two basic functions: (1) monitoring the health of terrestrial digital transmission media and facilities, (2) controlling major transmission media and facility hardware at both manned and unmanned sites from the remote master station.

This subsystem has a master terminal that normally is at the transmission facilities the FCO supervises. The master terminal, equipped with a computer, requests status information from the remote units and, in turn, can transmit back to the locations. This performance data is then transmitted to a TRAMCON master terminal on request. At the master station, the alarm conditions and performance indicators are presented to the systems controller. The systems controller can issue commands to control equipment at the terrestrial digital transmission facilities, which the terminal supervises. This includes substituting suspected faulty online digital transmission equipment with redundant equipment, putting the station on backup power, and other functions (fig. 2-1). Some TRAMCON subsystems already in existence are in Europe, Japan, Korea, and the Philippines.

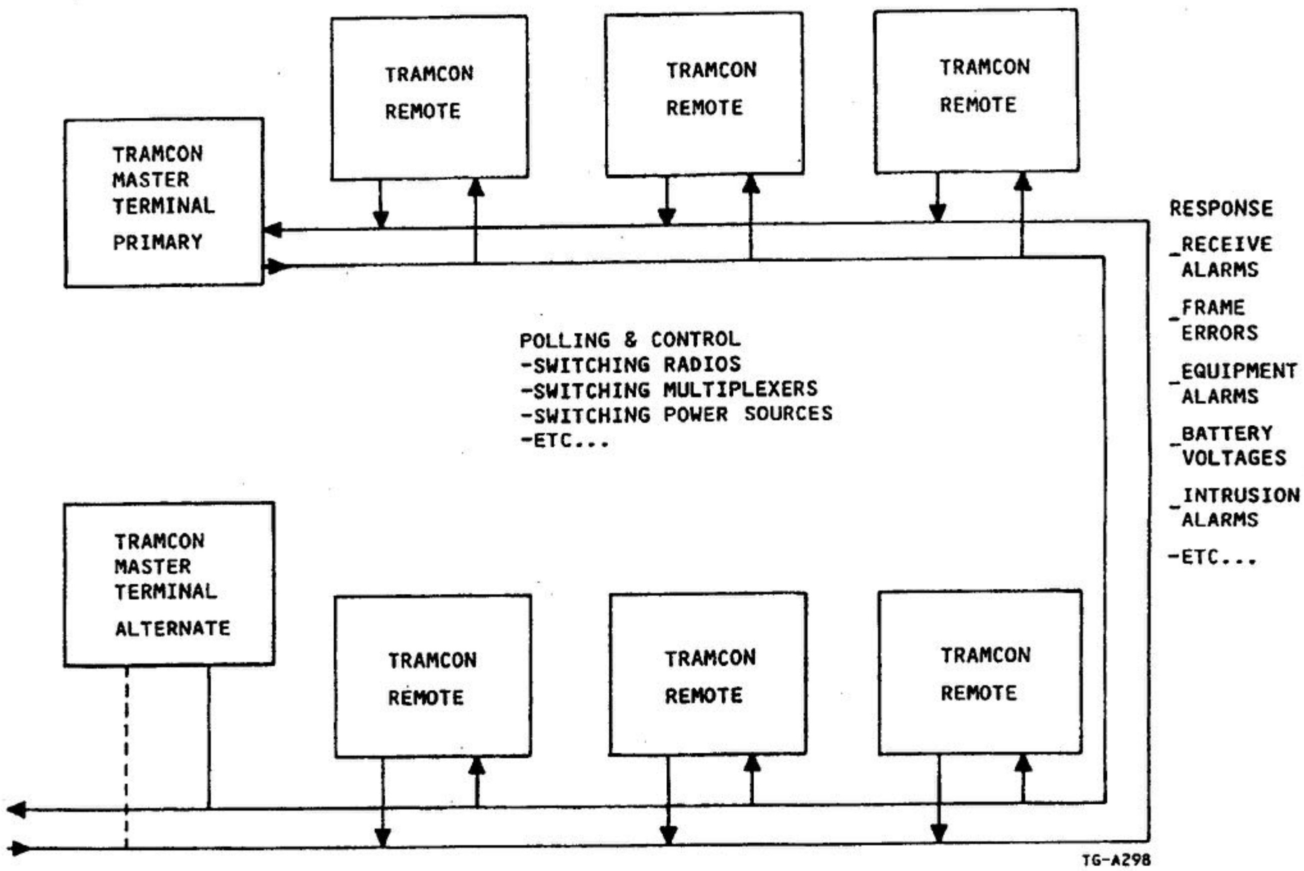


Figure 2-1. Basic diagram of TRAMCON.

In any given system configuration employing two or more TRAMCON terminals, only one terminal has full monitoring and control capability. Such a terminal operates in the "master" mode. Other TRAMCON terminals can monitor in the "slave" mode. Under normal system operation, two or more TRAMCON terminals operating in a master mode cause the system to malfunction.

The master TRAMCON facilities use the full capability of the TRAMCON terminal to isolate faults and restore degraded services. Followup notification is made to appropriate control facilities responsible for operations and maintenance at locations found or suspected to have faulty equipment. In the event of a total system outage, the master TRAMCON terminal may be capable of determining the failed link. But if the fault lies beyond the capability of the master terminal to effect restoral, a system slave TRAMCON is brought online in the master mode to effect the necessary restoral action.

Systems made up of several bulk encrypted links and/or independently encrypted T-1 (1.544 Mbps) trunks require periodic crypto key changeover procedures. Effective systems control is achieved only through prior scheduling and coordination of these key changeovers. As a minimum, no two bulk encrypted links can be changed over simultaneously. Also, no facility simultaneously changes over two independently encrypted trunks. All affected DCS facilities must exercise judgment in scheduling changeovers and ensure final coordination of crypto changeover schedules. These coordinated schedules are developed and implemented by the TRAMCON master station.

Employing TRAMCON capabilities on DCS systems has been a key factor in removing site people at some DCS sites. These now unmanned sites are still as critical to the DCS mission as they were when manned, and your station may be tasked with supplying the maintenance support for one of these facilities.

TRAMCON system operation and restoral procedures are developed at all stations having this capability. Due to systems protocol limitations, these procedures include a rotational schedule to allow TRAMCON slave terminals to be configured for the master mode operation. But the primary master station may at any time assume control of the system. This ensures operational training and experience are afforded to all TRAMCON system operators. Establishing these procedures necessitates coordination among the operations and maintenance control elements and is approved by the area communications operation centers (ACOCs). The polling TRAMCON master terminal monitors and analyzes the status of the monitored segments at all times using the entire capability of the TRAMCON system. A hazardous condition (HAZCON) is opened by the master terminal when these segments cannot be backed up 100 percent.

The supervisor logs onto the mater terminal, as the operator, at the beginning of each shift. He or she then checks the current performance of the monitored segment. At a minimum, the supervisor will:

a. Check all station status and alarm displays for the segment monitored by the master terminal.

b. Check all current link parameter displays for the segment monitored by the master terminal.

c. Tell other master terminal operators on the monitored segment of any conditions which may indicate potential problems during the coming shift (for example, fading, multiplex reframe attempts, etc.).

The supervisor at the master terminal has a responsibility if a station, link, or mission bit stream fails to try at once to restore service by these means:

a. Coordinating with the affected manned facility and helping in overall system fault isolation.

b. Switching to backup or secondary equipment if the affected manned facility cannot be contacted.

The master terminal does not normally switch equipment at a staffed facility if only a port or digroup problem is detected without coordinating with the affected facility. When a port or a digroup is restored through digital systems not monitored by the master terminal, the facility through which the restored port or digroup enters other digital systems is contacted by the master terminal to determine the status of its other networks. Once the status is known, the master terminal can determine whether that station can support the proposed restoral.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

428. Fault isolation

1. Match the items in column B with the descriptions in column A.

Column A	*Column B*
B (1) A chart prepared by the engineer who designed a link showing the calculated idle channel noise versus the median receive signal level for each VF group terminating in the station.	a. Written procedures.
F (2) A notebook listing conditioning equipment by type and number and showing distribution frame block and pin numbers to which they are connected.	b. Ready reference charts/placards.
D (3) A diagram mounted on the wall of a technical control facility near the analog patching bays showing the wideband system layout for your area.	c. Block diagrams.
E (4) Information on each circuit traversing a technical control facility is kept in a card file.	d. System/network plans.
H (5) A technical controller discovers that the composite VFCT level of a certain transmission is 3 dB below what it should be. The controller goes to the VFCT equipment and turns a control knob.	e. Circuit/trunk records.
J (6) Trouble in the AN/UCC-4 multiplexer set is indicated by office alarms, by a lighted red lamp on the master alarm panel, and by a lighted red lamp on each equipment that is in alarm condition.	f. Cable/wiring records.
	g. Intercommunications.
	h. Operational adjustments.
	i. Test facilities.
	j. Alarms and indicators.

429. Alarms and alarm systems

1. What are group pilot alarms used for? monitor signals from group mux shelves

2. What are station alarms used for? monitor power & building conditions

3. Low-transmitter power output, low-receiver input, low-fuel supply for generators, and high-received noise on the radio channel are what type of alarms? Radio alarms

4. High- or low-level pilot frequencies and failure of carrier supply are what type of alarms? Mux alarms

5. If a group pilot is 7 dB below the normal level, is this a major or minor alarm? Major Alarms

430. Characteristics of fault alarm and status reporting and transmission control (TRAMCON) systems

1. What is the main purpose of the fault alarm and status reporting system? aid tech. controller

2. What design feature within the FASR system makes replacement of equipment as rapid and effective as patching? equipt. for modular replacement

3. Why is the TRAMCON subsystem so important to the major systems control facilities? Supervise media & facilities.

4. In a system configuration employing two or more TRAMCON terminals, what would be the mode of operation of these terminals? one master one slave

5. When a TRAMCON system does not have 100 percent backup, what is the status of the system? Hazcon

2-4. Red/Black Concept

As you are by now well aware, communications security is a very important consideration at all times. From a security standpoint, two types of circuits are in most communications centers. Those circuits that have been approved for the transmission of clear text classified traffic are designated "red" circuits. Those circuits used to transmit encrypted traffic and clear text unclassified traffic are designated "black" circuits.

431. Applications of the red/black concept

All red circuits with associated equipment are in a communications building within an area designated as the "RED AREA." All black circuits, with associated equipment, are within the area known as the "BLACK AREA." These two areas are kept physically and electrically isolated from each another.

Electrical separation, as related to the red/black concept, is the isolating of batteried circuits from each other. This is done by using two separate battery sources and employing appropriate COMSEC (cryptographic) devices or battery isolation relays at a median point on communications circuits that traverse the red and black areas. Electrical separation is achieved in this manner because no true metallic path exists between the two segments of the communications circuit. Figure 2-2 shows the sending and receiving parts of a typical DC telegraph circuit that is electrically separated. Battery isolation relays are used in this example.

Physical separation, as related to the red/black concept, is the dispersion of electrical circuitry and equipment by a prescribed distance. In our communications centers, physical separation is achieved by providing duplicate equipment and facilities for the red and black areas and positioning them a specific distance from each another. For example, all patching facilities in the red area are remotely located from the nearest black area patching facility, usually farther apart than the length of the longest patch cord available. In part, this is done to prevent people from inadvertently making connections between the two areas with a patch cord, which could result in a security compromise of classified messages.

Study figure 2-2 again and determine the type of direct current keying being used for the telegraph circuit shown. Is it polar or neutral operation? Observe the positive and negative battery sources for each of the two circuit legs. This tells you that this must be polar operation.

Low-level polar keying is most often used within technical control facilities operating under the red/black concept. Compared with high-level neutral keying, polar operation has the advantage of lower electrical radiation, thus enhancing security.

Another advantage gained by using polar keying is that line characteristic distortion is effectively eliminated. That is to say, polar circuits are less susceptible to changing influences that may be present in the transmission line — inductance, capacitance, low or high currents, etc. Since current of one polarity flows during a marking condition and current of the opposite polarity flows during a space, these transmission-line influences affect both the mark and space elements equally without upsetting the mark-to-space and space-to-mark transition time.

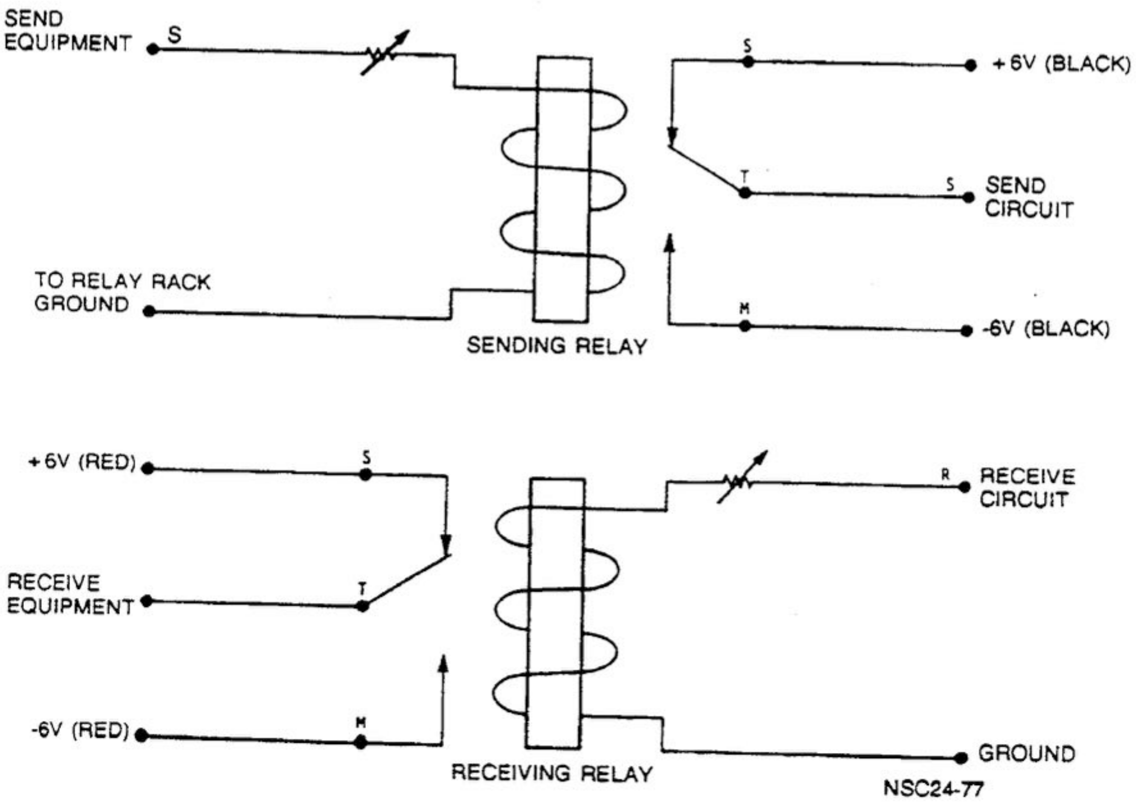


Figure 2-2. Battery isolation relay circuits.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

431. Applications of the red/black concept

1. By what two means are red and black areas of a control facility kept separated?
Electrically + physically

2. Why are the red and black areas physically separated?
Security

3. How is electrical separation accomplished, as it pertains to the red/black concept?
Isolating ckts,

4. What type of keying is most often used within technical control facilities operating under the red/black concept? Low level polar keying

5. Give two advantages polar operations have over high-level neutral keying. Lower electrical radiation + line characteristic distortion

2-5. Distribution Frames

In our future discussions of patch bays, you will notice that we say this or that type of equipment is connected to the patch panels. Of course, you know that seldom - if ever - is any type of equipment connected directly to any patch bay. All connections are made from equipment to patch bays through distribution frames. Although you will probably never have to do any actual wiring on distribution frames, you should be familiar with them since they can be a cause of circuit outages under certain conditions. You should be able to isolate circuit outages caused by faults, on any distribution frame, should the need arise.

In this section, we discuss types of distribution frames commonly found within a DCS station. We discuss the primary function of each type of frame individually, and then, since all frames have common characteristics, we discuss these common characteristics collectively.

432. All about distribution frames

All DCS stations are built so that every communications circuit entering, leaving, or passing through the station is routed through a single point—the distribution frame. The distribution frames are part of the wire facilities of a communications station. In practice, there may be more than one distribution frame installed at a single communications center. This depends on the types and complexity of circuits associated with the facility.

As a technical controller, you are concerned with wire facilities regardless of where you are assigned. Even the smallest station requires a certain amount of wiring to connect the equipment or circuit components together. You won't normally do any of the actual connecting. Instead, this work is assigned to a work section known as the wire maintenance section. It is this support facility that does the soldering of wires and other related tasks so that we may have continuity of circuitry within our communications centers. The wire maintenance section is subdivided into two specialized units known as inside plant wire maintenance and outside plant wire maintenance. Inside plant is responsible for repair and minor installation within the communications center. The outside plant is responsible for maintenance of communications cables connecting local subscribers to the communications center.

You must have a basic knowledge of wiring techniques and facilities. Such knowledge is essential to direct and coordinate activities concerning troubleshooting, installing new circuits, and monitoring of circuits.

The types of distribution frames in a DCS complex are distinguishable on the basis of how each is actually used. The names used to describe the frames are main distribution frame, combined distribution frame, intermediate distribution frame, black distribution frame, and red distribution frame. The basic term "distribution frame" is defined for reference purposes as a structure for terminating permanent wires of a communications building (for example, DCS technical control facilities and commercial telephone central offices). It also permits easy change of connections between them with temporary crossconnecting wires. Now, let's discuss each frame individually, beginning with the main distribution frame.

Main Distribution Frame (MDF). You are familiar with the construction of a distribution frame with respect to vertical and horizontal terminal blocks. From outward appearances, distribution frames look the same and vary only in size and usage. The main distribution frame is so named because it is normally much larger than other frames and is the terminal point for all outside lines coming into a station.

Outside lines are terminated on the vertical blocks of the frame through protective devices. Horizontal blocks carry all in-station equipment that carries circuits to be connected to outside lines. Connections between the two sides are made by cross connections, which we discuss later.

Intermediate Distribution Frame (IDF). This type of frame has been borrowed for military use from the commercial telephone industry. It is officially defined as a distribution frame on which the subscriber line multiple appears on one side and the subscriber line circuit on the other for interconnection. You generally encounter this type of frame at a communications center where telephone switchboard facilities are provided. A "subscriber line multiple" is a circuit accessible at several switchboard positions so that more than one operator may have access to the same line. The term "intermediate distribution frame" has also been used to describe a frame facility positioned at an intermediate point (in the technical control room) between a main distribution frame and the technical control patching facilities. In this case, it doubles as the black distribution frame associated with the red/black concept.

Combined Distribution Frame (CDF). This type of frame combines the functions of a main distribution frame and an intermediate distribution frame. Part of this frame is used to connect all outside lines entering the station. Another part is used to connect cables that terminate in electronic devices and other equipment within the station. This arrangement permits the association of any outside line with any desired terminal equipment.

Red Distribution Frame. The red distribution frame is used to make connections between red circuits, patching facilities, and equipment. Wiring that terminates equipment, such as transmitter distributors and reperforators, is connected to the vertical side of the red distribution frame. Wire connections for the unencrypted side of cryptographic devices, battery isolation relays, red circuit control, and switching and monitoring devices are made on the same portion. The horizontal side of the red distribution frame is used to connect red patching facilities and the positive and negative rectifiers that furnish battery.

Black Distribution Frame. The black distribution frame is used to make connections between black circuits, patching facilities, lines and channels, and equipment. The black distribution frame has the same configuration as the red distribution frame. At many stations, the red distribution frame is much smaller, and it is sometimes enclosed in a cabinet. The horizontal side of the black distribution frame is used to connect analog and digital patching facilities and the positive and negative battery supplies. The vertical side is used to connect the following items: all landlines, both analog and DC; VF channels derived from radio media; encrypted side of cryptographic devices; battery isolation relays; and any black circuit control, switching, or monitoring devices used in the technical control facility.

Distribution Frame Components. In addition to the metal frame structure itself, a distribution frame has several detachable parts, such as terminal boards and wire guides.

Terminal boards. Terminal boards are insulated bases, or slabs, provided specifically to mount a group of wiring terminals. Wood, ceramic, and plastic are among the materials used in their construction. The two parts of a terminal board are the wiring terminal support and a mounting board, which also serves as a wire guide. The terminal boards are secured to the metal frame structure by screws so that they may be added or removed as required.

All of the terminal boards on one side of a distribution frame are positioned vertically. This side is called the vertical side, and the terminal boards are called vertical terminal boards. The other side of a distribution frame has terminal boards positioned horizontally. They are called the horizontal terminal boards. On the terminal boards, there are insulated terminals to which two or more wires may be connected. The terminals, called tie-points, are usually of different lengths, with the longer ones positioned toward the rear to make wiring and soldering easier.

Wire guides. There are two types of wire guides—jumper rings and fanning strips. Jumper rings are heavy metal loops positioned between the vertical and horizontal sides to guide cross-connecting wires. Fanning strips are wooden guides through which several small holes have been drilled. They are positioned close to the terminal boards or protectors to guide wires to these devices. Fanning strips associated with the cable protectors are usually one continuous guide reaching the entire height of the vertical side of the frame. The other fanning strips are the same length as the terminal board and are considered part of it, as mentioned earlier.

Permanent wiring. Permanent wiring is found on the left side of the vertical terminal boards and the bottom of the horizontal boards. As the name implies, permanent wiring is fixed permanently to the frame. This wiring connects such equipment as outside cables, multiplexing equipment, teletype equipment, COMSEC equipment, battery taps, and patch panels to the frame. Patch panels, battery and ground taps, are wired to the bottom side of the horizontal boards. All other equipment is wired to the left side of the vertical boards. Heat coils serve as the vertical terminal boards for landline connections. Heat coils are protective devices that, when heated above a predetermined temperature, allow a mechanical device to move, opening the circuit.

Temporary wiring. Cross connections, also called jumpers, are wired from the right side of the vertical boards to the top of the horizontal boards. These jumpers are loose connections (an individual wire or twisted pair), so they can easily be changed to suit the needs of the station. Cross connections make it possible to change the routing of a circuit without having to open a cable.

Wiring terminology. Since cable facilities are a vital part of the communications complex, you should have an understanding of wiring terminology. This understanding aids you in coordinating with wire maintenance when problems arise.

Some common faults that occur in a group of lines or cables are tip and ring short, tip to ground short, ring to ground short, tip to tip cross, and opens. A short occurs when two conductors of a pair make contact. A cross occurs when two conductors, each of a different pair, are wired or soldered to the wrong contacts.

"Pair" is a term applied to two like-conductors employed to form an electrical circuit. "Tip" and "ring" are two names used to separate and identify the individual conductors of a pair.

Your OJT supervisor has probably, by this time, given you some training on the patch bays and distribution frames we have discussed here. To become proficient in the use of patch bays and to become able to identify troubles on a distribution frame requires actual on-the-job training. As you apply the knowledge you have gained here while you are on the job, be sure to ask your supervisor questions when you encounter problems you don't understand.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

432. All about distribution frames

1. What equipment is connected between all patch bays and their associated equipment?

   D-frames

2. What types of equipment are tied to the horizontal and vertical blocks of distribution frames?

   in station horizontal block
   out vertical blocks

3. What type of facility usually has an intermediate distribution frame? Telephone switchboard

4. The intermediate distribution frame is sometimes used as which distribution frame?

   Black

5. To which distribution frames are reperforators wired? Red & frames

6. To which distribution frames are battery isolation relays wired? red & Block

7. What are the two parts of a terminal board?

   fanning strips & Jumper rings

2-6. Patch Bays

Before starting our discussion on patch bays, let us first define what we mean by patch bay. Several terms in use now describe the part of a technical control facility where patches are made. The terms are used interchangeably and sometimes cause confusion. Terms such as patch bay, patch panel, and patching facility are often used to describe the same subject—depending on who is doing the describing. A patch panel, as defined in DCAC 310-70-1, is "a board or panel where circuits are terminated in jacks." The circular further defines a DC (digital) patch bay as "specific patch panels provided for termination of all DC circuits and equipment used in a DCS station." For our discussion here, we define a patch panel as the boards or panels in an equipment rack having jacks to which individual circuits are connected. If that same equipment rack also has test equipment for testing the circuits, we shall call the entire rack a patch bay. One or more patch panels or bays that have all the circuits of a particular type we call the patching facility. In our discussion, we talk in terms of bays rather than panels because most racks have some sort of test equipment as well as panels. Let us first discuss the red patch bay.

433. Patching logic pertaining to the red patch bay

As you know, red patch bays are in the clear, or unencrypted, area of the control facility and provide you with the capability to monitor, patch, and test associated equipment within that area. Red patch bays are isolated from black bays by COMSEC equipment or signal battery isolation relays. You will see how this isolation takes place as we discuss the wiring arrangements of the bays.

Wiring Arrangements. Depending on where you are stationed, you may see a two-jack, three-jack, or even an eight-jack configuration. The four-jack system is the one found in most modem facilities; therefore, we are using it as our typical example.

There are 100 send-and-receive jack sets with cut keys on each red patch bay. The jacks within each set are the three conductor, tip-ring-sleeve type, as shown in figure 2-3, and, of course, they require the use of the standard tip-ring-sleeve patch cords. Each jack set is wired for normal-through operation that, as you know, means that, if no patch cord is inserted in any jack of the circuit, traffic flows through the circuit with no interruption. You will see how this is done as you study each type of jack set individually. As our first jack set, let's look at a send jack set on a typical red digital patch bay.

Send Jack Set. A typical send jack set on the red patch bay is shown in figure 2-4. A close analysis of the connections within the jacks shows the flexibility of the system. The items in a send jack set include a line patch jack, an equipment patch jack, a line monitor jack, an equipment monitor jack, and a send cut key with associated lamp. The cut key assures you remote control of a circuit from the patching facility.

Now let's see how the jacks are wired to complete a normal-through circuit. The send equipment is wired to the tip contact of the equipment monitor jack; the signal is then routed to the ring contact through the use of normally closed contacts within the jack. A 22-ohm shunt resistor is wired

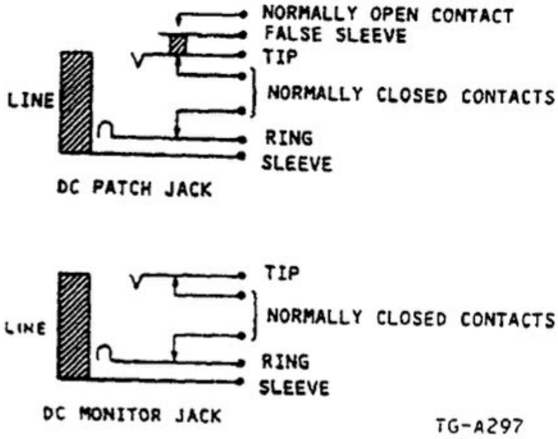


Figure 2-3. Digital patch jacks.

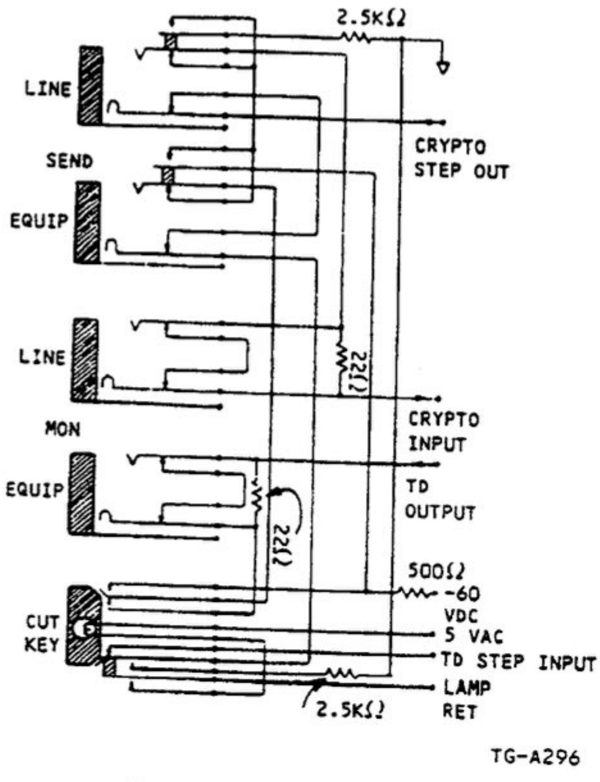


Figure 2-4. Digital red send jack set.

between the tip and ring contact to provide for shunt monitoring. The signal leaving the ring contact is wired through the cut key, giving you remote control of the circuit. The signal leaving the cut key is wired to the tip contact of the equipment patch jack through the equipment patch jack to the normally closed contact of the line patch jack. From the tip contact of the line patch jack, the signal is wired to the tip contact of the line monitor jack. The signal then passes through the line monitor jack; from the ring contact, it goes to the send COMSEC equipment. Refer to figure 2-4 and trace the signal through the jack set.

Most teletype transmit devices must have a step pulse. Step pulses are generated by COMSEC equipment and are used to control transmit teletype devices by providing signal timing, clutch control and character intervals of the required length. These Units are self-contained within the COMSEC devices. The stepper pulse is wired to the ring contact of the line patch jack, through the jack, to the normally closed contact of the equipment patch jack. From the ring of the equipment jack, the stepper pulse is wired through the cut key to the transmitter distributor step input. To complete the send jack set, a –60 VDC power source is wired through a cut key to a normally closed contact on the equipment patch jack, and a 2,500-ohm resistor is wired to the false sleeve contact on the line patch jack. To illuminate the lamp when the cut key is activated, 5-volts AC and a ground return through the cut key are used. Activating the send cut key does the following:

a. A –60 VDC is applied to the signal line.

b. The stepper pulse is terminated through a 2,500-ohm resistor to ground, thereby disabling the send device.

c. The send cut lamp is activated.

d. The output of the send device is opened.

All of the requirements for a normal-through circuit are met by the jack set. But suppose a piece of equipment should malfunction. How will you provide restoral action? Will you call wire maintenance and have them switch to spare equipment on the distribution frame, or will you tell the proper maintenance agency and have them repair the faulty equipment? Neither! You simply insert one end of a patch cord into your good line and the other end into some compatible spare equipment, thus restoring the circuit until repairs have been made.

Let's take a closer look at how you use a patch cord to provide a temporary path for communications. When a patch cord is inserted into a jack, all closed contacts open and all open contacts close (fig. 2-5). These actions take place when you insert a patch cord in the line patch jack of the red patch bay.

a. The input to send COMSEC equipment is connected to the tip of the patch cord.

b. The output of the crypto stepper is connected to the ring of the patch cord.

c. The output of the send teletype equipment is terminated to ground through a 2,500-ohm resistor.

When a patch cord is inserted into the equipment patch jack of the red patch bay:

a. The output of the send teletype equipment is connected to the tip of the patch cord.

b. The TD step input is connected to the ring of the patch cord.

c. The crypto step pulse is opened.

d. Negative 60 VDC is applied to the input of the send COMSEC device.

If you wish to monitor a normal-through circuit, you may patch from your test equipment into either of the monitor jacks of the circuit. Remember that if the circuit has been patched, you must monitor in the monitor jack of the spare equipment or the monitor jack of the good normal equipment. One exception to this rule is: If you wish to check the crypto stepper pulse, you patch from a meter into "line patch jack" of the send jack set because the step pulse does not appear on any of the monitor jacks. It is wise to remember to patch into spare equipment first to avoid possible electrical shock from the other end of the patch cord.

As we said earlier, the patch bays in your facility may or may not be the same as those we are discussing; however, if yours are different, you will have little difficulty understanding them if you study closely these under discussion. Now that we have an understanding of the send jack sets of the red patch bays, let's look at their counterparts–the receive jack set.

Receive Jack Set. The receive jack set is basically the same as the send jack set; however, there is no stepper pulse on the receive jack set. A typical receive jack set is shown in figure 2-6. It has four jacks: the line and equipment patch jacks and the line and equipment monitor jacks. Also included is a receive cut key. The equipment connected to the line patch jack is the output of the receive COMSEC device. Receive teletype equipment is associated with the equipment patch jack. Activating the receive cut key does the following:

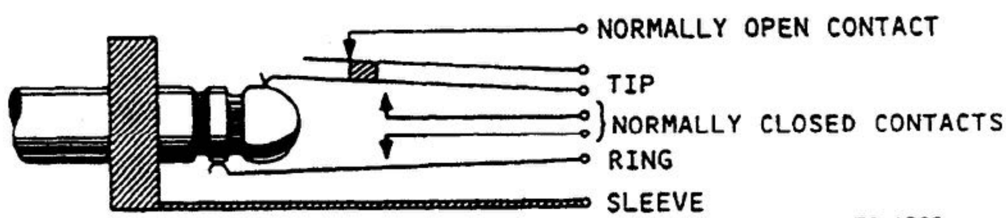


Figure 2-5. Action of the patch jack.

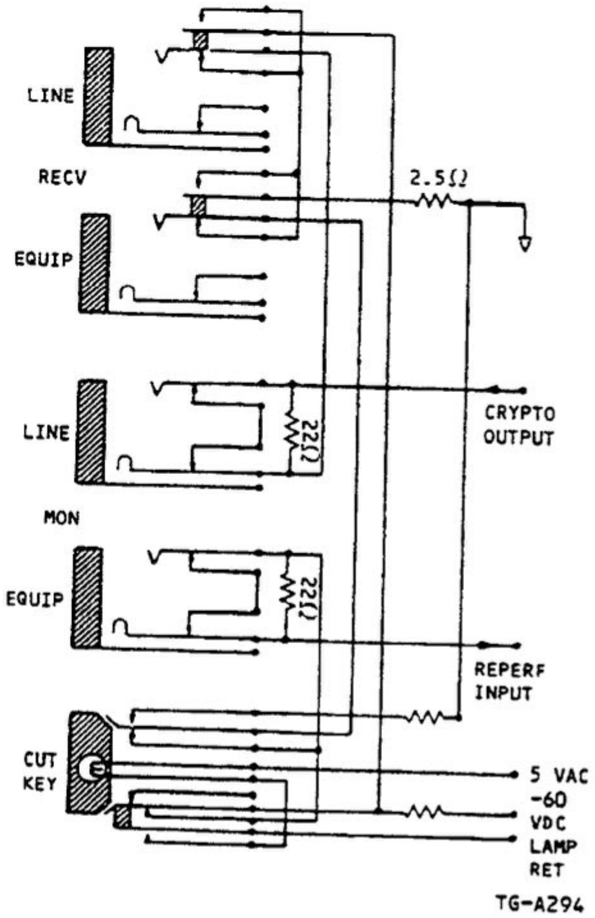


Figure 2-6. Digital red receive jack set.

a. The incoming signal is terminated to ground through a 2,500-ohm resistor.

b. Negative 60 VDC is applied to the receive teletype device.

c. The receive lamp is activated.

Let's trace the flow of traffic on a receive jack set using the diagram in figure 2-6. The signal leaving the output of the receive COMSEC equipment is wired to the tip contact of the line monitor jack and then to the ring of the line monitor jack through the normally closed contact within the jack. From the ring contact, the signal is routed to the tip contact of the line patch jack. From the line patch jack, the signal is then wired to the normally closed contact of the equipment patch jack. The signal leaving the equipment patch jack is routed through the cut key to the tip contact of the equipment monitor jack through the normally closed contacts of the jack and out on the ring contact to the receive teletype equipment.

When you insert a patch cord into the line patch jack, the following happens:

a. The output of the receive COMSEC equipment is connected to the tip of the patch cord.

b. Negative 60 VDC is applied to the input of the receive teletype device.

As in a send circuit, the instant the patch cord is inserted, the receive loop is split. The new loop is formed when the other end of the patch cord is inserted into another patch jack.

When you insert a patch cord into a receive equipment patch jack:

a. The input to the receive teletype is connected to the tip of the cord.

b. The output of the receive COMSEC equipment is terminated to ground through a 2,500-ohm resistor.

Remember that the 22-ohm resistor wired between the tip and ring of the monitor jacks makes it possible for you to monitor, using high-impedance shunt monitoring.

Let's discuss how to restore a defective piece of teletype equipment on the receive jack set. First, patch into the equipment patch jack of the spare equipment. On the tip of the patch cord you have the input to the equipment. Patch the other end of the patch cord to the line patch jack of the normal COMSEC equipment that is still operating. You have now isolated and removed the defective equipment from the circuit and replaced it with a spare. If you now wish to test the defective teletype equipment, patch from the test equipment into the equipment patch jack of that equipment.

We have covered the jack sets that make up the larger part of a red digital patch bay—the send and receive jack sets. Other jack sets on the bay are called miscellaneous jacks. We do not discuss miscellaneous jacks in detail since their configuration depends on the needs and requirements of a particular facility.

Miscellaneous jack sets, as you know, occupy the bottom part of each patch bay, and it is here that you find the output jacks for distortion analyzers, milliammeters, battery taps, and spare monitor printers as required for your particular facility. You will also find parallel jack sets and interbay trunks, if required, in the miscellaneous jack sets. We could go on and on listing possible configurations that might appear in the miscellaneous jacks of your patch bays. As we said, exactly what appears in these jacks in your patch bays depends on your station's requirements.

434. Patching logic pertaining to the black patch bay

To continue our discussion of digital patch bays, let's look at the counterpart of the red patch bay: the black digital patch bay.

The black patch bay is in the black, or encrypted, area of the technical control facility. The black patching facility provides a means for substituting equipment and channels for maintenance and repair purposes.

Each bay has 120 send and receive jack sets, 20 more of each than on the red patch bay. The jack sets may be wired in a two-jack, three-jack, or four-jack configuration and use the three conductor patch and monitor jacks. As with the red patch bay, the four-jack configuration is more commonly used on black patch bays; therefore, we discuss the four-jack configuration beginning with the send jack set.

Send Jack Set. Figure 2-7 shows the jacks and circuitry for the black send jack set. The send jack set includes a line patchjack, an equipment patchjack, a line monitor jack, an equipment monitor jack, and a cut key and lamp.

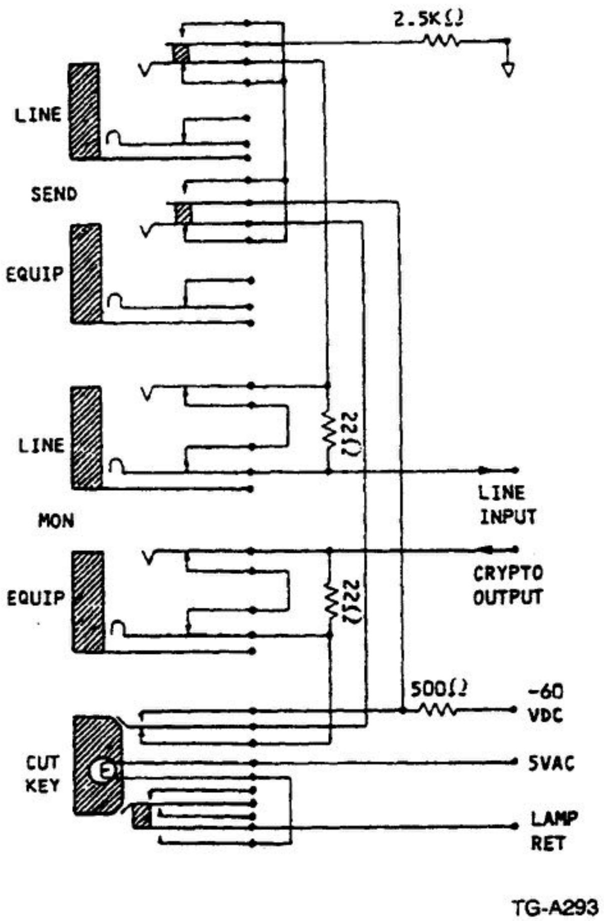


Figure 2-7. Black send jack set.

To form a normal-through send circuit, the send equipment is connected to the tip of the equipment monitor jack. The signal is then routed to the ring contact through the normally closed contacts within the jack. Leaving the ring contact of the equipment monitor jack, the signal is wired to the tip contact of the equipment patch jack through the send cut key. From the normally closed contact of the equipment patch jack, the signal is wired to the normally closed contact of the line patch jack. The tip contact of the line patch jack is wired to the tip contact of the line monitor jack. It is then routed from the ring of the monitor jack to the input to the proper send mux channel or DC landline.

To complete the send jack set, a –60 VDC is wired to the cut key and paralleled to a normally closed contact on the equipment patch jack. A 2,500-ohm resistor and a ground are also wired to the cut key and paralleled to a normally closed contact on the line patch jack. A 5-volt AC and ground return is wired through the cut key to illuminate the cut lamp when the cut key is activated. Activating the cut key does the following:

a. The output of the send equipment is opened.

b. Negative 60 VDC is applied to the send signal line.

c. The send cut lamp is activated.

Now let's see what equipment is connected to the jack sets in the black area. On a send jack in the black area, the equipment connected to the line patch jack is a DC landline or the input to a mux channel. The item connected to the equipment patch jack is the output of an isolation relay or the output of transmit COMSEC equipment.

Look closely at figure 2-7. When you insert a patch cord into the line patch jack, you have the input to the DC landline or send mux channel connected to the tip of the patch cord, and the output of the send equipment is terminated to ground through a 2,500-ohm resistor. You can also see that patching into the equipment patch jack connects the output of the send COMSEC equipment or isolation relay to the tip of the patch cord and, at the same time, applies –60 VDC to the send mux channel or DC landline. In this manner, you can patch any spare COMSEC equipment or spare isolation relays into any mux channel or DC landline. You can also patch your normal equipment into any spare mux channel or spare DC landline. You can test or monitor your lines and/or equipment through these jacks. Keep in mind, however, that monitoring must be done in the monitor jacks to prevent signal interruption. As on the red patch bay, the counterpart of the send jack set is the receive jack set. Let's look at one.

Receive Jack Set. A receive jack set on the black digital patch bay is shown in figure 2-8. The items in this jack set include a line patch jack, an equipment patch jack, line monitor jack, equipment monitor jack, and a cut key with the associated lamp.

The direction of signal flow on the receive jack set is opposite that of the send jack set. The signal leaving the mux channel is wired to the tip of the line monitor jack, through the jack, and from the ring to the tip contact of the line patch jack. The signal is then routed to the equipment patch jack. The signal then leaves the tip of the equipment patch jack and is wired to the cut key and then to the tip contact of the equipment monitor jack. From the monitor jack the signal is wired to the input of the receive COMSEC equipment. Negative 60 VDC, a 2,500 ohm resistor, 5-volt AC, and a ground return are wired to the cut key to complete the jack set. When you activate the receive cut key, you do the following:

a. The output of the receive mux channel is terminated to ground through a 2,500-ohm resistor.

b. Negative 60 VDC is applied to the input of the receive COMSEC equipment.

c. The cut lamp is activated.

The output of a receive mux channel or DC landline is connected to the receive line patch jack. The receive COMSEC equipment or isolation relay equipment is connected to the equipment patch jack.

What happens when you insert a patch cord into the patch jack? Look at figure 2-8 to see that inserting a patch cord into a receive line patch jack connects the receive mux channel or DC landline to the tip of the patch cord and, at the same time, causes –60 VDC to be applied to the receive COMSEC equipment or isolation relay through the normal operation of the contacts within the jacks. As with the send jack set, the normal loop is split as soon as the patch cord is inserted into the patch jack, and a new loop is formed by patching the other end of the patch cord into another receive equipment patch jack.

Inserting a patch cord into the receive equipment patch jack connects the receive COMSEC equipment or isolation relay to the tip of the patch cord and terminates the output of the receive mux channel or DC landline to ground through a 2,500-ohm resistor. This also is done through the normal operation of the contacts within the jack.

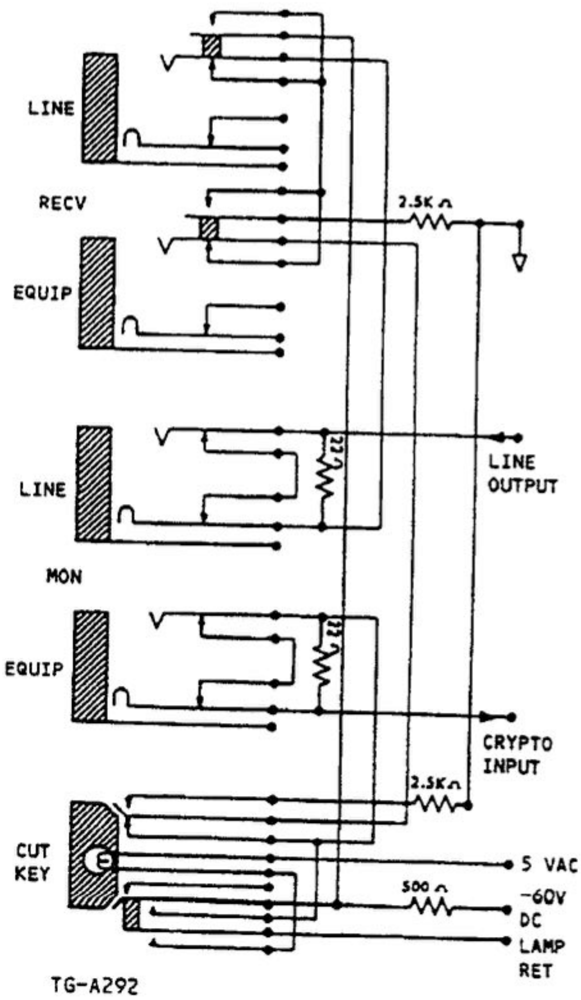


Figure 2-8. Black receive jack set.

As you study figures 2-7 and 2-8, keep in mind that the normally closed contacts open and the normally open contacts close when a patch cord is inserted. If you keep this in mind, you should have no trouble determining exactly what you are doing as you make patches in these jack sets. This applies regardless of what type of equipment is connected to the jacks.

Like red patch bays, black patch bays also have miscellaneous jack circuits. Again, we do not go into detail on black patch bay miscellaneous jack circuits since they, too, depend on station requirements as to their content and wiring configurations. It is in these jacks that such items as test transmitter outputs, regenerative repeaters, distortion analyzers, battery taps, terminating jacks, monitor printers, and other miscellaneous devices appear. You will learn how and where they are wired from your OJT supervisor.

435. Circuit patch bay

The circuit patch bay or "equal level patch bay," has a configuration of jacks that provide a circuit monitoring and testing capability. It also provides convenient access for substituting faulty equipment or transmission lines. All circuit patch bays have jacks designated as LINE, DROP (sometimes called "equipment"), and MONITOR.

The purpose of the circuit patch bay is to provide flexibility of associated terminal and circuit conditioning equipment. All analog circuits, send and receive, going through a technical control facility appear at the circuit patch bay. As previously stated, the circuit patch bay is sometimes referred to as the equal level patch bay because both send and receive signals of a circuit are at the same reference level (for example, at AUTOVON sites, the reference level at the circuit patch bay is –2 dBr). A patch panel of the circuit patch bay has space for 100 full duplex circuits. The number of bays in a particular facility depends on individual station requirements.

The labeling of the bays varies, depending on the individual station. The most commonly used method is to label the circuit conditioning equipment as the RECEIVE or TRANSMIT signal LINE. The terminal equipment (telegraph multiplexers, data, facsimile, and telephone terminals) is labeled RECEIVE or TRANSMIT, EQUIP, or DROP. A line monitor jack is labeled MON.

Patch Jacks. As you can see in figure 2-9, three jacks make one receive or send jack set on the circuit patch bay. On an AUTOVON voice circuit going through an AUTOVON TCF, we simply add jacks for E/M leads, a jack to carry the pilot make busy (PMB) tone, and a jack for the echo suppressor control (ESC). In this arrangement, we have five jacks in one jack set. Thus, the circuit patch bay jack configuration can vary, depending on the type of circuit connected to it.

The individual analog circuits are connected to jacks on the circuit patch bay. Remember, a jack set is the number of jacks it takes to make one send or receive circuit. Each jack on the circuit patch bay has connections for three conductors. These conductors are tip, ring, and sleeve. The sleeve conductor is not normally used. Again, refer to figure 2-9 to see that the circuit conditioning equipment is wired to the tip and ring of the line jack, and the terminal equipment is wired to the tip and ring of the equipment (drop) jack. You can see how the jacks are interconnected through the use of normally closed contacts within the jacks. This provides the normal-through operation. When no patch cord is inserted into any jack, the signal travels from the equipment jack to the line jack, then on to the circuit conditioning equipment. The monitor jack is simply connected in parallel with the associated line jack. This is done by connecting the tip and ring contacts of the line jack to the tip and ring contacts of the monitor jack.

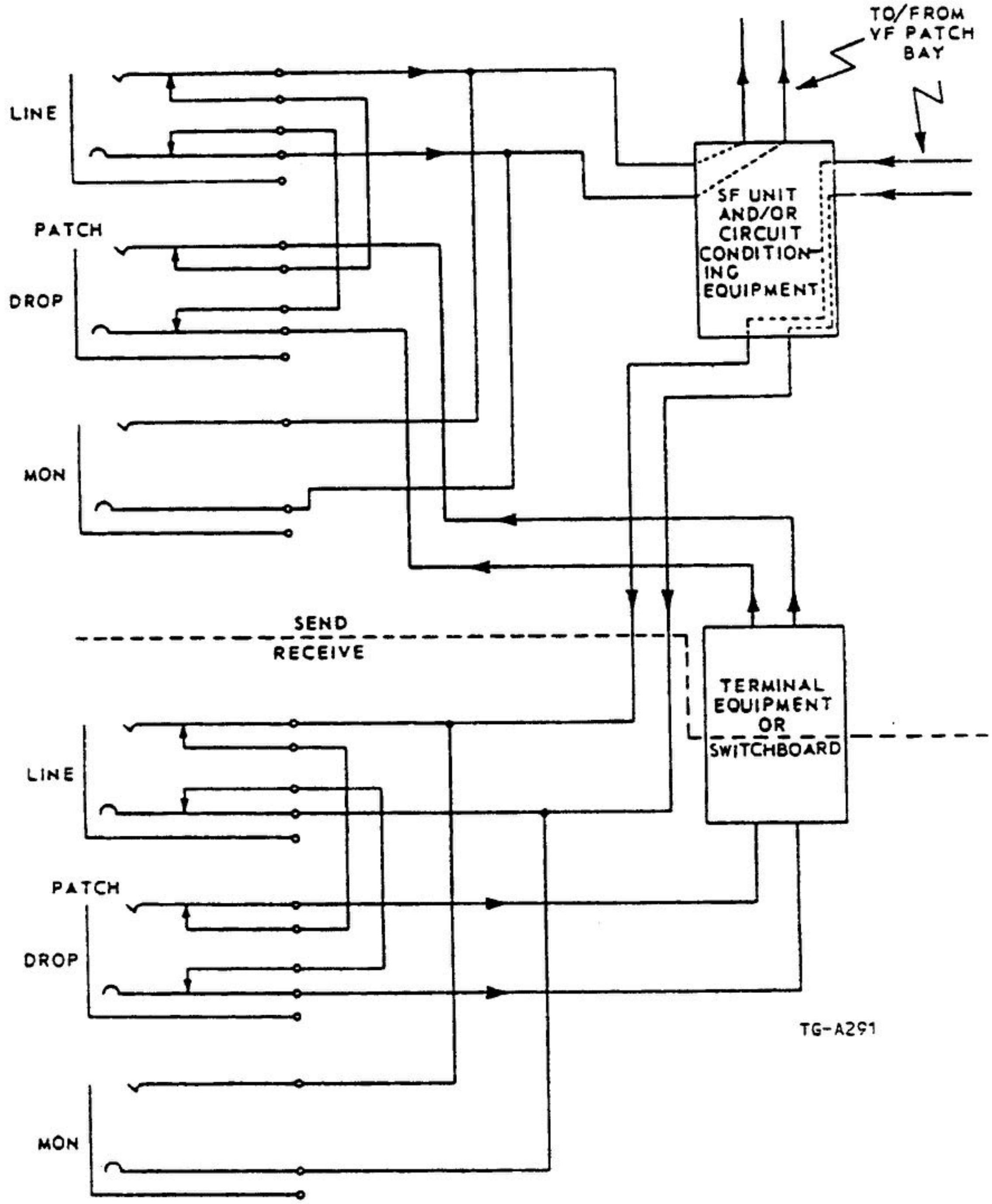


Figure 2-9. Circuit patch bay.

Some stations employ two monitor jacks (line and equipment), but we use only one monitor jack in our discussion and diagrams since this configuration is more common.

When a patch cord is inserted into a patch jack, the tip, ring, and sleeve of the jack are connected to the tip, ring, and sleeve of the patch cord. You can now see how a line or piece of equipment can be rapidly patched to a spare. It is this capability that provides you with the flexibility of lines and equipment for testing, troubleshooting, and patching.

On-Call Circuit Patching. An on-call circuit is a permanently designated and identified circuit that is activated only upon request of the user. This type of circuit is usually provided when a full period circuit cannot be justified and the duration of its use cannot be anticipated. During periods when the circuit is not activated, the communications facilities required for the circuit are available for other requirements. On-call circuit users request circuits as required. This service is authorized by TSOs to meet these requirements. This permits greater efficiency in communications plant utilization. You must establish on-call patches upon the request of users having this type of circuit. First ensure continuity and quality of circuitry to the distant-end user before turning the circuit to your local user for traffic.

436. Voice frequency patch bay

To allow for complete communications, there must be a connecting link between the circuit patch bay and the next bay in our configuration. This connecting link is through the circuit conditioning equipment to the voice frequency patch bay.

The voice frequency (VF) patch bay serves as an interface between VF multiplex equipment and the circuit patch bay. All voice frequency circuits from the carrier multiplex equipment are connected through the VF patch bay. When cable is used as link equipment, the circuits are routed to a cable patch bay instead of VF patch bay. The VF patch bay provides jack appearances for the carrier multiplex channel modulator input (CH MOD IN) and channel demodulator out (CH DEMOD OUT). Monitor jacks for the CH MOD IN and CH DEMOD OUT jacks are also provided. An additional jack is employed at AUTOVON facilities (LINE/EQUIP SIGNAL). It is primarily used on voice circuits that use out-of-band signaling or on-voice order wires.

The purpose of the VF patch bay is to provide flexibility of associated channels and equipment. You have direct access to the communications system terminal equipment at this point. This permits testing, patching of equipment units, and monitoring of system performance to ensure a high degree of circuit reliability.

The number of circuits on one VF patch bay can vary. But one channel group designation strip has the capabilities for 24 full duplex circuits. The jack sets within the strip are mounted side by side; i.e., one receive jack set and one send jack set utilizing three-conductor patch jacks. Three-conductor monitor jacks (tip, ring, and sleeve) are often used. Some newer facilities use a two-conductor monitor jack (tip and sleeve).

Look closely at figure 2-10. To connect the *output* of a carrier channel demodulator to the tip and ring of a patch cord, you should patch into the channel DEMOD OUT jack. Likewise, insert a patch cord into the EQUIP IN jack to connect the *input* to the circuit conditioning equipment to the tip and ring of the patch cord. Inserting a patch cord into the CH MOD IN jack connects the carrier channel modulator to the tip and ring of the patch cord. When a patch cord is inserted into the EQUIP OUT jack, the output of the circuit conditioning equipment is connected to the tip and ring of the patch cord.

As you study figure 2-10, pay close attention to the contacts of the jacks and you can easily trace signal flow with and without a patch cord inserted into a jack. When you become familiar with the wiring configurations we have discussed here, you will have very little difficulty in understanding what you are doing and why you are doing it when you make patches in any VF patch bay. This applies regardless of whether you are monitoring, testing, analyzing, or patching around defective VF channels or equipment.

Monitoring or analyzing on a VF patch bay is high-impedance shunt. This means you must use analyzing equipment offering high impedance to prevent circuit interruption. Test equipment items for analog signals are covered later in the course. You may need to review somewhat to see where to insert a particular type of test equipment into a VF patch bay for a specific type of test.

437. Group and supergroup patch bays

Signals appearing on the VF bays we have discussed so far are within the audible frequency range and normally can be heard. We group two additional bays with the VF bays, however, that do not have signals in the VF range: the group and supergroup patch bays. We group them with the VF patch bays because, when they are in a technical control facility, they are associated directly with the VF patch bays. These bays are in wideband communications technical control facilities. They provide you with the normal patching, testing, and monitoring capabilities of any patch bay.

We group these bays together because, depending on station installation, they may both appear on the same bay. The jack sets for supergroup patching are usually above the jack sets wired for group patching.

Figure 2-11 shows the placement of group and supergroup patch bays within a technical control facility. It also shows other patch bays we have discussed.

The jacks on the group patch bay are labeled CHAN BK OUT (or GROUP CONN IN), GROUP MOD IN, GROUP DEM OUT, CHAN BK IN (or GROUP CONN OUT). Monitor jacks for the GROUP MOD and GROUP DEM jacks are also provided. Three-conductor patch and monitor jacks are employed on the group patch bay. Figure 2-12 shows the patch and monitor jacks used on a group patch bay. Though the number of circuits on one group patch bay varies, each patching module has 30 jack sets.

The equipment associated with the send GROUP MOD IN is the group modulator input, and the CHAN BK OUT is the channel bank output. A channel bank has 12 channels. It forms a part of a carrier multiplex terminal. The equipment associated with the receive GROUP DEM OUT is the group demodulator output, and the CHAN BK IN is the channel bank input.

To connect the input to the group modulator to the tip and ring contacts of a patch cord, insert the patch cord into the send GROUP MOD IN. To connect the output of the channel bank to the tip and ring contacts of a patch cord, insert the patch cord into the CHAN BK OUT. You can see in figure 2-12 that the same process occurs on the receive side except in reverse order.

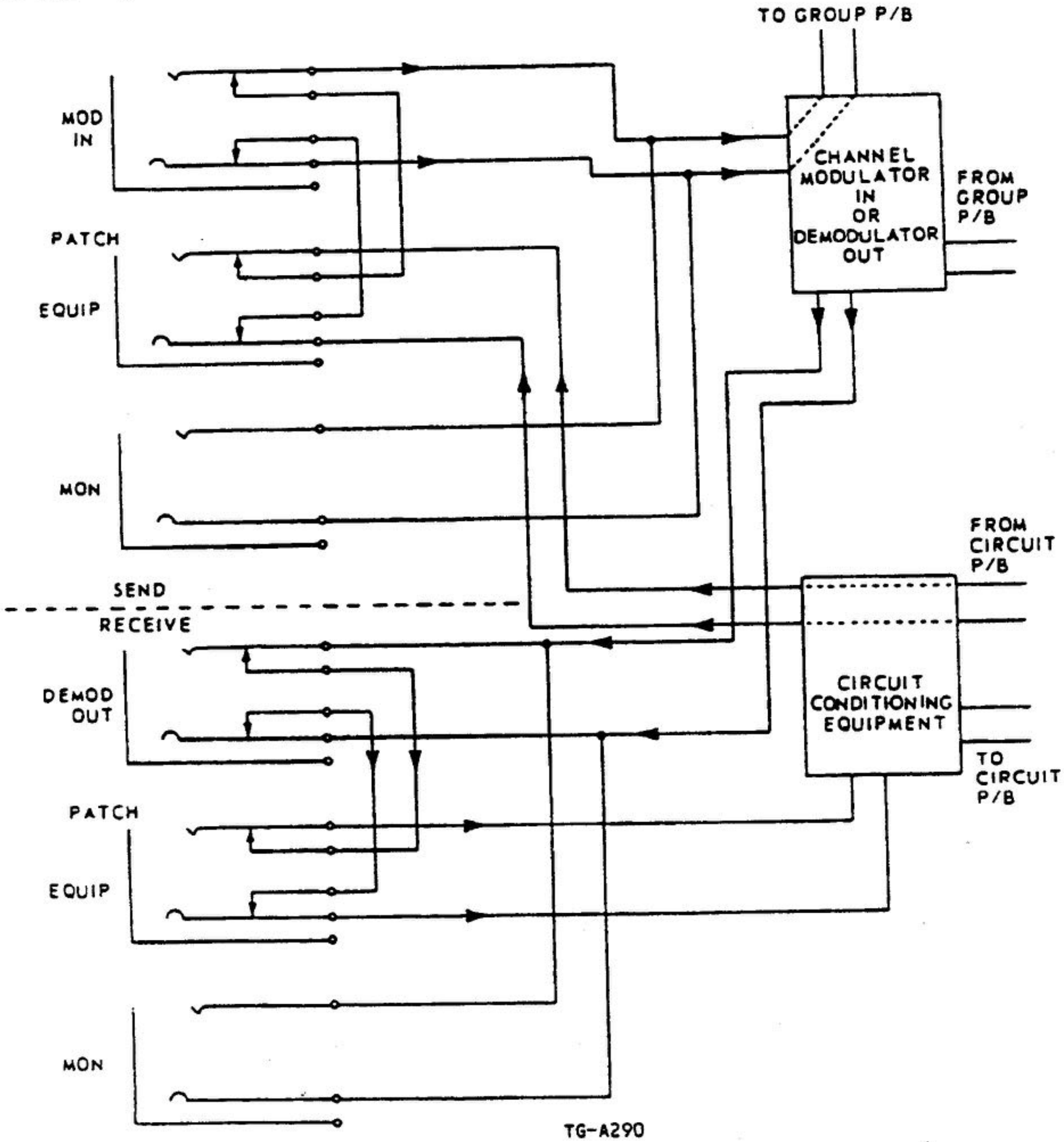


Figure 2-10. VF patch bay.

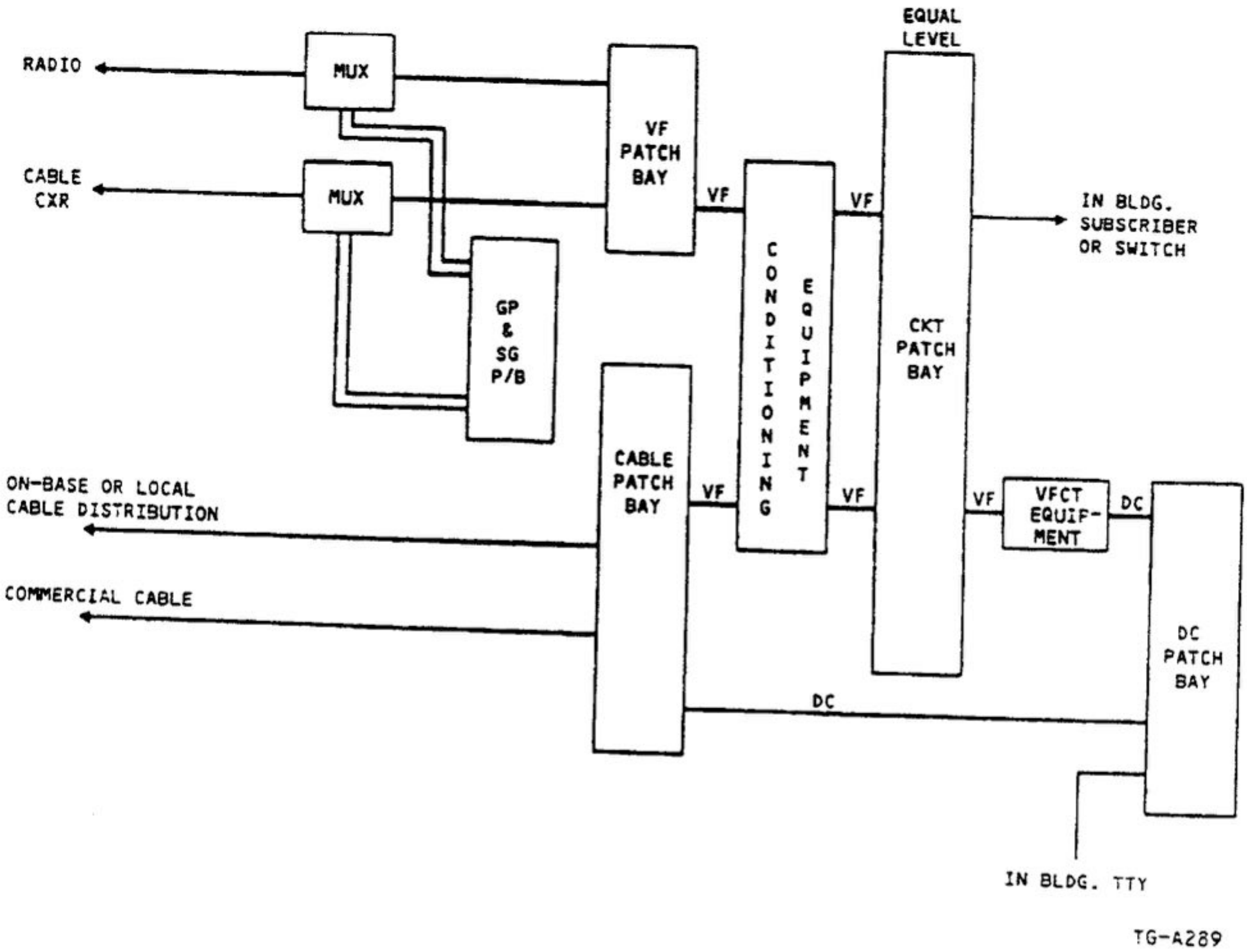


Figure 2-11. Patch bay location.

As we said earlier, a supergroup patch bay is normally a part of the group patch bay. This is due to the wide frequency range of signals at the supergroup level requiring the use of special grade *coaxial* cabling that must be kept as short as possible to prevent unwanted signal loss and to prevent stray noise pickup.

A supergroup is a subdivision of a carrier multiplex system. It is normally 60 voice channels of a wideband path. The supergroup patch bay provides jack appearances for baseband, supergroup, and baseband inputs and outputs from the radio or other wideband transmission equipment. It also provides access for measuring group and supergroup pilots and gives you access to the radio order wires. All VF multiplex equipment is cabled to this patch bay. Coaxial jacks and connectors are used instead of the type that has been used thus far. The coaxial jacks do not provide for continuity within send or receive jack set. Therefore, the coaxial connectors must stay plugged into appropriate coaxial jacks so that signals may traverse a given jack set.

Figure 2-13 shows the type of jacks and coaxial plugs used on supergroup patch bays. Depending on whether it is a send or receive supergroup, the coaxial jacks are labeled SGP MOD IN (supergroup modulator in), GP MOD OUT (group modulator out), SGP DEM OUT (supergroup demodulator out), GP DEM IN (group demodulator in).

The equipment associated with the SGP MOD IN patch jack is the input to the supergroup modulator or radio equipment. The output of the group modulator is connected to the GP MOD OUT coaxial jack. Monitoring capabilities are provided for the send line coaxial jack. The output of the supergroup demodulator or radio equipment is connected to the SGP DEM OUT patch jack. The input to the group demodulator is connected to the GP DEM IN coaxial jack. Monitoring capabilities are also provided for the receive line coaxial jack.

Only in recent years has the requirement for this patch bay in a technical control facility been realized. As a result, newer facilities have incorporated it. It is also being added to many of the older facilities. In the past, common practice was to colocate it with the multiplex equipment. The new concept gives you still another method of ensuring complete circuit reliability and performance.

As you can see, patching on group and supergroup patch bays is relatively simple, however, be extremely cautious

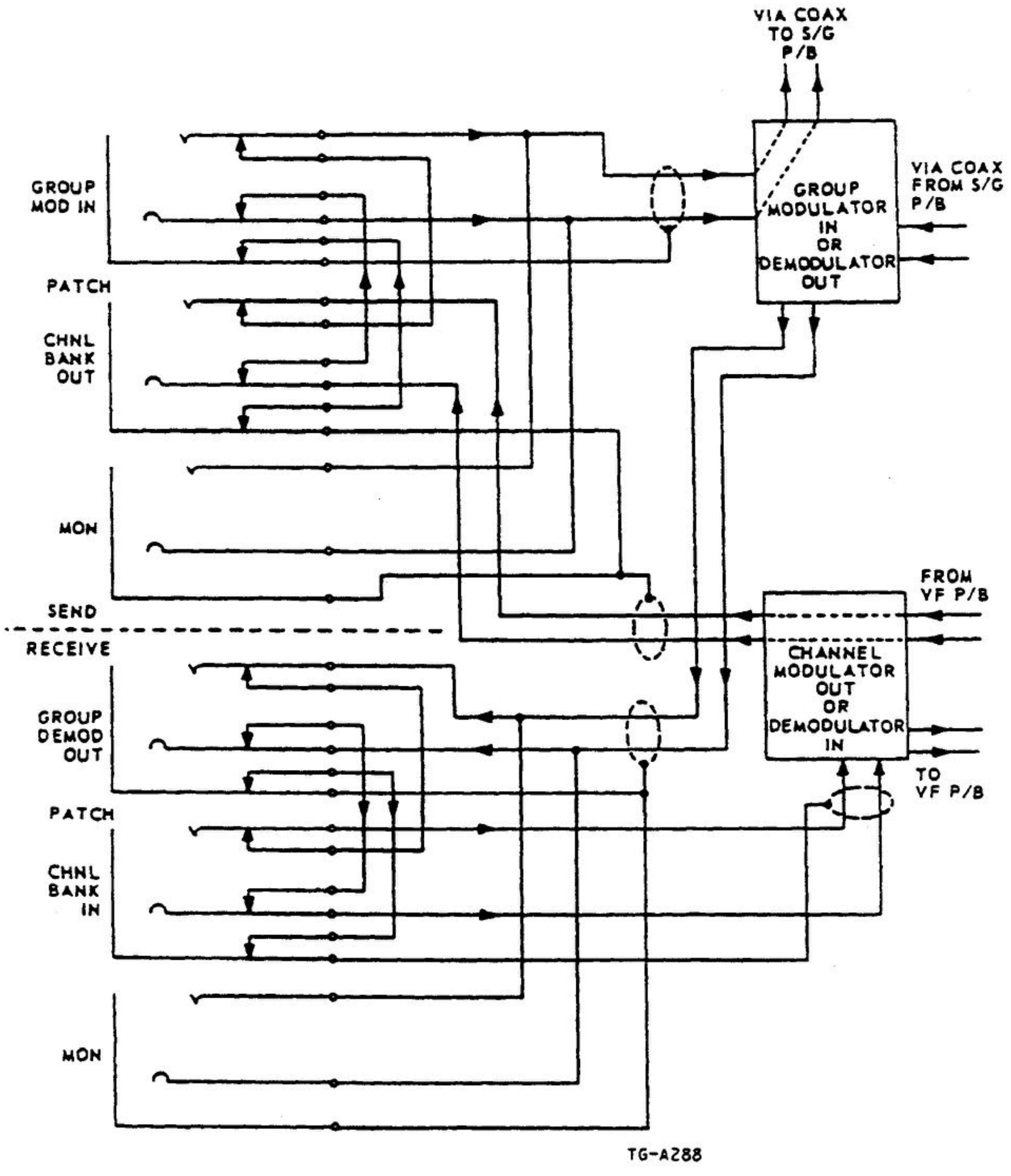


Figure 2-12. Group patch bay.

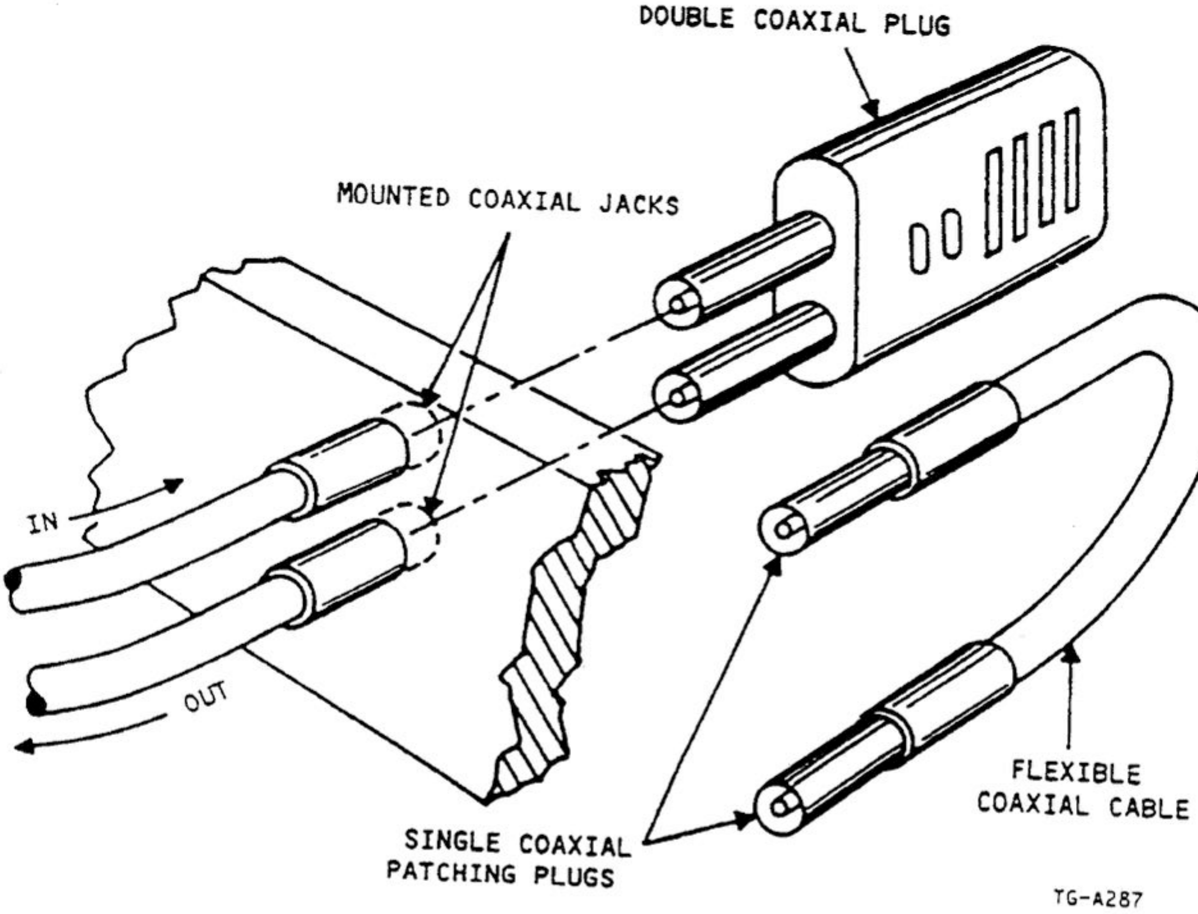


Figure 2-13. Supergroup and base-band patch bay.

when making patches on these bays. Keep in mind that you have control of literally hundreds of circuits at your fingertips, and that you can seriously disrupt communications through your facility by indiscriminate patching on these bays. You normally are supervised closely while making patches at this level until you are thoroughly familiar with these bays.

438. Digital Patch and Access System (DPAS)

This is a totally new element in the facility makeup of the T1 system. This addition does not replace or act as an alternative for any single part already in the T1 system. The DPAS is not meant to replace all circuit patching facilities, but to enhance digital circuit operations without the need to convert the circuit level. This provides the means of rapidly reconfiguring digital circuits within the DCS.

Operation. The operation of the DPAS offers an improved method for managing the circuits on T1 lines and digital terminals. It provides a 64-kbps electronic cross-connection and test access for digital signals operating at the 1.544- or 2.048-Mbps rate. The new cross-connect capability of the DPAS permits the assignment and redistribution of any 64-kbps channel in a 1.544- or 2.048-Mbps digital group to any other 64-kbps channel, whether that channel is in the same or a different 1.544- or 2.048-Mbps digital group.

The control of T1 groups and circuits is another aspect of DPAS that eventually provides significant operational advantages to support user requirements. This aspect is related to the digital switches being introduced into the DCS that have the capability to interface with each other via 1.544 Mbps (PCM-24) and 2.048 Mbps (PCM-30). These switches are not capable, by themselves, of integrating both the transmission and switching functions. Integration can be achieved by introducing a separate DPAS with the capability of interfacing the T1 lines of both the transmission and switching elements of the DCS. DPAS requires a control console through which all commands are entered and all information is given to the operator.

Features. DPAS enhances the flexibility of the DCS, reduces patch bay wiring on the main frame, and reduces first-level multiplexer requirements. It further improves the ability to reconstitute the DCS following catastrophic failures. Incorporating the transmission switching and circuit switching functions into a physically separate switch, rather than combining these functions into a telephone switch, has afforded them certain advantages. One advantage is that transmission switching functions are required at locations where telephone service is not required. Another advantage is that using a separate DPAS (transmission and circuit switching functions do not have to be physically integrated) allows for more flexible system architecture and results in improved survivability.

The control of a DPAS can be remoted to any desired location, or several DPASs can be controlled from a central location. To work from a central location, if you are the technical controller in charge, you have only to enter keyboard commands or send automatically generated commands by the processor into the system. This provides a flexible capability to restore circuits and reconstitute networks from a central facility, yet does not give up the capacity for local control if communications lines to the central facility are disrupted.

The deployment of DPAS offers many improvements to the DCS to include: improving circuit quality; decreasing the need for first level multiplexers, patch bays, wire distribution frames, and conditioning equipment; and providing a more dynamic circuit restoral capability by allowing access to circuits within T1 bit streams where these circuits could not normally be accessed (for example, T1 bit streams that pass through a facility without being demultiplexed). Figures 2-14 through 2-16 show how DPASs can be deployed in the DCS.

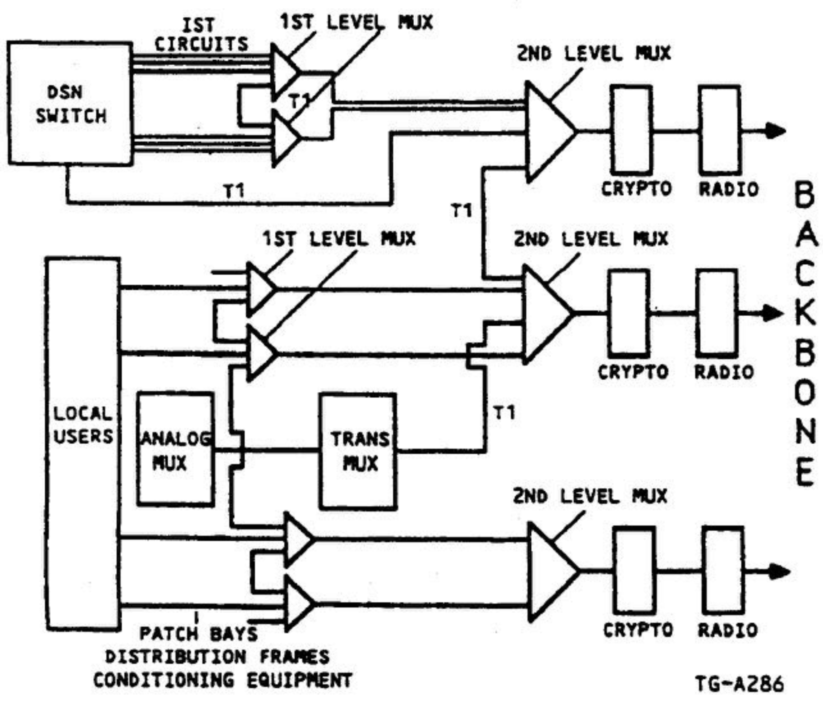


Figure 2-14. Circuit routing without DPAS.

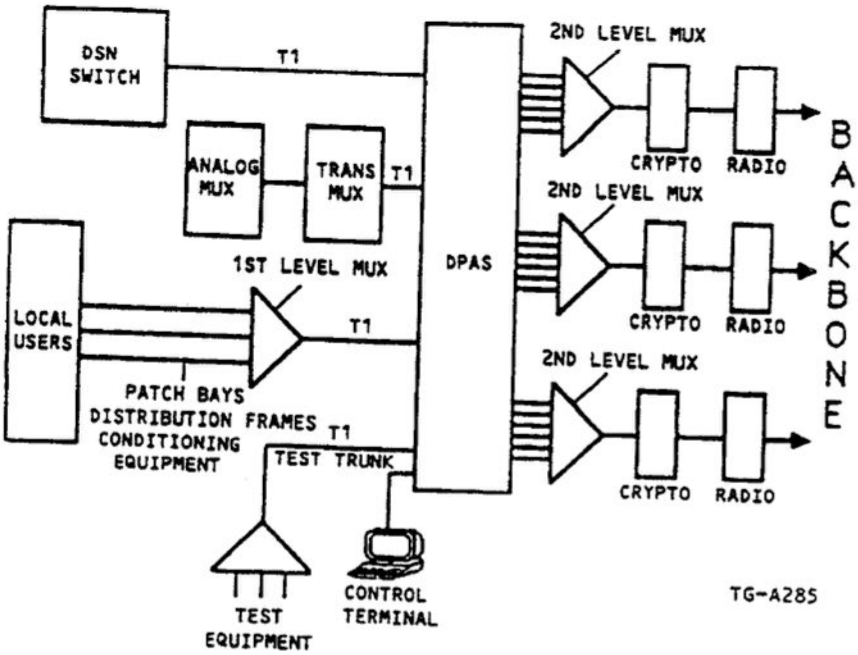


Figure 2-15. Circuit routing with DPAS

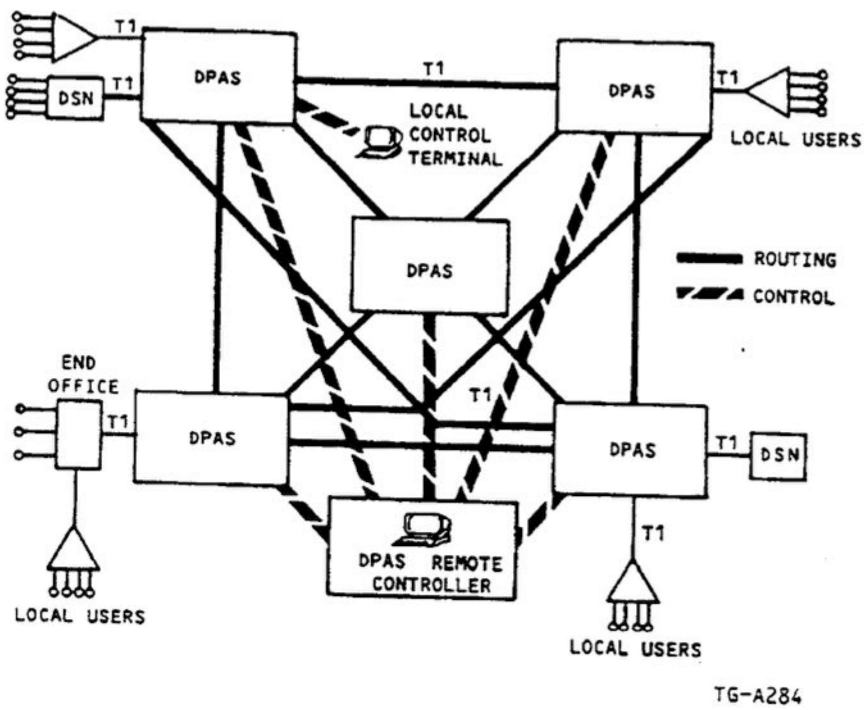


Figure 2-16. DPAS networking.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

433. Patching logic pertaining to the red patch bay

1. At which patch bay are clear-text messages patched?
   red

2. On the red patch bay, the output of the send jack set is applied to send what kind of equipment?
   Comsec

3. Where are stepping pulses generated?
   Comsec equipt

4. If a piece of equipment malfunctions, what should be the first restoral action taken by the controller?
   spares off equipt.

5. What is connected to the tip of a patch cord when it is patched into the send line patch jack of the red patch bay? input to comsec equipt

6. What is connected to the tip of a patch cord when it is inserted into the send equipment patch jack of the red patch bay. output is connected to the tip.

7. What jacks are used to monitor a normal-through circuit? monitor Jacks

8. Is it possible to check stepping pulses without interrupting the circuit? Explain.
   No

9. What signal appears on the send jack set but not on the receive jack set?
   stepper pulses

10. In a receive jack set, what is the purpose of the 22-ohm resistors wired to the monitor jacks?
    makes it possible to use high impedance

434. Patching logic pertaining to the black patch bay

1. Which digital patch bay is located in the encrypted area of the technical control facility?
   Black patch bay

2. How many send jack sets are located on a black patch bay? 120

3. The send equipment is connected to which contact of the equipment monitor jack in a normal-through circuit?
   tip

4. On a send jack set in the black area, what equipment is connected to the line patch jack?
   DC loop line

5. In the black area, the output of the transmit COMSEC equipment is applied to which jack?
Equipt. patch Jack

6. When using the jack sets for monitoring, what should you remember? only use monitor jack prevents interruption

7. On the black patch panel, what appears on the tip of a patch cord if the other end is patched into the receive line patch jack?
RX channel or DC landline

8. When patching into a receive jack set on the black patch bay, what happens to normally closed and open jack contacts? normally close jacks open & open jacks closed

435. Circuit patch bay

1. List the four types of jacks found on circuit patch bays. line, drop, monitor + E + M leads

2. Which conductor is not used on patch cords patched into the circuit patch bay? sleeve conductor

3. In an analog patch bay, are the monitor jacks in series or parallel? parallel

4. When establishing an on-call patch, what do you, as a technical controller do, PRIOR TO turning the circuit over to the local user?
Ensures continuity

436. Voice frequency patch bay

1. What equipment is normally connected between the circuit patch bay and the voice frequency patch bay?
ckt. conditioning equip*

2. What is the basic purpose of the VF patch bay?
To provide flexibility of associated channels + equipt.

3. Describe the patch that you should make to bypass a defective channel demodulator.
Plug one end in Equipt. in & the other end in Demod out

437. Group and supergroup patch bays

1. Which patch bays would you find in a wideband technical control but not at a CONUS AUTODIN technical control?
Group + Super-Group

2. How many conductor patch and monitor jacks are employed on the group patch bay?
3

3. How many channels make up a channel bank?

12

4. Inserting a patch cord into the send GROUP MOD IN connects the input to the group modulator to which contacts of that patch cord?

Tip + Ring

5. How do supergroup jacks and connectors differ from other patching equipment? Super group Jacks + connectors are of coat. So Jacks are not normal through

6. What would be the result if, on a supergroup patch bay, there are no connectors patched in?
in operative because jacks are not wired normal through

7. When you make a supergroup patch, how many channels are affected? 60 channels

8. Why is it very important that supergroup patching be thoroughly analyzed before a patch is made?
have control of hundreds of VF channels

438. Digital Patch and Access System (DPAS)

1. What capability does DPAS provide for managing circuits on a T1 line? cross connect & test for signals

2. How can you integrate two digital switches with DPAS equipment? using separate dpass interface

3. What three features make DPAS attractive to the DCS? System flexability, reduction of patch bay wiring, reduction of mux requirements

4. What methods do technical controllers have to command a DPAS from a central location?
compensate for differences,

2-7. Signal Train and Fault Isolation

The basic necessity in all troubleshooting is to have a thorough knowledge of the signal train. Without knowing the signal train, you could be testing a circuit aimlessly with no idea as to what signal should be present at a given test point or what equipment is physically located between patch bays. Knowing that the signal is good at one test point and bad at another test point is not good enough for our purposes; we need to be able to tell the maintenance people what specific piece of equipment is bad, That is our job, fault isolation!

439. Test points in a DC signal train

Throughout your career you will encounter many signal trains, but they basically will follow the same format discussed in the following text. In the next sections, we go through signal trains, mentioning each component as the signal travels down its path.

In our basic TTY circuit, we accommodate two types of users: in-station and out-of-station. The signal flow through your station is the same for both except for the section that appears at the DC patch panels. Let's start by discussing the in-station users we support along with how the signal passes through our facility.

In-station User. This user is normally an office or section that requires TTY service within your building. This could be the communications center in the next room or CRITICOM down at the end of the hall. The key to all these users is that, normally, they are physically within the same building you are in. Foldout 1 shows the signal flow of an in-station user, so let's trace the circuit by starting at the user.

On an in-station TTY circuit, the transmit signal at the user could be generated by a keyboard, transmitter distributor, magnetic tape unit, or other transmit device. The type of traffic this circuit carries, clear or encrypted, determines what happens to the circuit next. Since the circuit in Foldout 1 carries encrypted traffic, the next piece of equipment the signal passes through is the crypto equipment. From the output of the crypto equipment, the first place the signal appears in the technical control is at the DC circuit patch panel. All circuits appearing at the DC circuit patch panel are configured for low-level polar operation. A mark is normally +6V, 1 mA and the space –6V, 1 mA.

At the DC circuit patch panel, the signal from the user appears at the send equipment patch jack. From the equipment patch jack, the signal flows to the send DC circuit line patch jack, where it becomes one of 16 input channels that connect to a VFCT. The output signal of the send VFCT is a composite audio signal, derived from the 16 input channels, and it appears at the send VF equal level equipment patch jack at a level of –13 dBm0. Our new audio signal now continues from the send VF equal level equipment patch jack to the send VF equal level line patch jack, where it now becomes the input to the circuit conditioning equipment.

The circuit conditioning equipment at this point normally is an amplifier, used specifically to increase the signal level between the patch panels. The output of the circuit conditioning equipment is connected then to the send VF primary equipment patch jack, and it continues to flow up to the send VF primary line patch jack. This signal coming from the send line jack enters into a channel bank modulator and becomes one of 12 signals that supplies an input to a channel bank multiplexer.

The output of the channel bank multiplexer is now a composite of 12 channels, occupying a bandwidth of 48 kHz. It appears on the send group equipment patch jack (labeled CHAN BK OUT). From the send group equipment patch jack, the signal flows to the send group line patch jack (labeled GROUP MOD IN). The signal leaving the send line jack enters a group modulator, and its output is one of five inputs to the group multiplexer.

We now are at the output of the group multiplexer, where we have a composite audio signal with a 240-kHz bandwidth that has a maximum of five groups. (Some systems could have six groups if a star group were used, but this is not common practice in standard multiplex plans.) Keep in mind that the wiring used in the patch panels from this point on is usually coaxial or triaxial cable and cannot be wired up like the previous jack sets. To have the continuity between the equipment and line patch jack, you need a double coaxial plug or a flexible coaxial cable as shown in figure 2-13. This output now appears on the send supergroup equipment patch jack (labeled GP MOD OUT) and flows to the supergroup line patch jack (labeled SGP MOD IN), but only if continuity is provided. The signal leaving the send line jack enters a supergroup modulator, and its output is one of 10 inputs into the supergroup multiplexer.

The output of the supergroup multiplexer is now a composite of 10 supergroups occupying a maximum bandwidth of 2,480 kHz and appears on the send baseband equipment patch jack (labeled SGP MOD OUT). From the send baseband equipment patch jack, the signal flows to the send line baseband patch jack if we supply continuity. This is the last test point we are responsible for. From here the signal goes to the transmitter, where it is transformed into a suitable signal for transmission.

Since the first circuit discussed in this section, we tried to simplify as much as possible to clear up any problems you may have had or just to refresh your memory from technical school. The discussion for the next circuits is briefer; but, if you have any trouble, you might want to use this section as a review.

The receive section of this circuit is basically the same, just reversing the direction the signal flows. We will take you down the receive signal path now, starting with the signal coming into the receiver. The output of the radio receiver appears on the receive baseband line patch jack; if continuity is supplied, it continues on to the receive baseband equipment patch jack (labeled SGP DEM IN). Our signal at this point becomes the input to the supergroup demultiplexer. The output of the demultiplexer is applied to the individual supergroup demodulators to develop 10 individual supergroups. Each of the 10 individual supergroups have their own appearance at the receive supergroup patch bay.

The output signal from the supergroup demodulator first appears on the receive supergroup line patch jack (labeled SGP DEM OUT); if continuity is present, it flows to the receive supergroup equipment patch jack (labeled GP DEM IN). Out of the receive equipment jack, the signal flows into the group demultiplexer, where it is applied to the individual group demodulators so that five groups can be developed. One of the five group demodulator outputs appears on the receive group line patch jack (labeled GP DEM OUT) and then flows down to the receive group equipment patch jack (labeled CHAN BK IN). As the labeling shows, we trace the signal from the equipment jack to the input of the channel bank demultiplexer. The channel bank demultiplexer applies its output to the channel bank demodulators, where the group is broken down to the original 12 signals it started with.

Individual channel bank demodulator outputs appear on the receive VF primary line patch jack and flow to the receive VF primary equipment patch jack to become the input to the circuit conditioning equipment. The circuit conditioning equipment at this point is an amplifier, to compensate for the test level points. Once the signal is at the proper level, it reappears on the receive VF equal level line patch jack and continues on to the receive VF equal level equipment patch jack. At this point, you still have a composite audio signal, and it becomes the input to the receive VFCT. The output of the receive VFCT now is 16 individual DC TTY circuits, which are connected to the receive DC circuit line patch jacks.

From the line patch jack the signal flows to the receive DC circuit equipment patch jack and on to the input of the receive crypto equipment. The output of the crypto equipment supplies the input to the user's receive terminal equipment, which could be a printer, reperforator, or similar device.

You can now see that tracing the signal flow is not that difficult, as long as you do it in an orderly way. It also saves you valuable time and lets you correct problems with minimum outage time. You can give maintenance a more accurate picture as to the definite problem and specific piece of equipment giving you that problem. We now move on to the next TTY user we have.

Out-Of-Station User. This user can be anywhere on the base outside your building, for example, base weather, base operations, or TAC, SAC, and MAC operations. Since the user is physically separated from the technical control facility, and sometimes is on the other side of the base, this poses another problem for circuit engineers. While we trace the signal flow for an out-of-station user, compare the signal train to an in-station user and watch for the differences present.

With an out-of-station user, the transmit signal is originated by similar means to that of an in-station user. This type of circuit normally carries clear traffic, so follow along in Foldout 1 as we trace through the circuit. The signal that starts at the user travels over a landline to the technical control facility, where it first appears on the receive DC primary line patch jack. You should notice something different with this patch bay: the directions we talk about are determined with respect to the user, whereas the other patch bays directions are determined with respect to the distant end.

Once the signal appears at the receive DC primary line patch jack, the signal flows through to the receive DC primary equipment patch jack to become the input to the receive line level interface unit (LLIU). The LLIU is needed to convert the high-level polar keying from the user to low-level polar keying needed throughout the system. Some confusion comes into play at this point; recall that we receive from the user and send to the distant end. So the output of the receive LLIU now appears on the send DC circuit equipment patch jack. From there the signal travels to the send DC circuit line patch jack and becomes one of 16 inputs for the VFCT. From this point on, the circuit is the same as the in-station user, so we go to the receive side and pick up the circuit at this point.

From the receive DC circuit line patch jack, the signal goes to the input of the transmit LLIU, where the signal level is converted from low- to high-level keying. The output of the LLIU is connected to the send DC primary equipment patch jack, and it continues on to the send DC primary line patch jack. The signal is then sent out on the send landline to the user, where it is interfaced with the receive terminal equipment.

We have just discussed TTY circuits with in-station and out-of-station users; as we said earlier, most stations that have DC TTY circuits configure them this way. These TTY circuits are very common. Even with high-speed data replacing the slower speed circuits, they will be around for some time to come.

440. AUTOVON signal train

This circuit is typical of a 4-wire subscriber circuit you may encounter that uses E&M signaling. The term set at the user is a pushbutton phone used to talk over and to give on-hook and off-hook conditions so that the signaling string can react accordingly.

We will start tracing the signal on foldout 1 from the user's send phone mouthpiece, and we will find that it is connected to the send 4-wire drop and normally goes through your base central exchange before it comes to the TCF. The first place we see the send part of this circuit is at the receive VF subscriber primary line patch jack; but, if we were to check the circuit at this test point, the line should be idle unless someone is talking on the phone. The only way we can tell the status of the circuit to and from the user is by checking the E&M signaling leads at the VF subscriber primary. The condition of the E&M leads tell you whether the circuit is on- or off-hook; when any checking needs to be done at the VF subscriber primary, check these leads first.

The signal from the receive VF subscriber primary line patch jack continues to flow to the receive VF subscriber primary equipment jack, where it becomes the input signal for the receive part of the signaling string. The output of the signaling string is connected to the send VF equal level equipment patch jack. Now, depending on whether the circuit is on- or off-hook, we may have a signal present at this point. Let's assume the circuit is on-hook; if so, we should have a 2,600 Hz single-frequency (SF) tone present at a -20 dBm0. This SF signal travels to the send VF equal level line patch jack and connect to the input to the circuit conditioning equipment.

The circuit conditioning equipment on this line is no different than on the TTY circuit; most times it's just an amplifier to compensate for the difference in test points. The output of the send circuit conditioning equipment is connected to the send VF primary equipment patch jack, and it continues on to the send VF primary line patch jack. This signal coming from the send VF primary line jack enters into a channel bank modulator and is one of 12 signals that supply an input to a channel bank multiplexer. The output of the channel bank multiplexer appears on the send group equipment patch jack (labeled CHAN BK OUT). From the send group equipment patch jack, the signal flows to the send group line patch jack (labeled GROUP MOD IN).

The signal leaving the send group line patch jack enters a group modulator, and its output is one of five inputs to the group multiplexer. After the group multiplexer, the output signal appears on the send supergroup equipment patch jack (labeled GP MOD OUT). From here the signal travels to the send supergroup line patch jack (labeled SGP MOD IN), but only if continuity is provided for between the equipment and line patch jacks. The signal leaving the send line jack enters a supergroup modulator, and its output is one of 10 inputs to the supergroup multiplexer.

The output of the supergroup multiplexer appears on the send baseband equipment patch jack (labeled SGP MOD OUT), and it continues on to the send baseband line patch jack if we supplied the continuity needed. From this point, the signal goes to the transmit radio and out over the air. Let's turn around now and discuss the receive path of this circuit, starting with the signal coming from the receiver.

The output of the radio receiver appears on the receive baseband line patch jack; if continuity is supplied, it continues on to the receive baseband equipment jack (labeled SGP DEM IN). Our signal at this point becomes the input to the supergroup demultiplexer. The output of the demultiplexer is applied to the individual supergroup demodulators to develop 10 individual supergroups. Each of the 10 individual supergroups has its own appearance at the receive supergroup patch bay.

The output signal from the supergroup demodulator first appears on the receive supergroup line patch jack (labeled SGP DEM OUT); if continuity is present, it flows to the receive supergroup equipment patch jack (labeled GP DEM IN). Out of the receive equipment jack, the signal flows into the group demultiplexer, where it is applied to the individual group demodulators so that five groups can be developed. One of the five group demodulator outputs appears on the receive group line patch jack (labeled GP DEM OUT), then it flows to the receive group equipment patch jack (labeled CHAN BK IN). As the labeling indicates, we trace the signal from the equipment jack to the input of the channel bank demultiplexer. The channel bank demultiplexer applies its output to the channel bank demodulators, where the group is broken down to its original 12 signals.

Individual channel bank demodulator outputs appear on the receive VF primary line patch jack and flow to the receive VF primary equipment patch jack to become the input to the circuit conditioning equipment. The output of the circuit conditioning equipment is connected to the receive VF equal level line patch jack, and it continues on to the receive VF equal level equipment patch jack, which is the input of the receive signaling string. Keep in mind that this is the last point on your receive where you should be able to hear and measure the SF signal.

The output of the receive signaling string is connected to the send VF subscriber primary equipment patch jack, and this should be idle unless someone is talking on the circuit. To check the condition of the send side of this circuit to the user, you again need to look at the E&M leads to see what state they are in. From the send VF subscriber primary equipment patch jack, the signal flows to the send VF subscriber primary line patch jack that is connected to the send 4-wire drop and the user. Troubleshooting this type of circuit is not difficult as long as you keep in mind what you should be seeing at the VF subscriber primary patch bay. This area seems to create the most confusion, so, as a rule of thumb, always check the E&M leads at the VF subscriber primary before making a conclusion.

441. Test points in a high-speed data signal train

High-speed data circuits give us many options similar to some of those seen with DC TTY circuits. We first need to know a little bit about data circuits. You may recall from technical school that you were told data circuits need a modem to convert audio to DC and vice versa. The location of the modem—-at your user or in your facility—determines how the circuit is configured at your station.

High-Speed Modem Circuit. We start on foldout 1 and trace a high-speed data circuit that has the modem at the user's location. On a circuit of this type, we never have a chance to check the DC part, so the user's modem sends the technical control an audio signal via a receive landline.

The receive landline carrying the signal is connected to the receive VF subscriber primary line patch jack (labeled 4WR). From the receive VF subscriber primary line patch jack, the signal flows to the receive VF subscriber primary equipment patch jack and on to the input of the circuit conditioning equipment. (The circuit conditioning equipment is optional in this type of configuration; if none is needed, the signal from the receive VF subscriber primary equipment patch jack is connected directly to the send VF equal level equipment patch jack.) Since we are using circuit conditioning equipment, the output is connected to the send VF equal level equipment patch jack. The signal then flows to the send VF equal level line patch jack.

As you can see from the signal train, this is the last point in your facility where you can monitor the individual circuit since it is riding a TDM/PCM system. From the send VF equal level line patch jack the signal becomes one of 24 channels that get multiplexed together and appear as a composite signal at the send baseband equipment patch jack. Now, if continuity is supplied, the signal flows to the send baseband line patch jack, where it becomes the input to the transmit radio.

It's time to change around and follow the signal coming into our station. The signal our receiver sends us is connected to the receive baseband line patch jack and flows to the receive baseband equipment patch jack if continuity is supplied. The receiver baseband equipment patch jack now supplies the input to the TDM/PCM demultiplexer, where the composite signal is demultiplexed into 24 individual channels. The output of the demultiplexer is connected to 24 receive VF equal level line patch jacks. The signal from the receive VF equal level equipment patch jack, where it becomes the input to send circuit conditioning equipment. (As we stated earlier, circuit conditioning equipment might not be used; if it is not, the signal is connected directly to the send VF subscriber primary equipment patch jack.)

Since we are using circuit conditioning equipment, its output signal is connected to the send VF subscriber primary patch jack, and from there it flows to the send VF subscriber primary line patch jack. The send VF subscriber primary line patch jack is connected to the send landline, so the user can receive the signal and connect it to the input of their receive modem. There is not much to a circuit of this type, and it only gives us two test points, so fault isolation should not be too difficult.

High-Speed Data Circuit (In-Station User). On this type of circuit, the modem is in your facility and you are responsible for it. You also have the opportunity to monitor the DC part of the circuit before it goes to the user. Follow along on Foldout 2 as we trace the signal flow on this circuit.

The in-station user sends a DC signal to the input of the send crypto, and the output of the crypto is connected to the send DC circuit equipment patch jack, the first place it appears in our station. From the send DC circuit equipment patch jack, the signal flows to the send DC circuit line patch jack and becomes the input to the send modem. The output of the modem, which is now an audio signal, is connected to the send VF equal level equipment patch jack. The audio signal travels from the send VF equal level equipment patch jack to the send VF equal level line patch jack. The send VF equal level line patch jack is then connected to the input to the circuit conditioning equipment.

The circuit conditioning equipment on this line is just an amplifier to compensate for the difference in test points. The output of the send circuit conditioning equipment is connected to the send VF primary equipment patch jack, and it continues on to the send VF primary line patch jack. This signal, coming from the send VF primary line jack, enters into a channel bank multiplexer. The output of the channel bank multiplexer appears on the send group equipment patch jack (labeled CHAN BK OUT). From the send group equipment patch jack, the signal flows to the send group line patch jack (labeled GROUP MOD IN).

The signal leaving the send group line patch jack enters a group modulator, and its output is one of five inputs into the group multiplexer. After the group multiplexer, the output signal appears on the send supergroup equipment patch jack (labeled GP MOD OUT). From here, the signal travels to the send supergroup equipment patch jack (labeled SGP MOD IN), but only if continuity is provided for between the equipment and line patch jacks. The signal leaving the send line jack enters a supergroup modulator, and its output is one of 10 inputs into the supergroup multiplexer.

The output of the supergroup multiplexer appears on the send baseband equipment patch jack (labeled SGP MOD OUT), and it continues on to the send baseband line patch jack if we supplied the continuity needed. From this point, the signal goes to the transmit radio and out over the air. Let's turn around now and discuss the receive path of this circuit starting with the signal coming from the receiver.

The output of the radio receiver appears on the receive baseband line patch jack; if continuity is supplied, it continues on to the receive baseband equipment jack (labeled SGP DEM IN). Our signal at this point becomes the input to the supergroup demultiplexer. The output of the demultiplexer is applied to the individual supergroup demodulators to develop 10 individual supergroups. Each of the 10 individual supergroups has its own appearance at the receive supergroup patch bay.

The output signal from the supergroup demodulator first appears on the receive supergroup line patch jack (labeled SGP DEM OUT); if continuity is present, it flows to the receive supergroup equipment patch jack (labeled GP DEM IN). Out of the receive equipment jack, the signal flows into the group demultiplexer, where it is applied to the individual group demodulators so that five groups can be developed. One of the five group demodulator outputs appears on the receive group line patch jack (labeled GP DEM OUT), and then it flows to the receive group equipment patch jack (labeled CHAN BK IN). As the labeling shows, we trace the signal from the equipment jack to the input of the channel bank demultiplexer. The channel bank demultiplexer applies its output to the channel bank demodulators, where the group is broken down to its original 12 signals.

Individual channel bank demodulator outputs appear on the receive VF primary line patch jack, and they flow to the receive VF primary equipment patch jack to become the input to the circuit conditioning equipment. The output of the circuit conditioning equipment is connected to the receive VF equal level line patch jack, and it continues on to the receive VF equal level equipment patch jack, which is the input of the receive modem. The output of the modem, again a DC signal, travels to the receive DC circuit line patch jack, then on to the receive DC Circuit equipment jack. The signal at the receive DC circuit equipment patch jack becomes the input to the receive crypto equipment and its output is connected to the user's receiving terminal. Now let's compare the next type of circuit with this one.

High-Speed Data Circuit (Out-of-Station User). For most out-of-station user circuits, the user normally has the crypto equipment, so the signal we first receive is encrypted. The user sends us a digital signal that comes to the TCF via the receive landline, and this landline is connected to the receive DC primary line patch jack. The signal continues from the receive DC primary line patch jack to the receive DC primary equipment patch jack, where it becomes the input to the receive LLIU. The LLIU again converts high-level polar keying from the user to low-level polar keying to the distant end. After the signal goes through the LLIU, the output signal is cross connected to the send DC circuit equipment patch jack. The signal then travels from the send DC circuit equipment patch jack to the send DC circuit line patch jack to become the input to the modem. From this point, the circuit travels the same path as the in-station user until the receive signal appears at the receive DC circuit patch bay.

The output of the modem, again a DC signal, travels to the receive DC circuit line patch jack and on to the receive DC circuit equipment jack. The signal at the receive DC circuit equipment patch jack is the input to the send LLIU, and its output appears at the send DC primary equipment patch jack. From the send DC primary equipment patch jack, the signal flows to the send DC primary line patch jack, where it is connected to the send landline to the user. Since the signal is now at the end of the landline, the user can connect the receive terminal equipment and complete the circuit. We have just traced the signal flow of three common high-speed data circuit configurations. From these descriptions, you should be able to see certain similarities and differences between them.

442. Test points in a two-wire subscriber signal train

We are going to talk about two types of two-wire subscribers that use the signal train in Foldout 2: dial loop and 20-Hz ringdown. The two circuits are wired up the same, with the circuit operation being the only difference. The dial loop circuit is a tone-on idle circuit, and the 20-Hz ringdown circuit is a tone-off idle circuit. Remember this distinction when troubleshooting the circuits.

The signal train of a two-wire subscriber starts at the user, who is connected to the VF subscriber primary line patch jack. The path between the user and the VF subscriber primary is a two-wire drop that carries no specific direction designator since it can be used for either the send or receive path, but not both at the same time. Also, the signal is present only if someone is talking on the circuit; otherwise, the line should be idle. From the VF subscriber primary line patch jack, the signal travels through to the VF subscriber primary equipment patch jack and connects to the signaling string.

The signaling string on the VF side splits and has a separate send and receive path. Since there are separate paths, the output of the signaling string on the VF side is connected to the send VF equal level equipment patch jack. From the equipment patch jack, the signal continues to flow to the send VF equal level line patch jack, where it becomes the input to the circuit conditioning equipment. The circuit conditioning equipment on this line is just an amplifier to compensate for the difference in test points.

The output of the send circuit conditioning equipment is connected to the send VF primary equipment patch jack, and it continues on through to the send VF primary line patch jack. This signal coming from the send VF primary line jack enters a channel bank modulator and become one of 12 signals that supplies an input to a channel bank multiplexer. The output of the channel bank multiplexer appears on the send group equipment patch jack (labeled CHAN BK OUT). From the send group equipment patch jack, the signal flows to the send group line patch jack (labeled GROUP MOD IN).

The signal leaving the send group line patch jack enters a group modulator, and its output is one of five inputs to the group multiplexer. After the group multiplexer, the output signal appears on the send supergroup equipment patch jack (labeled GP MOD OUT). From here, the signal travels to the send supergroup line patch jack (labeled SGP MOD IN), but only if continuity is provided for between the equipment and line patch jacks. The signal leaving the send line jack enters a supergroup modulator, and its output is one of 10 inputs to the supergroup multiplexer.

The output of the supergroup multiplexer appears on the send baseband equipment patch jack (labeled SGP MOD OUT), and it continues on to the send baseband line patch jack if we supplied the continuity needed. From this point, the signal goes to the transmit radio and out over the air. Let's turn around now and discuss the receive path of this circuit, starting with the signal coming into the receiver.

The output of the radio receiver appears on the receive baseband line patch jack, and, if continuity is supplied, it continues on to the receive baseband equipment jack (labeled SGP DEM IN). Our signal at this point becomes the input to the supergroup demultiplexer. The output of the demultiplexer is applied to the individual supergroup demodulators to develop 10 individual supergroups. Each of the 10 individual supergroups has its own appearance at the receive supergroup patch bay.

The output signal from the supergroup demodulator appears first on the receive supergroup line patch jack (labeled SGP DEM OUT); if continuity is present, it flows to the receive supergroup equipment patch jack (labeled GP DEM IN). Out of the receive equipment jack, the signal flows into the group demultiplexer, where it is applied to the individual group demodulators so that five groups can be developed. One of the five group demodulator outputs appears on the receive group line patch jack (GP DEMOD OUT), then it flows to the receive group equipment patch jack (labeled CHAN BK IN). As the labeling shows, we trace the signal from the equipment jack to the input of the channel bank demultiplexer. The channel bank demultiplexer applies its output to the channel bank demodulators, where the group is broken down to its original 12 signals.

Individual channel bank demodulator outputs appear on the receive VF primary line patch jack, then they flow to the receive VF primary equipment patch jack to become the input to the circuit conditioning equipment. The output of the circuit conditioning equipment is connected to the receive VF equal level line patch jack, and it continues on to the receive VF equal level equipment patch jack, which is the input to the receive side of the signaling string. The receive signal now follows the same path as the transmit signal did, and from the signaling string, the signal flows to the VF subscriber primary equipment patch jack. After the VF subscriber primary equipment patch jack, the signal continues to the VF subscriber primary line patch jack and travel out the two-wire drop to the user.

This circuit is not difficult to trace, but, again, it is worth mentioning to keep in mind the type circuit you are checking and whether a signal should or should not be present. This saves you some embarrassing moments when you call the distant end and tell them you are not receiving a signal on a 20-Hz ringdown circuit only to find that no signal is perfectly normal for that type circuit.

443. Test points in a facsimile signal train

You should remember from technical school that a facsimile circuit is a popular type of circuit used by weather people to transmit maps. Facsimile has also become important in the commercial world to people who want to send copies of letters across town, to place weekly orders, etc. Facsimile will be around for quite some time; for this reason, we show you in foldout 2 how a facsimile circuit is configured on FDM and TDM systems.

Facsimile Circuit (Over FDM System). A signal originates at the user's transmit equipment and travels down the receive landline to the TCF. We first see the audio signal when it arrives at the end of the receive landline on the receive VF subscriber line patch jack. From the receive VF subscriber line patch jack, the signal flows to the VF subscriber primary equipment patch jack that connects to the input of the circuit conditioning equipment. The output of the circuit conditioning equipment is cross-connected to appear on the send VF equal level equipment patch jack. As you can see on the signal train, the circuit conditioning equipment block between the VF subscriber primary patch bay and the VF equal level patch bay is in a dashed square to show that it is an optional item. If the conditioning equipment is not needed in the circuit at your station, the signal flows from the receive VF subscriber primary equipment patch jack and cross connects to the send VF equal level equipment patch jack.

The audio signal travels from the send VF equal level equipment patch jack to the send VF equal level line patch jack. The send VF equal level line patch jack is then connected to the input to the circuit conditioning equipment. The circuit conditioning equipment on this line is just an amplifier to compensate for the difference in test points. The output of the send circuit conditioning equipment is connected to the send VF primary equipment patch jack, and it continues on through to the send VF primary line patch jack. This signal coming from the send VF primary line jack enters a channel bank modulator and becomes one of 12 signals that supplies an input to a channel bank multiplexer. The output of the channel bank multiplexer appears on the send group equipment patch jack (labeled CHAN BK OUT). From the send group equipment patch jack, the signal flows to the send group line patch jack (labeled GROUP MOD IN).

The signal leaving the send group line patch jack enters a group modulator, and its output is one of five inputs to the group multiplexer. After the group multiplexer, the output signal appears on the send supergroup equipment patch jack (labeled GP MOD OUT). From here, the signal travels to the send supergroup line patch jack (labeled SGP MOD IN), but only if continuity is provided for between the equipment and line patch jacks. The signal leaving the send line jack enters a supergroup modulator, and its output is one of 10 inputs into the supergroup multiplexer.

The output of the supergroup multiplexer appears on the send baseband equipment patch jack (labeled SGP MOD OUT), and it continues on to the send baseband line patch jack if we supplied the continuity needed. From this point, the signal goes to the transmit radio and out over the air. Let's turn around now and, starting with the signal coming from the receiver, discuss the receive path of this circuit.

The output of the radio receiver appears on the receive baseband line patch jack; if continuity is supplied, it continues on to the receive baseband equipment jack (labeled SGP DEM IN). Our signal at this point becomes the input to the supergroup demultiplexer. The output of the demultiplexer is applied to the individual supergroup demodulators to develop 10 individual supergroups. Each of the 10 individual supergroups has its own appearance at the receive supergroup patch bay.

The output signal from the supergroup demodulator appears first on the receive supergroup line patch jack (labeled SGP DEM OUT); if continuity is present, it flows to the receive supergroup equipment patch jack (labeled GP DEM IN). Out of the receive equipment jack, the signal flows into the group demultiplexer, where it is applied to the individual group demodulators so that five groups can be developed. One of the five group demodulator outputs appears on the receive group line patch jack (labeled GP DEM OUT), then it flows to the receive group equipment patch jack (labeled CHAN BK IN). As the labeling shows, we trace the signal from the equipment jack to the input of the channel bank demultiplexer. The channel bank demultiplexer applies its output to the channel bank demodulators, where the group is broken down to its original 12 signals.

Individual channel bank demodulator outputs appear on the receive VF primary line patch jack and flow to the receive VF primary equipment patch jack to become the input to the circuit conditioning equipment. The output of the circuit conditioning equipment is connected to the receive VF equal level line patch jack, and it continues on to the receive VF equal level equipment patch jack, which is the input to the optional circuit conditioning equipment. As stated previously, if the circuit conditioning equipment is not needed, the signal goes directly from the receive VF equal level equipment patch jack to the send VF subscriber primary equipment patch jack. From this jack, the signal flows to the send VF subscriber primary line patch jack, where it connects to the send landline; then it flows to the user's receive terminal equipment.

Facsimile Circuit (Over TDM/PCM System). A facsimile circuit routed over TDM or PCM is very easy to trace and requires a minimum amount of troubleshooting. A signal originates at the user's transmit equipment and travels down the receive landline to the TCF. The receive landline carrying the signal is connected to the receive VF subscriber primary line patch jack (labeled 4WR). From the receive VF subscriber primary line patch jack, the signal flows to the receive VF subscriber primary equipment patch jack and on to the input of the circuit conditioning equipment. (The circuit conditioning equipment is optional in this type of configuration, and, if none is needed, the signal from the receive VF subscriber primary equipment patch jack is connected directly to the send VF equal level equipment patch jack.) Since we are using circuit conditioning equipment, the output is connected to the send VF equal level equipment patch jack. The signal then flows from the send VF equal level patch jack to the send VF equal level line patch jack.

As you can see from the signal train, this is the last point in your facility where you can monitor the individual circuit since it is riding a TDM/PCM system. From the send VF equal level line patch jack, the signal becomes one of 24 channels that get multiplexed together and appears as a composite signal at the send baseband equipment patch jack. Now, if continuity is supplied, the signal flows to the send baseband line patch jack, where it becomes the input to the transmit radio.

It's time to change around and follow the signal coming into our station. The signal our receiver sends us is connected to the receive baseband line patch jack and flows to the receive baseband equipment patch jack if continuity is supplied. The receive baseband equipment patch jack now supplies the input to the TDM/PCM demultiplexer, where the composite signal is demultiplexed into 24 individual channels. The output of the demultiplexer is connected to one of 24 receive VF equal level line patch jacks. The signal from the receive VF equal level line patch jack continues to flow to the receive VF equal level equipment patch jack, where it becomes the input to send circuit conditioning equipment. (As stated earlier, circuit conditioning equipment might not be used; if it is not, the signal is connected directly to the send VF subscriber primary equipment patch jack.)

Since we are using circuit conditioning equipment, its output signal is connected to the send VF subscriber primary patch jack. From there it flows to the send VF subscriber primary line patch jack. The send VF subscriber primary line patch jack is connected to the send landline, so users can receive the signal and connect it to the input of their receive terminal equipment. As you can see, they both basically follow the same configuration, except for the multiplex area, where TDM/PCM is less involved than FDM.

You have just completed all the signal trains on foldouts 1 and 2. If you know them and can follow them, you should be able to take most DD Forms 1441, Circuit Data, to your station and trace the circuit diagrams on them.

444. Fault isolation procedures from fault indications or conditions

DCA prints general fault isolation guidelines in DCAC 310-70-1. Whether you are at a fixed station or with a tactical or combat communications unit, you can use these guidelines to prepare your own local procedures. We have based the information in this part of the text on DCA's guidelines.

Generally speaking, fault isolation should proceed from the point of fault recognition toward the signal source to a point where the fault exists. It may not be necessary to take each step in the order it is listed in written procedures. Depending on the trouble indications, it is possible that some steps may be taken in different sequence, with other steps, or even eliminated completely.

You should, however, give some general guidance in your written procedures and in your on-the-job training sessions, such as:

a. Coordinate with other stations through which the circuit or trunk is routed and with the local maintenance section. Don't take actions without letting others know what you are going to do.

b. Do not make adjustment at intermediate points to compensate for a problem at some other point in the circuit or system.

c. If a known fault cannot be corrected within a reasonable time (i.e., 10 minutes) and the circuit is out of service, begin restoration actions under restoration priorities.

Voice Frequency Fault Isolation. When you discover, by personal observation or alarms, that a circuit or multiplex group is not operating in the prescribed manner, you should make the appropriate inservice monitoring tests and checks to find the size and general location of the fault. You should find out whether a single channel, an entire group, a supergroup, or the baseband is affected, and whether the fault is within the station multiplex or line-conditioning equipment by selectively monitoring at the available circuit monitoring points. The goal is to find and correct faults before user's service becomes unusable.

In coordination with the distant stations and the FCO, CCO, or ICO, as appropriate, you eliminate one part of the circuit at a time to find the fault area. In-station monitoring, in many instances, finds the fault specifically enough to permit you to change the fault isolation procedures given below. To attack the problem directly, either substitute for the faulty item or make a patching substitution and use out-of-service testing procedures, or use the in-station test and alignment procedures.

Keep in mind that the fault isolation procedures here serve only as a guide for efficient technical control operations. They don't represent a rigid sequence of steps. Bypass any unnecessary steps to get the fastest fault isolation and service restoration.

You should do two things when you find that a single voice channel of a VF group is unusable or deteriorated. *First*, coordinate to transfer service to a spare channel or preempt a lower priority user. *Second*, request a test signal on the faulty channel by the appropriate out-of-service test procedure. You must notify a low-priority user when you preempt for this purpose.

When you have isolated trouble to a particular area, proceed as follows:

(1) Find which equipment is at fault.

(2) Coordinate the repair or alignment.

(3) Coordinate the replacement of equipment.

(4) Make the appropriate test to ensure proper operation of the circuit.

(5) Tell the user when the trouble has been cleared and restore service to the normal route as soon as possible.

(6) Complete station records, trouble reports, log entries, etc., by established procedures.

When you find that an entire FDM group or supergroup is deteriorated or unusable, you should:

(1) See whether alternate equipment is available.

(2) If none is available, request that test signals be sent on specific channels (1, 6, and 12 are best).

(3) Tell local users of circuit failure.

(4) Monitor test signals and coordinate maintenance. When you can't isolate the trouble or correct it within a reasonable length of time (10 minutes), restore service by using an unassigned group or supergroup, if available, or individual VF channels, or by preemption of circuits under assigned restoration priorities.

(5) After isolating and correcting the trouble, report the nature of the malfunction and request removal of test signals.

(6) Restore user service to normal routing.

(7) Complete station records, trouble reports, log entries, etc.

When you find that the entire radio-multiplex baseband is deteriorated, you should:

(1) See whether alternate equipment is available.

(2) Have distant users notified of circuit failure.

(3) Tell local users of circuit failure.

(4) Determine the quality of the order-wire circuits. If their performance is normal, the trouble is with common equipment at either the local or distant multiplex or radio equipment.

(5) Make sure multiplex-baseband patch connections at the radio-multiplex jack fields at both terminals are good and that all radio and multiplex-equipment meter indications are normal and stable.

(6) Measure the multiplex-group regulation pilots at the radio-multiplex baseband monitor jacks with a frequency selective voltmeter and spectrum analyzer at both terminals. Make sure the levels are in accordance with the appropriate radio subsystem block and level diagrams and that they are free of noise.

(7) If this signal is excessively noisy or of incorrect level with nominal indications at the transmitter terminal, go to step 8. If indications are nominal and operation of the order wire is not affected, go to step 12. If you can't correct the trouble within 10 minutes, tell the appropriate DOCC element or other management agency and request rerouting instructions for any high-priority circuits involved.

(8) Connect a frequency-selective voltmeter and a spectrum analyzer to the radio-multiplex baseband monitor jack to test for interference or manmade noise at the receive terminal. Observe the baseband signal for noise pulses or interfering signals.

(9) Work with the maintenance people as they alternately deactivate the individual receivers while observing the baseband signal and multiplex performance to determine the frequency sensitivity (interfering effect) or unwanted signals or to isolate a defective receiver.

(10) Request alternate deactivation of diversity transmitters to ensure that unwanted signals or noise are not caused by the distant-end transmitters. Direct maintenance people to make transmitter and common baseband equipment tests to verify normal operation.

(11) If the fault has not been isolated at this point in the test procedure, request deactivation of both transmitters. Monitor the receiver output on an oscilloscope and the automatic gain control (AGC) meters. The presence of noise spikes or pulses show either radio interference or local manmade noise.

(12) Direct performance of receiver and common baseband equipment tests to verify normal operation.

(13) Test the common circuitry of the multiplex terminal.

(14) When the trouble has been isolated and corrected, report the nature of the problem and request removal of any test signals used.

(15) Restore user service to normal when corrective action has been taken.

(16) Complete station reports, trouble reports, log entries, etc.

DC Fault Isolation. When you are notified by subscribers, or discover by personal observation, that one or more DC circuits are not operating properly, you should make the appropriate in-service monitoring tests and checks to see whether a single channel or the entire VFCT group is faulty. If the entire VFCT group is affected, continue monitoring to see whether the fault is within the VF subsystem circuitry, the multiplex-channel equipment, or the local or distant VFCT equipment.

Multichannel faults not involving the VF Subsystem or multiplex-channel equipment are limited to the send or receive VFCT equipment. You should proceed at once to isolate the fault within those parts of the VFCT applicable to all channels (use the equipment handbook as necessary).

You may find single DC channel faults by coordinating with the distant station to eliminate selectively each part of the circuit that is working properly. In-station monitoring procedures may often find the fault specifically enough to permit you to change the fault isolation procedures given below. To attack the problem directly, either replace the faulty item or make a patching substitution and use out-of-service testing procedures, or the in-station test and alignment procedures.

When you find that one channel of a VFCT is unusable, you should:

(1) Coordinate with the distant technical control to restore service on a spare channel or preempt a low-priority user.

(2) Request a test signal on the faulty channel.

(3) When you have isolated the fault to a particular area, find out which equipment is at fault and coordinate its repair, alignment, or replacement. Then, do the appropriate test to ensure proper operation, tell the user that the trouble has been corrected, and restore the service to the normal route.

When monitoring procedures show that the user's traffic signal (or a control test signal) on a VFCT channel is satisfactory, find out whether the fault is between the user and the user's serving TCF, or between your TCF and the local user.

Controllers at both ends of the circuit should monitor the user's test signal and thus isolate a fault area. Then, they should coordinate the needed repair or alignment, do the appropriate tests to ensure proper operation, and tell the users that all is clear. Last, they should complete station records, trouble reports, log entries, etc.

When you find that all channels on a VFCT are unusable, you should:

(1) Tell the distant control facility to block users' inputs on all channels. Tell users the circuit has failed, and deactivate all traffic equipment.

(2) Do voice frequency fault isolation procedures.

(3) If the results are satisfactory, request that the distant technical control send a test signal on specific channels (1, 8, and 16 are preferred) and proceed to check the level of the VFCT tones at the VF patch panel. Have the level and the frequency of the individual channel tones at both the transmit and receive locations checked by out-of-service test procedures; then coordinate the necessary alignment or repair.

(4) When corrective actions have been made, tell the distant technical controller of the nature of the problem and restore user circuits to normal.

(5) If the problem cannot be corrected within 10 minutes, tell the appropriate DOCC element or other management agency; if required, request rerouting instructions for priority circuits pending the completion of repairs.

(6) Complete station records, trouble reports, log entries, etc.

445. The systems approach to fault isolation

Systems approach is a methodology pioneered by the Air Force Communications Service (Air Force Communications Command). It is the basis for the current wideband transmission system assessment and performance monitoring guidelines given in DCAC 310-70-57. Steps have been taken to introduce the systems approach idea into the tactical communications environment. This part of the text tells how the systems approach relates to fault isolation.

Any connected string of individual components can be analyzed and maintained by two different methods: the black-box approach and the systems approach.

The black-box approach treats each component as an entity to be tested independently. In effect, this approach "says" that each user circuit, each receiver, each transmitter, each radio link, each landline, and so on, can be checked and aligned individually. If each item is run properly, everything else takes care of itself.

The black-box approach may have been good in the past when circuits were shorter and when transmission links were really individual, but that is not the way things are done now. User circuits are often very long, and transmission links are connected electrically to form very long routes. Take, for instance, a circuit running from Washington, D.C. to a remote facility 10,000 miles away. To get there, it must traverse multihop and multimedia transmission facilities. When tested end-to-end, the circuit may fail parameters. Then, when individual channels over which the circuit is routed are tested between relay points, the results turn out to be "within specifications."

This sort of thing can be frustrating to you. It is caused by the fact that the specifications referred to above are liberal technical order specifications that, in some cases, allow as much as ±3 dB variation on signal levels. This becomes quite a problem when the circuit performance requirement is ±1 dB end-to-end.

Under the black-box approach, the controller working on the above-mentioned circuit can expect little help from those relay stations. You would probably get such comments as "five-by here," or "leaving me loud and clear," or "trouble must be at your station—my link tests out good."

The systems approach, on the other hand, recognizes that the group of components strung together is the entity—a communications system. In effect, the systems approach "says" there are no individual components. The system must work as a system. In fault isolation, the most desirable way to analyze a connected string of individual components is the systems approach. The system must be tested first as a system, not as a conglomeration of components. The main reason for this is that an action anywhere in the system affects the whole system, not just the station where the action took place.

If the system does not work properly, every TCF and every relay station must become involved in finding out why. It matters very little that individual stations or links are operating "within specifications." Customers still can't communicate!

If every facility worked on the black-box principle without considering its effect on the system, everyone would be constantly adjusting and compensating for someone else's adjustment. It is this chaos that plagues large systems unless a systems approach is taken.

In using a systems approach, parameters that directly affect system performance are monitored. When a problem is found, an isolation procedure is started to identify the source of the problem. This procedure requires close coordination between the facilities in a system.

In many cases, a problem can be solved by a corrective action at the affected station. While the problem may disappear at this facility, it may appear intensified at another facility. This is the reason why all corrective actions must be coordinated at the system level. Start the black-box method of troubleshooting only after you have isolated the source of the problem to a single component.

Complex systems do not automatically take care of themselves. The system performance indicators must be continuously monitored and corrective actions must be controlled if a systems approach is to be maintained. This function is done by technical controllers. In a very real sense, you are system managers. You are the only individual in the personnel component of the system technically capable of continually "taking the pulse" of the system, that is, performance assessment and system quality control.

Contained in this responsibility are the functions of fault isolation and control of fault correction. The functions must be approached from a systems viewpoint, and, again, you are responsible for this action. You must anticipate difficulties in sufficient time to permit corrective action before excessive degradation or circuit failure occurs within the system.

If a circuit fails, reroute the customer and supervise the restoration of the circuit. While this function is often emphasized, avoid it if possible. If reroute and restoration actions are necessary, the system has failed in its objective. Your prime goal must be to prevent outages or reroutes. Only by emphasizing the quality control aspect of your duties can you fulfill your role as the system manager.

You may hear maintenance people at your station say that the system is only as good as they make it. To a certain extent, this is true. The system, for all its complexities, is still made up of components that must be kept within operating specifications. The maintainer is ultimately responsible for the performance of the system hardware.

The principle of quality control to prevent failure also applies to the maintenance of a system. Degradation should be diagnosed and the fault corrected before a failure occurs. In this respect, you must work together with maintainers. A maintenance quality control program should detect and correct component discrepancies before they cause system degradation. It is your responsibility to detect system degradation, isolate the link, and then rely on the maintainer to correct the fault. Such teamwork is essential to the systems approach.

To provide maximum communications capability throughout the total worldwide complex, a procedure is required to anticipate difficulties in sufficient time to permit appropriate corrective action before significant deterioration or actual failure of the communications circuit or system. This function is assigned to you under the classification of quality assurance and fault isolation. This function is done by measuring certain parameters and based on analysis of these parameters, faults may be identified, isolated and corrected before further degradation or failure occurs.

When considering the systems approach to fault isolation, circuit restoration actions are the undesirable technical control activities. Every time there is a reroute or restoration that is not scheduled, the system has failed to provide adequate service and a subscriber is denied communication. It also becomes obvious that the most important activities in technical control must be those that preclude or minimize unscheduled outages or reroutes. These prime activities are performance assessment, quality control, and fault isolation.

In today's technical control environment, we make many different quality assurance and quality control measurements. Individual circuits are tested periodically to verify their parameters on an end-to-end basis. These same circuits are monitored regularly on an in-service basis to check on such parameters as normal user traffic signals, telephone supervisory signals, and composite data transmission levels. The average performance of wideband links and routes is assessed by daily performance monitoring tests.

The results from any of these measurements may vary day to day or minute to minute, due to inadequate maintenance, poor alignment, or some other equipment condition. They may be affected by transients due to adjustments, natural or manmade interference, or changes in traffic loading. If the change is momentary, such as level changes caused by improper use of test instruments, no correction can or should be made. If the change is of an extended nature, some correction is required.

When instruments of any sort show trouble, the many possible faults make analysis and isolation difficult. Immediate isolation of a problem to one segment of the system is mandatory. You and the maintainers must continue to search for the source or the problem—to fault isolate until one link, one station, one component is identified. Then, and only then, do you turn over the problem to maintenance for correction.

Prime responsibility for locating a fault may have to be handed down the links of a system from the discovering technical controller to several control stations removed before final fault isolation is achieved. Once the fault is found, every concerned station should be notified of its nature. Intended corrective actions should be discussed and agreed to. In case equipment substitution or shutdown is needed, the controllers and maintainers at each station involved in the project should synchronize their actions to avoid or minimize outage time to subscribers.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

439. Test points in a DC signal train

1. What are the two different configurations available for DC circuits? In station & out of station

2. You have a TTY problem and suspect your receive LLIU is putting out high distortion. What two test points would you check to confirm that the equipment is bad? RX DC primary equipt. mon jack
TX DC equipt. mon. jack

3. Where can the DC signal on your receive channel be measured first in your station?
RX line mon. jack

4. Why does circuit conditioning equipment appear between the VF equal level patch bay and the VF primary patch bay on DC circuits? So there is continuity between DC & your patch bays.

440. AUTOVON signal train

1. What signal is located on the send VF primary line patch jack of an AUTOVON circuit?
in put to channel bank modulator

2. Can you conclude that you have an equipment failure if you know that an AUTOVON circuit has a signal present on the receive VF equal level equipment patch jack and no signal present on the send VF subscriber primary equipment patch jack? Why?
No. need to check status on E&M leads

3. If the AUTOVON circuit you're checking is on-hook, could you check levels on the circuit? Why? Yes SF levels should be present

4. When you check the signal on an AUTOVON circuit at the receive VF equal level line patch jack and find an SF tone present at -20 dBm0, what does this tell you? compensate for test level points

441. Test points in a high-speed data signal train

1. If your final receive test point on a high-speed data circuit is the send VF subscriber primary patch bay, what does that tell you about the location of the circuit's modem? located at user

2. On an out-of-station high-speed data circuit that uses a modem, at what test point would you measure the output of the receive modem? What type of signal would be present? DC line jack

3. Which high speed data circuit user does not require a landline? Why? instation user, located at same building

4. Where would the crypto equipment be located on an out-of-station high speed data user? at user location

442. Test points in a two-wire subscriber signal train

1. What is the major difference between dial loop and 20-Hz ringdown circuits? Dial loop tone on ringdown tone off while idle

2. What is the path between the user and the VF subscriber primary patch bay on a dial loop circuit called? 2 wire drop

3. After checking a 20-Hz ringdown circuit, no signal was observed at the receive VF equal level line patch jack. Does this indication warrant further testing? Why? No, its normal

4. Where is the send output of the signaling string located on a dial loop circuit? send VF down equipt jack

443. Test points in a facsimile signal train

1. On a facsimile circuit, where is the next test point the signal appears after leaving the receive VF subscriber primary patch bay? VF down equipt jack

2. What signal is present on the receive line jack of a facsimile circuit at the VF primary patch bay? output of channel bank demod

3. What piece of equipment is wired between the VF equal level and VF primary patch bays on a facsimile circuit? CCE

444. Fault isolation procedures from fault indications or conditions

1. The circuits on channels 3, 5, and 6 of a VFCT are suddenly reported out of service by the user. The technical controller monitors these circuits and observes total distortion on each of them. List a sequence of fault-isolation procedures that probably will locate the cause of the trouble in the shortest amount of time. check other channels VF isolation procedures ~~send~~ pass test tones

2. What are the first two actions to take when you find that a single-voice channel of a VF group is unusable or deteriorated? Spare off + request test tones.

3. What fault-isolation procedures should you follow when you find that an entire FDM group is deteriorated or unstable? Pass tones notify user, request maintenance log everything

4. What fault-isolation procedures should you follow when you find that the entire radio-multiplex baseband is deteriorated? do checks, work with maintenance, log everything

445. The systems approach to fault isolation

1. What is the prime objective of a technical controller using the systems approach to fault-isolation? correct before excessive degradation

2. What is the purpose of a quality-control program with respect to fault-isolation? detect degradation + correct component discrepancies

3. What are the prime activities of technical controllers in preventing unscheduled outages? assesment quality control + fault isolation

4. What action should you take once a system fault is located? notify each station of fault + corrective actions

ANSWERS TO SELF-TEST QUESTIONS

426

1. Lowest level consistent with authority and resources.
2. To a predetermined course of action for a specific condition and an improvised course of action for an unanticipated event.
3. Facility surveillance, traffic surveillance, network control, traffic control, and technical control.

427

1. (1) f; (2) b; (3) d; (4) e; (5) a; (6) g; (7) h; (8) c.
2. It's often their only means of knowing that a problem exists at your station.

428

1. (1) b; (2) f; (3) d; (4) e; (5) h; (6) j.

429

1. To monitor the 60- to 180-kHz signals from the group multiplexer shelf.
2. They monitor power and building conditions in the technical control element; they also provide both visual and audible alarms and can be paralleled with remote alarm panels installed in locations within the building complex.
3. Radio alarms.
4. Multiplex alarms.
5. Major alarm.

430

1. To assist the technical controller in isolating a failure or degradation to a location and item of equipment.
2. The equipment was designed for modular replacement.
3. It provides them with the capability to supervise subordinate digital terrestrial transmission media and facilities.
4. One terminal would be master, the other would be slave.
5. A hazardous condition (HAZCON) exists.

431

1. Electrically and physically.
2. Because of security (so that personnel cannot patch red and black areas together).
3. By isolating circuits using battery from each other.
4. Low-level polar keying.
5. Lower electrical radiation and line characteristic distortion are effectively eliminated.

432

1. Distribution frames.
2. In-station equipment is tied to the horizontal blocks, and outside lines are connected to the vertical blocks.
3. Telephone switchboard facility.
4. Black.
5. Red distribution frames.
6. Black and red.
7. Jumper rings and fanning strips.

433

1. Red.
2. COMSEC.
3. In the COMSEC equipment.
4. He patches in spare equipment to bypass the malfunctioning equipment.
5. The input to the send COMSEC equipment.
6. The output of the send teletype equipment is connected to the tip.
7. Monitor jacks.
8. No. If you have a reason for monitoring the stepper pulses, the circuit is already experiencing trouble.
9. Stepper pulses.
10. The 22-ohm resistor makes it possible to use high-impedance devices for monitoring.

434

1. Black patch bay.
2. 120.
3. Tip.
4. A DC landline or input to a multiplex channel.
5. Equipment patch jack.
6. Monitoring must be done in the monitor jacks to prevent signal interruption.
7. Receive multiplex channel or DC landline.
8. The normally closed jacks open and the normally open jacks close, as in all cases.

435

1. Line, drop (sometimes called "equipment"), monitor, and E & M lead jacks.
2. Sleeve conductor.
3. Parallel.
4. Ensure continuity and quality of circuitry to the distant end user.

436

1. Circuit conditioning equipment.
2. To provide flexibility of associated channels and equipment.
3. You would insert one end of a patch cord in the normal EQUIP IN jack and the other end into a spare channel DEMOD OUT jack.

437

1. Group and supergroup patch bays.
2. Three.
3. 12.
4. Tip and ring.
5. Supergroup jacks and connectors are of the coaxial type; therefore, the jacks are not normal-through.
6. The system would be "inoperative" because the supergroup (coaxial) jacks are not wired normal-through.
7. Normally, 60 channels.
8. Because you have control of hundreds of VF channels at your fingertips when patching supergroups.

438

1. Electronic cross-connect and test access for the 64-kbps digital signals.
2. By using a separate DPAS to interface the T1 line and the switching elements of the DCS.
3. The systems flexibility, reduction of patch bay wiring on the main frame, and reduction of first level multiplexer requirements.
4. Manually with a keyboard or automatically with a processor.

439

1. In-station and out-of-station.
2. The receive DC primary equipment monitor jack and the send DC circuit equipment monitor jack.
3. Receive DC circuit line patch jack.
4. To compensate for the differences in test-level points.

440

1. Input to the channel bank modulator.
2. No, because you need to check the status of the E & M leads.
3. Yes, because SF levels should be present to measure.
4. It tells you that there is continuity on the receive side of the circuit between the distant ends send VF equal level patch bay and your receive equal level patch bay.

441

1. The modem is located at the user's location.
2. Receive DC circuit line patch jack. Digital.
3. In-station user. Because they are located in the same building.
4. At the user's location.

442

1. Dial loop circuit is tone-on idle, and the 20-Hz ringdown circuit is tone- off idle.
2. Two-wire drop.
3. No. This is a normal condition for this type circuit.
4. Send VF equal level equipment patch jack.

443

1. Send VF equal level equipment patch jack.
2. Output of the channel bank demodulator.
3. Circuit conditioning equipment.

444

1. Check all other channels for excessive distortion; perform VF fault isolation procedures; and request test signals from the distant end TCF on the faulty channels.
2. Coordinate to transfer service to a spare channel or preempt a lower priority user and request a test signal on the faulty channel in accordance with the appropriate out-of-service test procedure.
3. See whether alternate equipment is available; if none is available, request that test signals be sent on specific channels (1, 6, and 12 are best); notify local users of circuit failure; monitor test signals and coordinate proper maintenance (reroute if necessary); after isolating and correcting the trouble, report the nature of the malfunction and request removal of test signals; restore user service to normal routing when corrective action has been taken; complete station records, trouble reports, log entries, etc., in accordance with the established procedures.
4. See whether alternate equipment is available; notify distant TCF and local user of circuit failure; determine the quality of the orderwires to isolate fault; ensure patches at terminal jack fields are good and meter indications are normal and stable; ensure multiplex and group pilots are at the proper level and free of noise; work with maintenance personnel as they alternately deactivate the individual receivers while they determine the frequency sensitivity (interfering effect) of unwanted signals or isolate a defective receiver; request alternate deactivation of transmitters; if fault has not been isolated at this point, request deactivation of both transmitters, direct performance of receiver and common baseband equipment; test common circuitry of the multiplex terminal; when the trouble has been isolated and corrected, report the nature of the problem and request removal of any test signals used; restore user service to normal; complete station reports in accordance with local procedures.

445

1. To prevent outages or reroutes by anticipating and correcting difficulties before excessive degradation or circuit failure occurs.
2. Its purpose is to detect system degradation and correct component discrepancies before they cause system failures.
3. Performance assessment/quality control and fault isolation.
4. Notify each concerned station of the nature of the fault and discuss the corrective actions required.

Do the Unit Review Exercises (URE) before going to the next unit. ➡

UNIT REVIEW EXERCISES

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

50. (426) Which control has the authority to reconfigure a system back to a previously known configuration?

    a. Systems control.
    b. Network control.
    c. Traffic control.
    d. Technical control.

51. (427) A receiver site is considered what kind of facility?

    a. Radio relay site (RRS).
    b. Patch and test facility (PTF).
    c. Technical control facility (TCF).
    d. HF technical control facility (HFTCF).

52. (427) All AC-powered communications equipment manufactured in the United States is available in models that require what input frequency?

    a. 50 Hz.
    b. 60 Hz.
    c. 120 Hz.
    d. 240 Hz.

53. (428) Line diagrams that show transmission facilities such as trunks, links, and voice frequency carrier telegraph (VFCTs) are examples of

    a. placards.
    b. system plans.
    c. cabling files.
    d. ready reference charts.

54. (428) Which maintenance facility maintains cabling records and wiring files?

    a. Computer maintenance.
    b. Teletype maintenance.
    c. Wideband maintenance.
    d. Inside plant maintenance.

55. (429) Which alarms are used at the receiving terminal to monitor the 60-108 kHz signals from the group multiplexer shelf?

    a. Radio alarms.
    b. Station alarms.
    c. Multiplex alarms.
    d. Group pilot alarms.

56. (429) Which condition will activate a radio alarm at your station?

    a. High-receiver input.
    b. Low-transmitter output.
    c. Failure of the carrier supply.
    d. Failure of the pilot generator.

57. (430) The main function of fault alarm and status reporting (FASR) is to assist you

    a. in quality control testing.
    b. in isolating a failure to a specific location.
    c. by providing system phase lock and synchronization.
    d. by providing the system with parity error detection.

58. (430) Where is the master terminal of a transmission control system located?

    a. FCO.
    b. CCO.
    c. DOCC.
    d. ACOC.

59. (430) The capabilities of a TRAMCON system were a key factor in

    a. eliminating hazardous conditions (HAZCONs).
    b. requiring only slave terminals to operate.
    c. being able to establish more unmanned sites.
    d. deleting maintenance support to remote facilities.

60. (431) What do the battery isolation relays provide for the red/black concept?

a. Electrical separation.
b. Lower electrical radiation.
c. Low-level keying capability.
d. High-level keying capability.

61. (431) The type of keying most often used within technical control facilities operating under the red/black concept is

a. low-level polar.
b. high-level polar.
c. low-level neutral.
d. high-level neutral.

62. (432) Wire connections for the unencrypted side of cryptographic devices appear only at the

a. red distribution frame.
b. black distribution frame.
c. combined distribution frame.
d. intermediate distribution frame.

63. (433) To check the output of the crypto stepper pulse, you should patch from a meter directly into the

a. send line patch jack.
b. receive line patch jack.
c. send equipment patch jack.
d. receive equipment patch jack.

64. (433) Which of these output jacks should you find in the miscellaneous jack sets on a red digital patch bay?

a. Battery taps and cut keys.
b. Termination plugs and spare crypto.
c. Milliammeters and distortion analyzers.
d. Spare monitor printers and crypto steppers.

65. (434) All of the following will be done when the cut key is activated in the black send jack set *except* that

a. the send cut key is activated.
b. the output of the send equipment is opened.
c. a 2500 ohm resistor is placed across the send line.
d. a negative 60 VDC is applied to the send signal line.

66. (434) At the black DC patch, where should you insert your patch cord if you want the input of the receive COMSEC equipment to appear on the tip of the cord?

a. Send line patch jack.
b. Receive line patch jack.
c. Send equipment patch jack.
d. Receive equipment patch jack.

67. (435) Which jacks listed below are on the circuit patch bay in an AUTOVON TCF?

a. ESC and PMB.
b. CH MOD IN and PMB.
c. E/M leads and CH DEM OUT.
d. CHAN BANK IN and E/M leads.

68. (436) Why are VF patch bays engineered for high impedance shunt monitoring?

a. To allow circuits to be rerouted.
b. They are easier for maintenance to service.
c. To prevent circuit interruption while testing.
d. It provides the circuit with a proper termination.

69. (437) Which of these patch bays uses a coaxial patch jack?

a. Group patch bay.
b. Circuit patch bay.
c. Supergroup patch bay.
d. Equal level patch bay.

70. (437) The output of the supergroup demodulator is connected to the

a. GP DEM IN patch jack.
b. GP MOD OUT patch Jack.
c. SGP MOD IN patch Jack.
d. SGP DEM OUT patch Jack.

71. (438) Which of the following is *not* considered an advantage of the Digital Patch and Access System (DPAS)?

a. Reduced staffing requirements.
b. Enhanced flexibility of the DCS.
c. Reduced patch bay wiring on the main frame.
d. Reduced first-level multiplexer requirements.

72. (438) What feature of the Digital Patch and Access System (DPAS) allows the DCS greater flexibility?

a. The need for more complex wiring on the main frame.
b. Telephone service is not required for DPAS operation.
c. The increased requirement for first level multiplexers.
d. Physical integration must exist between the transmission and circuit switching functions.

73. (439) What type of signal will be present on the receive equipment DC circuit patch jack of an in-station user?

a. The input to the VFCT.
b. The output of the VFCT.
c. The input to the crypto.
d. The output of the crypto.

74. (439) On a DC out-of-station user, between what patch jacks does the send line level interface unit (LLIU) appear on the signal train?

a. Send DC primary equipment and send DC circuit equipment.
b. Send DC circuit equipment and receive DC primary equipment.
c. Receive DC circuit equipment and send DC primary equipment.
d. Receive DC primary equipment and receive DC circuit equipment.

2-35

75. (440) What type of signaling is used on an AUTOVON circuit?

a. E&M.
b. Dial loop.
c. Out of band.
d. 20 Hz ringdown.

76. (440) What is the frequency and level of a single-frequency tone?

a. 1004 Hz at –10 dBm0.
b. 1004 Hz at –20 dBm0.
c. 2400 Hz at –10 dBm0.
d. 2600 Hz at –20 dBm0.

77. (441) Refer to Foldout 1. What is required between the VF subscriber primary and VF equal level patch bays on a high-speed data circuit where the modem is located at the user?

a. Signaling string.
b. Cryptographic equipment.
c. Circuit conditioning equipment.
d. Channel modulators/demodulators.

78. (442) What is the path between a 20-Hz ringdown user and the VF subscriber patch bay called?

a. Landline.
b. Cross connect.
c. Two-wire drop.
d. Four-wire drop.

79. (442) What signal is present on the receive VF primary line patch jack on a dial loop circuit?

a. Input to the channel bank modulator.
b. Input to the channel bank multiplexer.
c. Output of the channel bank demodulator.
d. Output of the channel bank demultiplexer.

80. (443) What is the path that connects a facsimile user with the technical control facility called?

a. Landline.
b. Cross connect.
c. Two-wire drop.
d. Four-wire drop.

81. (443) Where is the last place in your facility that you can monitor an individual facsimile circuit before it enters the TDM/PCM equipment?

a. Baseband patch bay, send line jack.
b. VF equal level bay, send line jack.
c. Baseband patch bay, receive equipment jack.
d. VF subscriber primary patch bay, send line jack.

82. (444) When you find an entire frequency division multiplexing (FDM) supergroup is unusable, what is the *first* step toward fault isolation?

a. Record it on the master station log.
b. Notify local users of circuit failure.
c. Request test signals on specific channels.
d. See whether alternate equipment is available.

83. (444) When you find one channel of a VFCT is unusable, what should you do *first*?

a. Call maintenance for an alignment.
b. Restore service by patching to a spare channel.
c. Determine which station has the faulty equipment.
d. Request the distant end put a fox test on the circuit.

84. (445) What *procedure* was established to identify, isolate, and correct faults on systems before further degradation or failures occurred?

a. Systems approach.
b. Quality assurance.
c. System alignments.
d. Black-box approach.

Please read the topic page for Unit 3 and continue. ➡

STUDENT WORK SPACE

SYSTEMS MANAGEMENT

Page

3-1. Forms and Record

3-2. DCS Status Reporting

3-3. Circuit Actions

3-4. Miscellaneous Plans and Outages

This unit covers forms and reports you must fill out and keep. This career field is no different than any other in the Air Force; it has its share of paperwork, and most of it is needed for us to do our job correctly. Some of the forms and reports may not seem relevant when you fill them out, but, maybe, when you are having a difficult problem, you might be able to look at a form or report you filled out 6 months earlier and find a corrective action. Lastly, the unit covers reporting procedures as outlined by the Defense Communications Agency (DCA).

3-1. Forms and Record

We sometimes think paperwork was "invented" to give us something to do when we have idle moments. In our career field, records are made necessary by the requirement to report our activities to others. They help to overcome that human trait—forgetfulness. Let's face it, filling out an outage ticket is much easier than trying to remember all of the specific details of an outage 2 weeks or even 2 days after the event. Remembering is almost impossible if you are working a large station and dealing with 50 to 100 outages a day.

You may also be responsible for gathering status and reporting on another station's outages, Without some method of recording another station's activities, we could not effectively conduct our job. It is one of your basic duties.

Several forms and records are required to properly record the information necessary to maintain a continuing knowledge of the operational status of circuits and equipment of your station. In this section, we discuss some of the forms and records you will be using. We limit our discussion to forms and records prescribed by DCA.

446. DD Form 1753, Master Station Log

The Master Station Log, shown in figure 3-1, is a journal of your station's daily activities. The Master Station Log is commonly called simply the MSL. It is used to record, in a narrative form, such information as power failures, complete system failures, equipment outages, shift changes, and any other significant event that occurs during your tour of duty. But entries are not limited to the general categories just mentioned. You should make any entries necessary to cover events you consider important. Experience and guidance from your supervisor will help you decide what entries to make. Some TCFs log every circuit outage in the MSL, while others log only priority one- or two-type circuits. You will also have written local procedures that, from time to time, specify that certain information or events must be recorded. References may be made to supporting documents (trouble tickets, equipment work orders, 55-1 reports, etc.) that must be retained at least as long as the master station log. Remember, this form is a legal document containing a permanent record.

Your shift supervisor is required to make the first entry on the MSL covering your shift's tour of duty. The supervisor signs the shift on duty and makes remarks outlining station status, shift personnel accountability, and duty assignments. All entries are made in chronological order. The supervisor also signs the shift off duty at the end of your tour. Your supervisor, you, and your coworkers should use only generally accepted phrases and abbreviations when making narrative remarks.

This is an official log often used to brief your commander on the communications status. In the event of later disagreement with, or inquiries from, other communications activities, it is a record of the controller's actions and opinions during significant occurrences. Be careful when stating opinions. Do not make any derogatory remarks you can't fully support. Keep your remarks factual.

Logs are retained in the TCF for the calendar month. Thereafter, they must be kept in the current files area for 11 months before destruction or disposition under military department directives. The MSL is not a controlled document; therefore, NO classified information may be placed in it.

These items must be entered on the master station log:

a. Facility. The name and function of the facility.

b. Date. Current day, month and year.

c. Time period. ZULU time of the first log entry (FROM) and ZULU time of the last log entry (TO) on this page.

d. Subject. Identification of the communications channels, circuit, trunk, system, link, etc., about the log entry.

e. ZULU (Z) time. Greenwich Mean Time (GMT) time of the event or action.

f. Operator initials. Initials of the individual making the log entry.

g. Action or event. Narrative explanation of the action or event. Enter sufficient detailed information to fully explain the situation. Common abbreviations may be used.

MASTER STATION LOG	FACILITY	DATE	TIME PERIOD FROM	TO
	HUM TCF	21 Sep 87	ØØØ1 Z	24ØØ Z

CHANNEL OR CIRCUIT	ZULU TIME	OP INIT	ACTION/EVENT
NURADAY	ØØØ1	AS	BEGIN NEW RADIO DAY WITH 9CMM OUT DUE TO RECEIVING NO SF, AND 9MNH OUT TO ANNUAL QC. REST OF STATION FIVERS WITH "C" SHIFT REMAINING ON DUTY....... Frank M. Adams /AS
PILOT ALARM	ØØ31	AS	RECEIVING A PILOT ALARM ON THE "A" STAR GROUP FROM INO ATT. TRYING TO RAISE INO ATT.
PILOT NOTE	ØØ39	AS	PROBLEM CLEARED ATT. WIDEBAND MAINTENANCE AT INO/HK FOUND LOOSE CONTACTS ON THE PILOT INJECTION NETWORK CARD. THERE WAS NO LOSS OF COMMUNICATIONS DUE TO THE PILOT FAILURF.
9CMM	Ø1ØØ	AS	CIRCUIT LOGGED BACK IN ATT. RFO WAS A FAULTY SF UNIT AT MRE. MRE/VN ADV HE HAD A LOOSE WIRE ON THE REAR OF THE DRAWER. DCA/MR ADVISED.
BTXXPAMM	Ø115	AS	ROTA/DI REQUESTED AN ON-CALL PATCH BETWEEN ROTA AND NAPLES BOTHWAYS. USING 55DMØ1 SPARE CHANNEL ØØ3 BETWEEN RTA AND HUM.
BTXXPAMM	Ø125	AS	ADV MRE/VN SENDING HIM THE BTXXPAMM FROM ROTA TO NAPLES ON SPARE CHANNEL ØØ7 ON 55JTØ6 BOTHWAYS.
BTXXPAMM	Ø145	AS	ROTA/DI ADV ON-CALL PATCH LOGGED IN ATT. WILL ADV WHFN TERMINATED.
9MNH	Ø155	AS	LOGGED BACK IN FROM ANNUAL QC ATT. ALL TEST PASS. MRE/VN, DCA/MR
6D25	Ø215	AS	RECEIVING LOW LEVELS ON CIRCUIT AT Ø21ØZ. ZAFED TO SPR CHANNEL MY RECEIVE ONLY AT Ø215Z. TJN/GN. MAINTENANCE CHECKING NORMAL CHANNEL ATT.
6D25	Ø3ØØ	AS	NORMALED CIRCUIT UP ATT. MAINTENANCE ADV THEY REPLACED THE CHANNEL AMPLIFIER POT IN THE CHANNEL DEMODULATOR. ADV TJN/GN
IN SFRVICE QC	Ø415	AS	IN SERVICE QCs COMPLETED ATT WITH NO TROUBLE FOUND.
BB SWEFPS	Ø43Ø	AS	BB SWEEPS COMPLETED ATT WITH NO HOT LEVELS NOTED.
SHIFT CHANGE	Ø5ØØ	AS	"C" SHIFT OFF DUTY ATT WITH STATION FIVERS, BTXXPAMM REMAINS UP BETWEEN ROTA AND NAPLES, ONCOMING SHIFT BRIEFED... Frank M. Adams /AS

DD FORM 1753, 1 SEP 70 — REPLACES AF FORM 1019, NOV 60 AND DCA FORM 193 JUL 68, WHICH WILL BE USED UNTIL SUPPLY IS EXHAUSTED.

NCS24-65

Figure 3-1. Sample, DD Form 1753.

447. DD Form 1441, Circuit Data

Information on all circuits and channels appearing in the TCF must be recorded in such a manner to allow fast, easy access. This form is completed for all circuits. Filed in Kardex-type files, alphabetically, numerically, by CCSD and trunk designator, the circuit data form (fig. 3-2) serves as a locator card for quick reference. This form also provides a permanent record for administrative purposes.

Although the information recorded on this form may be very useful to maintenance people, it was not designed to serve as a wire record or equipment file; it is operational in nature and serves primarily to help the TCF in troubleshooting and circuit restoration. This form should be considered a permanent record for as long as the circuit exists and should be retained in a "read file" for 6 months after the circuit has been deactivated. Information for preparing the circuit data form is be taken from the telecommunications service order (TSO) as a primary source. In-station equipment and circuit appearances may be added as required. Follow the instructions discussed here when you make entries on a DD Form 1441.

a. CCSD. Enter the CCSD from the TSO.

b. Landline channel number. Enter multiplex trunk and channel number or cable designation for each direction from the TSO.

c. Terminals. Enter user terminal facilities by geographical location and en route facility code from the TSO.

d. Control facilities. Enter the geographic location on the TCFs adjacent to the user terminal location from the TSO.

e. NCS RP. Enter the NCS restoration priority from the TSO.

f. Term station. Enter geographical location of each terminal station on the line entries provided from the TSO.

g. Operating agency. Enter the O&M agency of the terminal station, if known.

h. User terminal equipment. Enter type or model of user terminal equipment (for example, M28 ASR, AN/FGC-39, etc.) from the TSO.

i. User contact. Enter user contacts from the TSO or as available.

j. Type circuit. Enter circuit parameter code from the TSO.

k. Use. Enter AUTODIN, AUTOVON, AUTOSEVOCOM, etc.

DD FORM 1441, 1 JAN 69

CIRCUIT DATA

CCSD	LANDLINE CHAN NO	TERMINALS	CONTROL FACILITIES	NCS RP
DTXX6D25	55JMØ5-ØØ6	Torrejon / Humosa	TJN - HUM	1D

TERM STATION	OPERATING AGENCY	USER TERM EQUIPMENT	USER CONTACT
Torrejon TCF	USAF AFCC	AN/FCC-19	TJN TCF Orderwire
Humosa TCF	USAF AFCC	AN/FCC-19	HUM TCF

TYPE CIRCUIT	USE	CCO (SCCO)	MODULATION RATE	CRYPTO SERVICE
D2	VFCT	HUM	3KHz Voice	N/A

ACTIVATION AUTHORITY	DATE AND TIME INSTALLED	CKT MODIFICATIONS(Continue on reverse side)	
TSO E7Ø341/6D25-Ø1	27 15ØØZ Sep 77	AUTHORITY	DATE AND TIME COMPLETED
DEACTIVATION AUTHORITY	DATE AND TIME CEASED		

CONDITIONING EQUIPMENT		REMARKS
PAD	# 21	Levels: -13 dBmØ
REPEAT COILS		
LINE AMPLIFIER	# 28	55JXØ3 - 16 channel system
DELAY EQUALIZER		3,5,7,9 only active channels.
AMPLITUDE EQUALIZER		
REGENERATIVE REPEATER (TTY)		
4 WAY 4 WIRE BRIDGE		
4 WAY TERMINAL SET		
ECHO SUPPRESSOR		
OTHER		

CCSD	LANDLINE CHAN NO	TERMINALS	CONTROL FACILITIES	NCS RP
DTXX6D25	55JMØ5-ØØ6	Torrejon/Humosa	TJN - HUM	1D

U.S. G.P.O. 1980-620-741/3188

NCS24-66

Figure 3-2. Sample, DD Form 1441.

l. CCO. Enter the CCO and ICOs from the TSO.

m. Modulation rate. Enter modulation rate from the TSO.

n. Crypto service. Enter security equipment nomenclature from the TSO.

o. Activation authority. Enter the TSO number.

p. Date and time installed. Enter the service date as shown in the In-Effect Report.

q. Deactivation authority. Enter the TSO number discontinuing the circuit.

r. Date and time ceased. Enter the date and time circuit discontinued.

s. Circuit modifications. Enter TSO number directing changes to the circuit, and date and time change completed.

t. Conditioning equipment. Enter conditioning and signaling equipment locations (rack number, jack number, etc.) for all in-station equipment.

u. Remarks. Enter circuit routing, type signaling, signalling frequency, test tone and operating levels, etc., from the TSO.

v. Bottom line of card. Complete the bottom line of the card, using the same entries as the top line, when a Kardex-type file is used.

w. Reverse side. Place a block diagram on the reverse side of the form showing the end-to-end circuit configuration, along with input and output levels at each PTF and TCF facility. Also, this area may be used to continue remarks or equipment configuration as necessary.

448. DD Form 1443, Trouble and Restoration Record

This form is used as a complete record and document of circuit, channel, trunk, and system outages and problems identified during in-service QCs. This record gives complete circuit and channel outage information needed to prepare DCS status reports. It is the primary source of information for that purpose.

Remember, it is only as accurate as you make it. Outage and trouble record files are cut off at the end of each month. They must be kept in the current files area for 11 months, then destroyed under appropriate military department directives.

When you are working a control position and an outage occurs, you must make sure all information on the outage is recorded on a DD Form 1443, as shown by the example in figure 3-3. Fill out the form as you work the outage. In some cases, a TCF coordinator first fills out the DD Form 1443, and then you add the rest of the information as you work the outage. Some information you need can be obtained from circuit or trunk records (DD Form 1441) and from your patch panel labeling. Other data, such as the RFO and the action taken, must come from you.

If your outage record is reporting a multichannel transmission path—a tone package, for example—you must get this information at once to the person who makes up the DCS

TROUBLE AND RESTORATION RECORD — DATE 21 Sep 81

OUTAGE TICKET

POSITION Digital		PRIORITY 1D		☐ SND	☒ RCV	CONTROLLER	REPORTS
TRUNK K 55JXØ3		OUT	IN	RFO	FREQ	OUT AS	OUT GN
CHAN CØØ3	CCSD DOOA3N61	OUT 142Ø	IN 163Ø	RFO LFY		IN AS	IN GN
CHAN	CCSD			CCSD		PRIORITY	SEND
AØØ4	DSOASSSS	OUT 1430	IN 1630	DOOA3N61		1D	
A		OUT	IN				
K							
A		OUT	IN				
A		OUT	IN				
A		OUT	IN				
A		OUT	IN				
A		OUT	IN				
A		OUT	IN				
A		OUT	IN				
A		OUT	IN				

USER OUTAGE

☒ REPORTABLE			☐ NONREPORTABLE	
CCSD			RFO	SEGMENT (If required)
U	OUT	IN		
	OUT	IN		
	OUT	IN		
	OUT	IN		

AMPLIFYING REMARKS (Use reverse if necessary)
Receiving high distortion / maintenance realigned channel # 3

DD FORM 1 JAN 69 1443 — ☆U. S. Government Printing Office: 1979—289-044/15

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Figure 3-3. Sample, DD Form 1443.

status reports. The same is true of any other special-interest circuit.

Remember, they must be reported as soon as possible. Here is an explanation of entry spaces on the trouble and restoration record (fig. 3-3):

Date. Contains the current radio day; i.e., 21 Sep 87.

Position. This is the control position of the technical controller responsible for conducting the outage.

Priority. The NCS restoration priority of the circuit/ system outage.

Send/receive. Enter the direction of the action required with respect to your location. Long-haul circuitry is logged as send or receive-as the on-base customer sees it. Off-base circuits are logged in relation to the technical control facility.

Controller (out/in). The personal sign of the controller initiating the form appears in the Out block. The personal sign of the controller terminating the outage appears in the In block.

Reports (out/in). The out/in blocks contain the personal sign of the controller who has reported the circuit/trunk outage to DCA.

Outage ticket. The part of the form labeled OUTAGE TICKET is used to record outages, REROUTE action, ON-CALL patches, and teleconference action on DCS trunks between the local TCF and the next directly connected DCS TCF.

a. Trunk outages. Indicate trunk identifier (K) by direction, OUT time, IN time, Reason for Outage (RFO) code, and in the case of frequency changes, the DCA code of the frequency in use on restoral.

b. Channel outages. Indicate the trunk (K) on which it rides and the channel involved (C) with a three-digit indicator, CCSD of circuit involved, OUT time, IN time and RFO.

c. Circuit reroute action. Circuit reroute action on the same trunk for the circuit outage caused by the above channel outage is indicated.

(1) Indicate the channel number of the PREEMPTED channel, the CCSD of the preempted circuit, the time (OUT) it was preempted, IN when restored, the CCSD of the circuit preempting it, and the restoration priority of the circuit preempting. (NOTE: If the channel is out both ways for local control purposes, the send side may be shown by marking the send channel preempted in the column marked SEND.)

(2) The above restoral action on a different trunk is shown by utilizing the second "K" line and its associated "A" line.

d. On-call patch (through station). Most through station patches are full duplex and require a DD form on each RECEIVE system/channel. Indicate the receive trunk (K) and the prescribed channel. In the column marked SEND, indicate the send channel/system carrying the through patch.

e. Teleconference and locally initiated on-call patches. Same as the through station on-call patch, with the exception that it only requires one ticket, which includes in the remarks, TIME REQUESTED, TIME MADE, and difficulties experienced.

User outage. User outages are any outages affecting the user directly connected to the DCS TCF or those outages on THRU-STATION circuits.

a. Reportable/nonreportable user outages. This is in reference to the DCAC 310-55-1 report.

More than one RFO is common to a reportable outage. Extra OUT-IN lines are provided to accommodate reopening of these outages.

This part of the form is also used for record keeping purposes on send system/circuit outages. These send outages are not reported to DCA.

b. Segment. This block is not being used.

Amplifying remarks. This part of the form explains the actions taken and the faults found that caused the circuit/ system outage. This section also has any other information that helps others to understand the nature of the outage and your corrective actions. Amplifying remarks are mandatory when "unidentified, negative contact, or personal error" are used as a reason for outage.

One of the biggest problems for a technical control supervisor can be the handwriting on an outage. Legibility is just as important as accuracy in completing the DD Form 1443. Always write clearly so each letter may be understood and not mistaken for something different. Printing usually makes the remarks neater and easier to read. Also, using a pencil prevents messy corrections. Figure 3-3 was typed for your convenience.

The back of this form is equally important as the front because the back is where you post your timed entries as you troubleshoot outages. This becomes a running log of what you have done and the indications you have measured and read. Without this information, it would be impossible for someone, other than the technical controller doing the troubleshooting, to know what was done to isolate the problem. Keep in mind that you can never put too much information in these entries.

Your fellow technical controllers are not mind readers. If they cannot answer questions about the outage from reading your entries, the only alternative they have is to get you out of bed after you just completed that long swing or midshift and call you back to the duty section. The little extra time you spend on your tickets could save you some lost sleep.

This part of the ticket is also very important to the person typing the status report for your station. Since certain outages require narrative remarks, most of the information can be taken from this section. Always make sure to include the initials of the person you work with at the various stations. This could save you embarrassment later when you try to log a specific outage to a station and you don't remember whom you worked with or who gave you the information you put on your ticket.

449. DD Form 1445, Technical Control Communications Work Order

The DD Form 1445, shown in figure 3-4, is used to tell maintenance people of failure or substandard operation of equipment. It also provides a record of HAZCONs and equipment status for you. Let's take an example. You completed a quality control check on your spare VFCT. You have discovered four channels with high bias on them. Maintenance advises they must order parts to fix the bias problem. You, the technical controller, use this information identifying the VFCT system number along with the channel numbers when you have to use the spare VFCT system.

It is imperative that you complete the work order as accurately as possible, identifying the name and type of equipment to distinguish it from other equipment. Follow up the DD Form 1445 with a call to NCMO or Job Control for a maintenance work order number. Put this information in the instruction section of the form.

The following basic procedures are provided to help you complete the DD Form 1445. Of course, by now, if you are working at a DCS technical control, you should be well versed in completing the form. These items are examples of the information entered on this form:

a. Work requested by. The signature of the controller who originated the request appears here.

b. Date. This entry includes the day, month, and year.

c. Time required. The time (GMT) that the request was initiated appears here.

d. Name. The identification of the equipment appears here.

e. Type. This entry includes the nomenclature and other identifying information about the equipment.

f. Work assigned. The activity or individual assigned to do the repairs appears here.

g. Defect. This entry includes specific details about the fault.

h. Time started. The actual time the repair was started appears here. This information is obtained from maintenance.

i. Time completed. The actual time the repair was completed appears here.

j. Instructions. This entry includes any specific information that helps the maintenance people in isolating the malfunction.

k. Repairs performed. The corrective actions taken by maintenance people appear in this block.

l. Work completed by. The name of the individual who completes the form and verifies that the equipment is operational appears here.

m. Filing. Work order record files are cut off at the end of each month, held for 11 months in the current files area, and then destroyed under appropriate military department directives. Remember that legibility is also important when completing this form.

TECHNICAL CONTROL COMMUNICATIONS WORK ORDER

WORK REQUESTED BY *(Signature)* Frank Adams		DATE 20 SEP 81
EQUIPMENT REQUIRING REPAIRS		TIME REQUIRED 1015 Z
NAME VFCT Multiplexer	TYPE AN/FCC-19	TIME STARTED 1025 Z
WORK ASSIGNED TO *(Maintenance activity)* Wideband Maintenance		TIME COMPLETED 1030 Z
DEFECT Blown fuse in the power supply		
INSTRUCTIONS No apparent reason for blown fuse		
REPAIRS PERFORMED Replaced blown fuse, equipment now operational.		
WORK COMPLETED BY *(Signature)*		

DD FORM 1 AUG 63 1445

NCS24-68

Figure 3-4. Sample, DD Form 1445.

450. DD Form 1697, Circuit Parameter Test Data

Use the DD Form 1697 to record quality control information and test and acceptance data. Use it when you test the circuit for activation. Also use it when you make any changes for reconfiguration of the circuit. Put a copy of the DD Form 1697 into the technical control circuit history files. Again, you are responsible for completing the DD Form 1697 each time the circuit is scheduled for quality control. Figures 3-5 and 3-6 are examples of completed DD Forms 1697.

The following procedures provide some guidelines on completing the DD Form 1697. DCA circulars require that certain tests are done in specific order. Refer to figure 3-5 at bottom of the form. After you make these tests, it makes no difference in what order you pull the rest of the tests.

a. Test started/test completed. This is the date/time group (ZULU) the QC test was started and completed.

b. CCSD. Command communications service designator of the circuit being tested.

c. Item no./parameter code. This information is obtained from the DCS technical schedules for the type of circuit being tested.

d. Receiving station. This always is the station receiving the circuit (your location).

e. Sending station. This is the distant terminal station of the circuit under test.

f. Other items. The remainder of the form is used as a worksheet when performing the quality control test. The *time started* and *time completed* are filled in for each test completed. The *remarks* and *specifications* columns are used to identify the parameters for each test description. The receive column is divided into the *initial* reading column and the *adjusted* column. If any adjustments must be made during the test to bring the circuit within parameters, the new readings after the adjustment are recorded in the adjusted column. The *send* column is similar to the *receive* column. Here you record the readings of the distant station.

The reverse of the form is reserved for *frequency response* and *envelope delay measurement.* For frequency response, you record the actual readings in dBm0 and the relative gains and losses for each frequency. The deviations are thus plotted on the frequency versus amplitude graph in what we call the "window." The window is the parameter of the circuit being tested. When performing envelope delay measurements, you should record your delay readings in the column marked "measured delay." Next, you should reference all the delay measurements to the fastest frequency (fig. 3-6, frequency 1,300 Hz). As with the frequency response readings, plot the delay measurements on the graph.

Since the DD Form 1697 is filed in the circuit history folder, it is important for you to fill it out accurately and legibly.

451. DD Form 1698, Wideband Outage Record

The DD Form 1698 is a wideband outage record used in a DCS technical control facility instead of a DD form 1443. Whether the wideband outage record is used or not is left up to the discretion of the section chief. Presently, DCA does not dictate when you use the form. Most technical controllers who have used the wideband outage record prefer it over the trouble and restoration record. This form, like the DD Form 1443, must be kept for 11 months. Figures 3-7 and 3-8 depict the DD Form 1698 completed. Keep in mind that this form also requires accuracy and legibility.

The following procedures are given for the completion of the DD Form 1698. Keep in mind that the procedures are basic guidelines and not the "law." Each station may fill out the form according to its local operating instructions (OIs).

a. Time in. Enter month, day, and time that the trunk or circuit was restored to service through corrective actions.

b. Control number. Indicate the control number assigned to the fault or outage report to which this form applies. An outage control number is assigned by the facility responsible for recording the outage. This control number is used for reference during the outage. Control numbers consist of a letter designation followed by a number assigned sequentially on a monthly basis. The letter designation identifies the facility.

c. Terminals. Enter the three-letter designators that identify the transmit and receive terminals of the trunk or circuit affected. The receive terminal always is the station that experienced the fault or outage on its receive path. The send terminal always is the distant trunk or circuit terminal.

d. CSD. Trunk identifier command service designator (i.e., 43JM07, 34JM07, etc.).

e. Channel number. Enter the appropriate channel number if the cause of the interruption was determined to be a channel outage. An entry in this block requires an entry in the CSD block.

f. CCSD. Enter all eight digits of the CCSD.

g. RP. Indicate the NCS restoration priority assigned to the circuit.

h. Time out. Enter month, day, and time the outage commenced (for example, 02130010).

i. Total time out. Enter total time, in minutes, that the trunk, channel, or circuit was inoperative for each reason for outage shown in columns 42, 43 and 44.

j. Total time rerouted. Enter total time, in minutes, that the trunk or circuit was successfully rerouted.

k. RFO. Enter the reason for outage code from DCAC 310-55-1.

l. Station charged. Enter the three-letter designator that identifies the geographical location of the stations or facilities against which the outage is chargeable. These designators can be found in DCAC 310-55-1, supplemented by whichever ACOC services your area.

m. Agency charged. Enter the squadron or agency against which the outage is chargeable.

n. Reported trouble. Tell, in narrative form, the trouble as reported by the user or other outage-detecting agency (i.e., negative contact with command post switchboard).

o. Equipment. Tell, in narrative form, the equipment part that caused the failure (i.e., bad tube in supergroup amplifier).

p. Hourly status check. Make an entry in the "Time" and "Remarks" columns at least once every hour during an outage as to the status of the circuit or system outage.

q. Received from. Enter the initials of the person and the three-letter designator of the station from which the trouble report was received.

r. Received by. Enter the initials of the person and the three-letter designator of the station receiving the report.

s. Cleared by. Enter the initials and the three-letter designator identifying the person and station confirming that the fault has been cleared. The station identified always is the same as that entered in the "RECEIVED FROM" block.

t. Completed by. Initials of the person completing the form.

u. Time. The date-time group corresponding to remarks.

v. Coordinate with: Out. Adjacent to the appropriate three letter station designators, enter the initials of the person notified of the outage and the time of notification. *In.* Adjacent to the appropriate three-letter station designators, enter the initials of the person notified when the fault was cleared and the time of notification. If three-letter designators are not listed, enter the appropriate designator in the blank columns under "STATIONS."

w. Reroute. Enter the CCSD of the rerouted circuit.

x. ZAF. The time the reroute was made.

y. ZTL. The time the reroute was broken.

Z. Preempt. The circuit being preempted for the reroute. If a spare channel is used, show the system and channel being used.

452. Service provisioning records and reports

This section provides a summary of records and reports used in activating, changing, and deactivating supergroups, groups, trunks, and circuits in the DCS. These consist of those records for local use and those required by the DCS. It would be advantageous if records kept by DCS facilities were such that additional records need not be kept purely for DCS purposes. Stations should use the guide in DCAC 310-70-1, Volume 11, to establish their own station's operating instructions.

Circuit Files. These records and reports are prepared and kept for all circuits installed:

a. DD Form 1441, Circuit Data: Prepared and kept by each technical control facility through which a circuit passes at the DC or VF patch bays.

b. DD Form 1697, Circuit Parameter Test Data: Completed for the first acceptance, and kept by each circuit control office (CCO) and servicing technical control facility (TCF) for the life of the circuit. The original DD Form 1697 that has the accepted circuit parameters is an important document for future reference.

c. Telecommunications service order (TSO): Copies of the original and latest TSOs that reflect the current end-to-end configuration are kept on each active circuit, trunk, or link by the control offices designated in the TSO and by all serving TCFs. The serving TCF is that TCF or PTF closest to each end user. Modifications or changes to DCS circuits are not made unless directed by a valid TSO.

d. History folders: History folders are established and kept on each active circuit and trunk by the facility assigned CCO or ICO responsibilities and all servicing technical control facilities, patch and test facilities, and monitoring and test centers. As a minimum, these folders must contain a copy of the first test and acceptance data (DD Form 1697) or an equal computer-derived product (baseline data); telecommunications service orders; in-effect, exception, and delayed service reports; commercial leased action messages (CLAMs) and copies of quality control waiver requests; a copy of the DCS user notification letters; and any related correspondence.

Servicing TCFs, PTFs, and MTCs also keep all QC test data IAW DCAC 310-70-1, Volume 2, Chapter 11. This chapter states that "All serving TCFs and PTFs will retain on file, in the circuit history folder, completed QC test data forms which reflect test data on the technical schedule circuit parameters designated in the TSO for all tests conducted during the last 12 months." When an exception or delayed service report is submitted that pertains to an intermediate facility, the intermediate facility involved establishes a history folder until the condition causing the report to be rendered is cleared and an in-effect report is submitted.

e. If the circuit files are lost or destroyed, TCFs are required to get the latest TSO that reflects the current end-to-end circuit configuration. A copy of the latest TSO should be obtained by contacting (in the following order) adjacent technical control facilities in the circuit routing, the geographical area FCO, and, as a last resort, the DCA issuing authority. When TSOs are not available at the TSO issuing authority, the DCS station provides detailed circuit information in a narrative message to the TSO issuing authority who determines the circuit's validity before issuing a complete end-to-end TSO.

These are records for local use by DCS facilities, which could be stored in a computer for ease of maintenance:

- TSO log.
- Record of equipment log. Inside plant cable record.
- Record of patch panel layouts.
- Cross-connect record.
- Fuse and ballast lamp record.
- Line isolation relay or DC level converter record.
- Strapping options used for communications equipment.

Waiver Records. In addition to an actual waiver issued by a DCA activity, a consolidated master list is kept at each facility. The master list needs only to consist of the waiver subject, file location, date granted, and granting authority. Each waiver is reviewed annually by the facility to ensure the requirement for the waiver still exists.

Miscellaneous Reports and Worksheets. Various local reports and worksheets are used to record certain activities conducted at DCS facilities. As a minimum, these documents are kept on file for the time specified:

a. PMIs and follow-up reports (current and previous 2 months).

b. DCAC 310-55-1 feedback reports (current and previous month).

c. DCAC 3 10-55-1 reports (current and previous month).

d. PMP data collection worksheet (current and previous 2 months).

e. In-service QC worksheet (current and previous month).

f. Communications/test equipment QC worksheet (current and previous three test results).

453. Computerized record keeping systems

The records previously mentioned may be kept in automatic data processing (ADP) systems to simplify record keeping and to enhance the analysis capability of the technical control. The design, implementation, and use of such systems must conform to the guidelines discussed here.

The system must provide for adequate backup capability so that, if there is a computer failure, it does not prevent the maintenance of the required records or the retrieval of information. Data stored on magnetic media must be duplicated on backup media at least once each day to minimize the chance of loss. Where possible, the backup process should use a different device than the primary data files (such as floppy disks to back up a hard disk). This minimizes the impact of peripheral equipment failures. The backup process should be a totally automated procedure, or at a minimum, must prompt the operator to take the required actions.

The system should be redundant with a second computer available to replace a failed unit on short notice (2 hours). If this is not possible, a hard copy of all records stored in the ADP system must be retained on file for the same length of time as the record it replaces.

The information that is required on DD Forms 1441 must be available in the operating area of the technical control and readily accessible to the technical controllers on duty, in a form not dependent on the ADP system.

If ADP systems are used to keep technical control records, all people also must be trained to use the paper forms required by this chapter and the training documented as required by the respective service. A 90-day supply of paper forms must be kept accessible to the technical controllers on duty. Local operating procedures must include instructions on how and when to revert to manual record keeping.

Detailed outage records, sufficient to reconstruct events during the outage, must be retained on file for at least 60 days. After this time, the detailed information may be purged from the records and the information necessary for long term analysis retained. The minimum information required for long-term analysis is the circuit, trunk, or link designator, the date and time out, date and time in, RFO code and location, and a brief narrative reason for outage.

Master station logs (DD Forms 1753) must be kept separately from the ADP system unless the file can be protected from alteration after the radio day is closed. Any information added after the radio day is closed must be clearly marked to protect the integrity of the MSL. If the ADP system is used, hard copies are required to be retained the same as DD Forms 1753.

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The military services must ensure the ADP equipment used for technical control record keeping is appropriate and has adequate capability, and that software conforms to good design practices, is properly documented, and is maintainable. Standardization is desirable, but not mandatory.

Since most of our office work is done with word processors, your station might want to convert to this type of record keeping system as a means of convenience. There are many options for using this system, and the amount of time you can save can be used doing other duties in your work section. It is only a matter of time before you will be required to keep a system of this type, so why not see what possibilities are available for your station?

CIRCUIT PARAMETER TEST DATA						TEST STARTED	TEST COMPLETED
						21Ø925Z SEP 87	21112ØZ SEP 87
CCSD: DTXX6D25	ITEM NO: 2A	PARAMETER CODE: D2	RECEIVING STATION: HUMOSA TCF		SENDING STATION: TORREJON TCF		

TEST	TIME START / TIME FINISH	REMARKS	SPECIFICATIONS	RECEIVE INITIAL	RECEIVE ADJUSTED	SEND INITIAL	SEND ADJUSTED
TEST TONE LVL	Ø925 Z / Ø927 Z	1004 HZ −10 dBmØ	± 1dB	-1 dB	dB	+.8 dB	dB
TD-1NB FREQ RESP	Ø931 Z / Ø951 Z	SPECTRUM	− / +	− / +	− / +	− / +	− / +
		3Ø4 -3ØØ4	3 / 12	1 / Ø		1 / Ø	
		3Ø4 -27Ø4	2 / 6	1 / Ø		1 / Ø	
		1ØØ4 -27Ø4	1 / 3	1 / Ø		1 / Ø	
TD-2NB ENV DELAY	1Ø22 Z / 1Ø55 Z	SPECTRUM	RELATIVE DELAY	RELATIVE DELAY	RELATIVE DELAY	RELATIVE DELAY	RELATIVE DELAY
		8Ø4 - 26Ø4	175Ø u secs	1ØØ		213	
		1ØØ4 - 24Ø4	1ØØØ u secs	8Ø		198	
		-	u secs				
TD-3NB NET LOSS VAR	1Ø56 Z / 1111 Z	1004 HZ	+4 −dB over 15 Minutes	+1 dB	dB	Ø dB	dB
TD-4NB CHANGE IN FREQ	1Ø19 Z / 1Ø21 Z	1004 HZ	5 HZ (3 HZ for S-2 & S-3 in CONUS)	1ØØ4 HZ	HZ	1ØØ4 HZ	HZ
TD-5NB LONG BAL		1004 HZ	IN 40dB / OUT 40dB	IN / OUT	IN / OUT	IN / OUT	IN / OUT
TD-6NB ICN	Ø928 Z / Ø93Ø Z	1Ø Miles	dBrnØ				
			+31 dBrncØ	+27dBrncØ		+38dBrncØ	+28dBrncØ
TD-7NB SINGLE TONE INTERFERENCE	1Ø12 Z / 1Ø15 Z	Record Interfering Tone Level in dB Above (+) or Below (−) Reference	-60dBmØ = 3 dB Below Circuit Noise (ICN)	HZ		HZ	
				NONE dB	dB	NONE dB	dB
				HZ		HZ	
				dB	dB	dB	dB
				HZ		HZ	
				dB	dB	dB	dB
TD-8NB IMPULSE NOISE	Ø952 Z / 1ØØ7 Z	High 78		2		3	
		Mid 72	15 Counts 15 Min	3		2	
		Low 62		5		4	
TD-9NB TERM IMPED		1004 HZ	540 To 660 OHMS	IN / OUT	IN / OUT	IN / OUT	IN / OUT
TD-11NB HARMONIC DIST	1ØØ8 Z / 1Ø11 Z	704 HZ	−10dBmØ	-1Ø		-1Ø	
		1408 HZ	−40dBmØ	-52		-53	
		2112 HZ	−40dBmØ	-55		-57	
		2816 HZ	· 40dBmØ	-60		-59	
TD-12NB PHASE JITTER	1Ø16 Z / 1Ø18 Z	Degrees Peak to Peak	15°	2 °	°	3 °	°
TD-1S TD-2S SIGNALING							
TD-1T TELEGR DIST		Total Peak	20%	%	%	%	%
		Max Bias	5% Govt 12% Coml	%	%	%	%
NOTE:	TD-6NB	TJN REPLACED NOISY CHANNEL MODULATOR TO CORRECT NOISE PROBLFM ON TJN RECEIVE.					

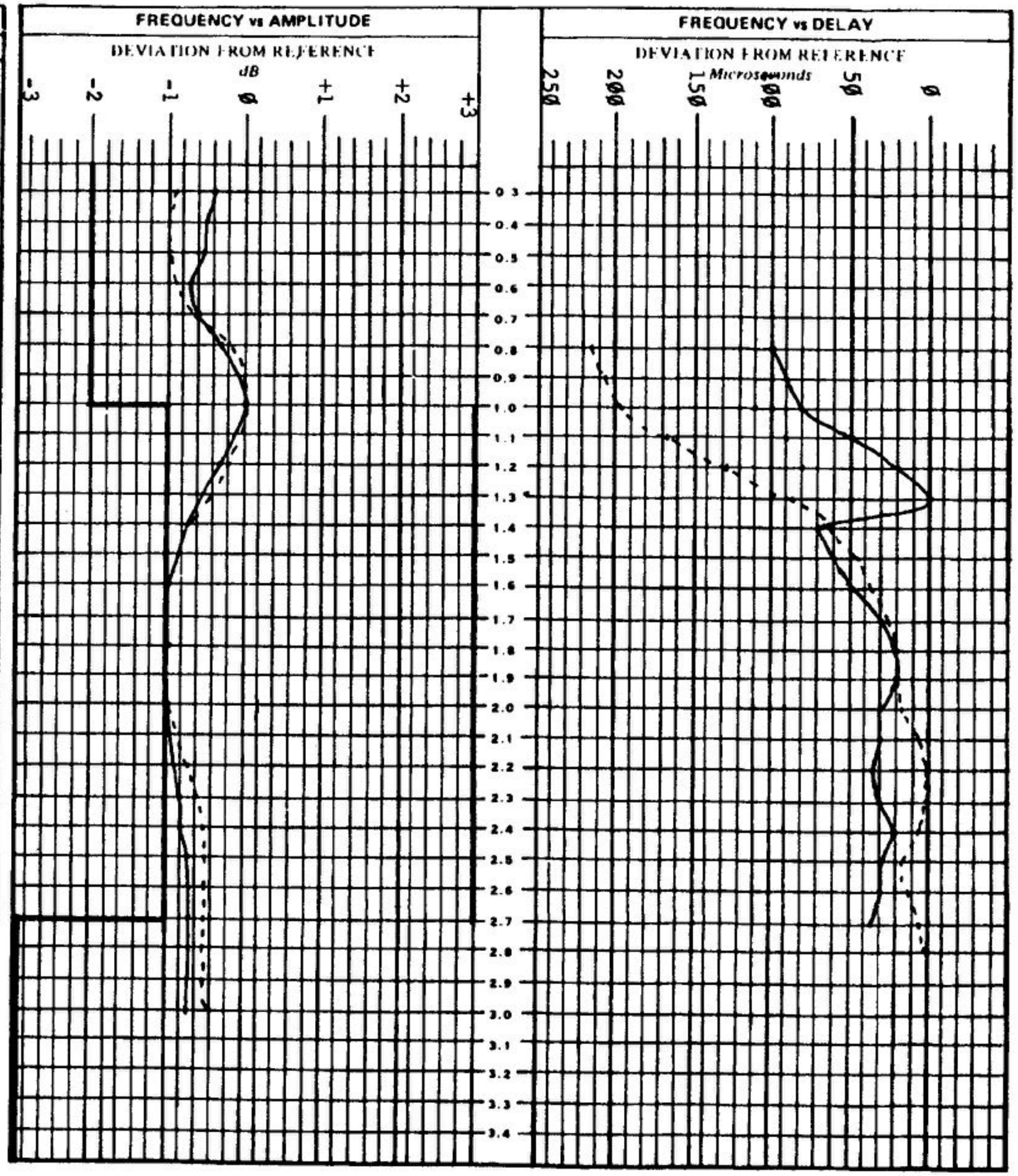
1. TEST TONE LVL., TD-6, TD-1, TD-8; IN THAT ORDER, WILL BE DONE FIRST.
2. CIRCLE ANY EXCEPTION IN RED.
3. TD-1NB: + IS MORE LOSS, − IS LESS LOSS.

SIGNATURE OF TESTER

DD Form 1697 PREVIOUS EDITION SHOULD NOT BE USED NCS24-25A

Figure 3-5. Sample, DD Form 1697 (front).

FREQUENCY KHZ	FREQUENCY RESPONSE				ENVELOPE DELAY			
	RECEIVE		SEND		RECEIVE		SEND	
	RECEIVED LEVEL	RELATIVE TO 1 KHZ	RECEIVED LEVEL	RELATIVE TO 1 KHZ	MEASURED DELAY	RELATIVE TO REF.	MEASURED DELAY	RELATIVE TO REF.
0.3	1Ø.2	-.4	9.7	-.9				
0.4	1Ø.1	-.5	9.6	-1.Ø				
0.5	1Ø.1	-.5	9.6	-1.Ø				
0.6	9.9	-.7	9.7	-.9				
0.7	1Ø.Ø	-.6	1Ø.Ø	-.6				
0.8	1Ø.3	-.3	1Ø.4	-.2	+8Ø	1ØØ	+185	213
0.9					+7Ø	9Ø	+18Ø	2Ø8
1.0	1Ø.6	Ø	1Ø.6	Ø	+6Ø	8Ø	+17Ø	198
1.1					+3Ø	5Ø	+14Ø	168
1.2	1Ø.3	-.3	1Ø.4	-.2	Ø	2Ø	+1ØØ	128
1.3					-2Ø	Ø	+ 58	86
1.4	9.9	-.7	9.9	-.7	+5Ø	7Ø	+ 38	66
1.5					+4Ø	6Ø	+ 18	46
1.6	9.6	-1.Ø	9.6	-1.Ø	+3Ø	5Ø	+ 7	35
1.7					+1Ø	3Ø	Ø	28
1.8	9.6	-1.Ø	9.6	-1.Ø	Ø	2Ø	Ø	28
1.9					Ø	2Ø	-1Ø	18
2.0	9.6	-1.Ø	9.6	-1.Ø	-1Ø	3Ø	-2Ø	8
2.1					-1Ø	3Ø	-28	Ø
2.2	9.7	-.9	9.9	-.7	-15	35	-25	3
2.3	9.8	-.8	1Ø.Ø	-.6	-1Ø	3Ø	-2Ø	8
2.4	9.8	-.8	1Ø.1	-.5	Ø	2Ø	-1Ø	18
2.5	9.9	-.7	1Ø.1	-.5	-1Ø	3Ø	-15	13
2.6	9.9	-.7	1Ø.1	-.5	-1Ø	3Ø	-2Ø	8
2.7	9.9	-.7	1Ø.1	-.5	-15	35	-25	3
2.8	9.9	-.7	1Ø.1	-.5				
2.9	9.9	-.7	10.1	-.5				
3.0	9.9	-.7	1Ø.2	-.4				
3.1								
3.2								
3.3								
3.4								



NCS24-69

Figure 3-6. Sample, DD Form 1697 (back).

WIDEBAND OUTAGE RECORD

TIME IN	CONTROL NUMBER(S)
Ø9 21 Ø3ØØ Z	H-215

TERMINALS SEND (1–3)	TERMINALS REC (4–6)	CSD (7–12)	CHNL NBR (13–15)	CCSD (16–21)	RP (22–23)	TIME OUT MO (24–25)	TIME OUT DAY (26–27)	TIME OUT TIME Z (28–31)	TOTAL TIME OUT (32–36)	TOTAL TIME REROUTED (37–41)	RFO (42–44)	STA CHARGED (45–47)	AGENCY CHARGED (48–52)
TJN	HUM	55JMØ5	ØØ6	DTXX6D25	1D	Ø9	21	Ø21Ø Z	ØØØ5Ø	ØØØ45	LEY	HUM	AFCC

REPORTED TROUBLE	RECEIVED FROM	RECEIVED BY
RECEIVING LOW LEVELS	HUM / RL	HUM / RL

EQUIPMENT	CLEARED BY	COMPLETED BY
CHANNEL AMPLIFIER POT IN CHANNEL DEMODULATOR	HUM / RL	HUM / RL

TIME	REMARKS	COORDINATED WITH: OUT	COORDINATED WITH: IN	COORDINATED WITH: STATIONS
21Ø21Ø Z	RECEIVING HITS ON TELETYPEWRITER ORDERWIRE. CHECKED COMPOSITE			
	SIGNAL, FOUND LOW LEVELS ON MY RECEIVE.	GN/Ø213		TJN
		CN/Ø22Ø		NCMO
21Ø213 Z	CALLED TJN/GN AND REQUFSTFD HE CHECK HIS TRANSMIT. TJN ADV	MR/Ø215		DCA
	THEY TRANSMITTING AT -13 dBmØ. REQUEST ZAF OVER TO SPARE		GN/Ø3ØØ	TJN
	CHANNEL Ø11 MY RECV ONLY ON 55JMØ5.		BR/Ø3ØØ	NCMO
			MR/Ø3Ø2	DCA
21Ø215 Z	CIRCUIT FIVERS ATT ON REROUTE. TJN/GN			
21Ø22Ø Z	NOTIFIED NCMO ATT FOR A WORK ORDER ON 55JMØ5/ØØ6 ... JCN # 265-5ØØ1.... NCMO/CN			
21Ø25Ø Z	MAINTFNANCE ADVISED CHANNEL SHOULD BE GOOD ATT. THEY ADVISED THEY REPLACED THE CHANNEL AMPLIFIER			
	POT IN THE CHANNEL DEMODULATOR. CHECKING CHANNEL OUT WITH TJN.			
21Ø255 Z	TJN/GN HAS TFST TONE ON CHANNEL AND RECEIVING AT -10dBm0 AT BASEBAND AND VF PATCH BAY.			
21Ø3ØØ Z	LOGGED CIRCUIT IN ON NORMAL PATH ATT.. TJN/GN			

DD FORM 1 JAN 69 1698

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Figure 3-7. Sample, DD Form 1698 (front).

REROUTE	ZAF	ZTL	PRE EMPT	ROUTING AND REMARKS
DTXX6D25	Ø215	Ø3ØØ	DSOVSSSS	55JMØ5 / Ø11 HUM RECEIVE ONLY

TIME	REMARKS

☆U.S. G.P.O. 1977-261-301/1360

NCS24-73

Figure 3-8. Sample, DD Form 1698 (back).

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

446. DD Form 1753, Master Station Log

1. What is the DD Form 1753, Master Station Log, used for? Journal of events
2. Why is a DD Form 1753 required at all technical control facilities? Log used as reference
3. What type of information should NOT be placed in the MSL? Classifieds

447. DD Form 1441, Circuit Data

1. What is the purpose of the DD Form 1441, Circuit Data Card? serve as locator card
2. How does a technical controller use the DD Form 1441 on a daily basis? T/S & restoration
3. What is the primary source for the majority of the data used on a DD Form 1441? TSO
4. Why is the reverse side of the Circuit Data card just as important as the front side? shows end to end ckt configuration & input output levels at each TCF

448. DD Form 1443, Trouble and Restoration Record

1. Are amplifying remarks mandatory on the DD Form 1443 when personal error is used as a reason for outage? Yes
2. What is the purpose of the DD Form 1443? Provides complete record of ckt
3. Where would you record reroute information? line Marked "A" on ticket

449. DD Form 1445, Technical Control Communications Work Order

1. What is the purpose of the DD Form 1445? notify maintenance of failure or substandard equipment

2. If a spare multiplex were found to be defective, which DD form would you use?

   DD Form 1445

3. What goes in the "Name" block of the DD Form 1445? Identification of the equipt requiring repairs.

450. DD Form 1697, Circuit Parameter Test Data - Analog

1. What is the purpose of the DD Form 1697? used to record test information specs + results.

2. Who is responsible for completing the DD Form 1697? tech. Controller performing test.

3. Where would you record the receive results of the frequency response test? "Recieved initial" column

451. DD Form 1698, Wideband Outage Record

1. Which DD form may be used instead of the DD Form 1443? DD form 1698 Wideband outage record

2. What is the purpose of the DD Form 1698? Record wideband outages for record keeping + DCS reporting

3. When completing the DD Form 1698, you determine the distant technical control facility has a receive VF channel demodulator failure. In what block under "terminals" would you record the station's three-letter designator?

   REC

452. Service provisioning records and reports

1. What main items are included in the circuit files category? DD form 1441, 1697

   service orders + history folders

2. Who is responsible for maintaining a history folder on each active circuit and trunk?

   All servicing TCFs PTFs MTCs,

3. How long must an intermediate facility maintain an exception or delayed service report in a circuit history folder? ~~only if the ADP system can be protected from alteration after the~~ when the condition causes the report to be cleared & ineffect report is submitted

4. What are the only required items needed on the master waiver records list that is maintained by each facility? Waiver subject file location date granted & granting authority

453. Computerized record keeping systems

1. Why must adequate backup capability be available when computerized record keeping systems are used? In case of computer failure retrieval of records & maintenance still allowed.

2. What information must be readily accessible to the technical controller in a form not dependent on the ADP system? info is required on 1441 & must be available at all times

3. When can master station logs be solely maintained in an automated data processing system? only if the ADP system can be protected from alteration after radio delay is closed

4. If an ADP system is used to maintain MSLs, in what format and how long are they kept on file? one month hard copy then 11 months before destruction

3-2. DCS Status Reporting

Technical controllers are responsible for reporting the status of transmission links and terminal equipment of their stations. If you are stationed at a DCS reported-on station, you report to another DCS station (a DCS reporting station). If you are assigned to a DCS reporting station, you report your own station's status as well as the status of any reported-on stations for which you have reporting responsibilities. As you know, status reports provide up-to-date information to the DOCC so that it can direct the operation of the DCS. It must be accurate information. To help you prepare accurate status reports, DCA issues a DCS reporting guide.

454. DCS reporting guides

A DCS reporting guide aids commands of DCS status reporting stations. It is a reference guide for people who prepare status reports. Use of the guide not only aids in the preparation of accurate reports but also promotes their prompt submission to the appropriate ACOC or RCOC.

Preparation. ACOCs periodically publish a reporting guide for each DCS reporting and reported-on station. The guides are produced by automatic data-processing techniques. Each one is a printout, derived for appropriate parts of the data base, listing all reportable facilities and circuits for a reporting or reported-on station.

Content. A reporting guide has information pertinent to the preparation of status reports. It is a useful ready reference. These guides are additions to the related parts of the data base, not substitutes. The identity of reportable items in status reports must be the same as items in the data base.

The guide is specifically designed for use in the preparation of automated format status reports. When both the facilities and circuit portions are printed, they contain the current identification of reportable facilities cited in the lettered lines of the report. The guide is the only official document that provides the link number, trunk number, or CCSD used in reporting. If the identifier is not in the reporting guide, the processor at the DOCC element rejects the information. To keep this from happening, the reporting guide must be updated. (102)

Updating. Each reporting station updates its guide when changes to the DCS directory are submitted. On receipt of an updated copy of the reporting guide, the DCS reporting station checks it against the outdated copy to ensure all changes are in the new issue. The old issue is then discarded under existing instructions. Any discrepancies in the new issue are sent at once to the appropriate DOCC element. On receipt of a discrepancy, the operations center checks its validity and either corrects the data base or sends the discrepancy to the office responsible for its data base correction. If the discrepancy is not valid, it is returned to the originator with appropriate comments.

455. How to use DCS status reports

Reports made by DCS reporting stations for the operational direction of the DCS are submitted in two different forms: nonformatted reports (NR) and formatted reports (FR).

The word "format" means a plan for organizing and arranging something. In this case, the "something" is a DCS status report. When you are assigned to prepare DCS status reports, you have to follow a specific set of rules and use certain symbols. The particular rules and symbols you will use depend on which of the two forms you are preparing. You must make sure that you follow the prescribed format exactly. If you do not, your report will be rejected. This rejection happens when a DOCC computer tries to process an incorrectly prepared report. Because of the rapidly changing nature of status reporting, we do not try to give any specific elements of the reporting formats. Instead, consult DCAC 310-55-1, *Status Reporting, for the Defense Communications System,* which governs reporting.

Nonformatted Reports. A narrative report of DCS status is required as soon as feasible after a reportable event occurs. This information is used for operational direction and control by the DOCC elements. A nonformatted report should be submitted on the next higher level in the reporting chain either by voice or informal teletypewriter communications. Nonformatted reports are submitted as near-real-time to the incident being reported as possible, normally within 10 minutes after an outage. All major or special-interest outages should be reported, giving as much information about the outage that is known at the time. Hazardous conditions items that may cause a major disruption of communications are also reportable via a nonformatted report.

Formatted Reports. A formatted report has historical information used for computer-assisted analysis of the performance of the DCS. This information is required in a specific format so that computers can automatically process the data. At least one formatted report with a cutoff time of 2400Z must be submitted each raday. DCA areas may direct submission of additional formatted reports as required. Sometimes, additional formatted reports may be submitted by facilities to reduce the reporting workload at 2400Z. When an item is logged in on a periodic report previous to the 2400Z, it does not have to be included again on the 2400Z. DCAC 310-55-1 lists all the criteria for DCS status reports. All reported outages must be at least one minute long. These conditions must be reported by formatted reports:

a. All reporting or reported-on facility outages of 1 minute or longer.

b. All link outages of 1 minute or longer.

c. High interest and special interest trunk and circuit outages of 10 minutes or longer.

d. HAZCON's that have existed for 24 hours or more and are still open at the time of reported submission.

e. Outages of 10 minutes or longer on circuits with purpose/use codes "TJ" and "TK."

f. Additional special conditions for the AUTODIN network as stated in DCAC 310-55-1, Chapter 5.

456. Requirements for the reporting of special items

Special Interest Items. We mentioned the term "special interest" several times in the preceding paragraphs. What is special-interest information? It is communications status information required by DCA field activities and other agencies or commands. It simply means that some—not all—circuits and trunks stopping at or passing through your station will be designated as being special interest. Designated in this way, they require special attention by technical controllers and, of course, by the DCS reports people. Who does the designating? Headquarters, DCA, is one such designator. The central element (DCAOC) of the DOCC is another. Additionally, each ACOC and RCF is a special-interest designating activity. The circuits, trunks, and other items specified by these activities are published as appendices to the DCA circular, which prescribes DCS status-reporting procedures.

A third question—What impact do special-interest requirements have on DCS reporting? To answer that question, consider this statement from DCA:

> Special-interest circuits impose additional reporting requirements on the reporting and reported-on stations as the stations are required to report these circuits on a near-real-time basis.

Remember, near-real-time reporting means it should be done as soon as possible. Because of the burden this places on you and the other people at your station, DCA has directed that special-interest designations be held to the absolute minimum. They also did this to prevent special-interest reporting from becoming unmanageable, a condition that could nullify the advantages of the system.

Suppose you are assigned to prepare status reports for your station. How are you going to get the information you need? You must know when circuit and trunk outages occur. You must know the details of what caused the outages and when and how they were restored to service. You could get this information by asking the technical controllers working the circuits. You must do this sometimes, but there is a better way—the forms and records kept in your technical control facility. This is another reason why the forms we filled out earlier must be accurate and legible. We have only covered the high spots of DCS status reporting. You will get further training on preparing and submitting DCA status reports during your on-the-job training.

High Interest Telecommunications (HIT) Items. HIT items may be circuits or trunks. They require reporting for trending, to help give operational direction, or to provide command attention. Reportable HIT items include:

a. DCA Headquarters designated trunks and circuits are shown in Table 3-1. The items on this list have either worldwide command interest or support critical command and control missions.

b. Each ACOC may place intra-area trunks and circuits on their area HIT list. This list contains only HIT items considered critical by the respective commander in chief (CINC) or DCA area commander. The area HIT items are published after approval.

Procedures for restoring items designated "special interest" or "high interest" must be in accordance with the assigned National Communications System (NCS) restoration priorities and are not altered by the designation of "SI" or "HIT."

Hazardous Conditions (HAZCONs). A HAZCON is a condition that applies only to links and facilities where the loss and severe degradation of communications is probable unless preventive action is taken. Although declaration of a HAZCON is discretionary, it must be viewed as an urgent notification of a major problem that has occurred or is projected to occur. If the individual responsible for making the decision is unsure whether or not a HAZCON exists, the ACOC should be contacted to help in the determination. The estimated time of termination of a HAZCON should be reported within 5 working days after the HAZCON is established. These guidelines are to be used to determine if a HAZCON should be reported:

a. Partial or complete evacuation of a DCS facility.

TABLE 3-1
SUMMARY REPORTABLE CONDITIONS

CONDITION	REPORTABLE DURATION (MINUTES)	
	NONFORMATTED (NR)	FORMATED (FR)
ISOLATION	1	-
FACILITY OUTAGE	1	1
LINK OUTAGES	10	1
HIT TRUNK OUTAGES		
Digital 1.544 Mbps and higher (Type trunk code "N")	30	10
DSCS (Type trunk code "S")	30	10
HIT CIRCUIT OUTAGES		
AUTODIN IST's	10	10
AUTODIN Subscribers	-	10
AUTOSEVOCOM		
Trunks and Subscribers	-	10
AUTOVON IST's	-	10
Special Networks	TBD	10
Circuits with Purpose/Use Code "TK" or "TJ"	-	10
SPECIAL INTEREST	TBD	10
HAZCON	30	1440

NOTE: The TBD time will be identified by the appropriate ACOC at least quarterly when the special interest listing is published.

TG-A283

b. Loss of diversity on a radio link.

c. Failure of any combination of primary, backup, or spare communications equipment or power facilities when failure of another like component would cause a link or facility outage or severe degradation and when sufficient equipment to sustain or restore operation is not immediately available.

d. Loss of environmental equipment where immediate restoral is necessary for link or facility operation, but where it is not possible to accomplish.

e. Specific overseas DSN network conditions as outlined in DCAC 310-55-1, Chapter 4.

f. Other situations or conditions that, in the opinion of the shift supervisor or designated responsible individual, could result in a link or facility outage.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

454. DCS reporting guides

1. What is the DCS "reported-on" station?
   reports to another station

2. What publication do you use for information on reporting circuit status information? Prepared by ACOC

3. If you are working at a reported-on station, where would you look to find which circuits are reportable?
   DCS reporting guide

455. How to use DCS status reports

1. List the two types of DCS status reports.
   formatted + Non formatted

2. Which type of report requires immediate reporting?
   Non formatted

3. Which publication provides guidance in preparing DCS status reports?
   DCAC 310-55-1

4. You are working at a wideband TCF. What type of report would you send after your station came back from a power failure?
   Non formatted

456. Requirements for the reporting of special items

1. What are the three items that need special reporting consideration? special interests high interest telcom + HICONs

2. Who can designate a special interest item?
   HQ DCA, DCAOC, ACOC, + RCF

3. Why do high interest telecommunications items need to be reported? trending purposes facilitate operational direction or provide command attention

4. When and on what items can a HAZCON be declared? links & facilities with great loss that needs to be prevented

3-3. Circuit Actions

In this section, we discuss the procedures necessary to request, activate, change, deactivate, and maintain DCS circuits. To complete such circuit actions requires the close coordination of all parties concerned. While one TCF, the designated CCO for a circuit, has responsibility for the circuit end-to-end, all intermediate stations must provide their full help and cooperation.

457. The telecommunications service request, and how to process a user's request for service

Request for Service (RFS). When subscribers or users of DCS or non-DCS assets determine a need for a communications circuit, an RFS is coordinated through their chain of command to their serving TCF. This RFS should specify the type of service required, its purpose, the location of required equipment, hours of operation for the circuit, a point of contact, and other pertinent information. The TCF must ensure all required information is known to process the request and initiate a telecommunications service request.

Telecommunications Service Request (TSR). A TSR is a request to DCA to staff, stop, or change circuits, trunks, links, or systems. Once a need is validated, the user's TCF submits a feeder TSR IAW DCAC 310-130-1 to a telecommunications certification office (TCO). The TCO for the Air Force on most circuits is the Air Force Communications Command (AFCC). The TCO must validate and send the request to DCA. The TCO ensures that the telecommunications service or facility is a validated, coordinated, and approved requirement of the department or agency, and that the department or agency is prepared to pay costs involved in fulfilling the requirement.

The TCO uses the information from the feeder TSR to build another TSR. This is transmitted to the National Communication System for restoration priority certification and to DCA for further processing. Again, these TSRs are formatted IAW DCAC 310-130-1, so they may be computer-processed.

The information contained in the TSR includes: service date, nature of requirement, type of action required, funding code, restoration priority, contact people, users' locations, details of service and user equipment, DCS interface data, and type and grade of service required. The TSR is submitted by message. If there is an urgent requirement where lead time is insufficient for use of normal transmission means, a TSR may be relayed by telephone followed by a written confirmation by complete TSR within 48 hours. The TCO is the only office authorized to submit a TSR to DCA.

458. The telecommunications service order, and how the TSO numbering system works

A TSO is the action taken by DCA on receipt of a TSR. DCA uses the information submitted, along with information from a data base, to issue an order completing the activation, deactivation, or change of circuits, trunks, links, or systems. Each DCA area has the responsibility for issuing TSOs on the circuits/systems that traverse or terminate within the area.

The TSO is used as the authority for the O&M agencies to procure specific devices and ancillary equipment necessary for the installation or operation of the circuit to which the TSO pertains. Verbal TSOs are issued when there is insufficient time to prepare and distribute a record TSO. Verbal TSOs are issued as an operational direction message (ODM), when possible, and confirmed by record TSO within 5 working days of issue.

Distribution. The TSO is normally sent for action to each DCS station on the trunk or circuit, the designated DCS control office, the leasing agency, if applicable, and the other DCA circuit allocation and engineering offices if the trunk or circuit enters their area of responsibility. An information copy of the TSO is also sent to the O&M agency headquarters of the DCS stations, and TCO, and the using agency. Additional distribution is made only as necessary to meet specific requirements that may arise within a DCA area, or to support a major project wherein engineering or logistics considerations are involved.

TSO Numbering. Each TSO is assigned an alphanumeric TSO number; for example, D70019/B350-02 or E75002/34JM02-02 derived as follows:

a. The beginning letter designates the issuing office: D - Headquarters, DCA; E - Europe; P - Pacific; and A or W - DCAOC Allocations Engineering Division (AED).

b. The first digit designates the year the TSO is issued, such as 2 for 1982.

c. The next four digits represent sequential TSO serial numbering within the year, beginning on 1 January.

d. The next character is a diagonal (/) to show separation. Following the diagonal are the last four characters (circuit number) of the command communications service designator (CCSD) of the circuit or the entire six-character designator of the trunk being acted upon.

e. The next character is a dash (–) to show separation. Following the dash is a two-digit number to identify the sequential action being taken on the circuit or trunk. The number 01 is always used as the first action, or start; numbers 02 through 99 are used in sequential order to show changes and discontinuance of the service.

f. A message or letter may contain one or two TSOs. Each circuit or trunk action for each service availability involved carries a separate TSO number, with each TSO of a multiple TSO in a separate part of the message or letter. The makeup of the TSO number illustrated above shows it was issued by Headquarters DCA in 1977, it was the 19th TSO issued by that office, and it was the second action taken on circuit B350.

459. DCS technical schedules and the use of quality control test schedules

DCS Technical Schedules. So far in this section, we have discussed the evolution of a circuit action, from the time the user determines there is a need to the issuance of a TSO by DCA. Before we can activate a new circuit, it must pass certain standards and test. DCA issues performance standards called DCS technical schedules to identify the parameters a circuit must meet. These schedules are itemized listings of all common services and circuit parameters provided by the DCS. Establishment of these schedules is a major step toward the creation of a common language for DCS circuit ordering, allocation, activation, operation, and maintenance. DCS technical schedules apply to all Government-owned circuits within the DCS, with the exception of voice circuits provided over high-frequency radio systems.

A minimum performance parameter code for each circuit is normally included in the activating TSO from DCA. If not, you can use the circuit information in the TSO and the DCS technical schedules found in DCAC 300-175-9, *DCS Operating-Maintenance Electrical Performance Standards*, Table 1. Table 3-2 is a table taken from 300-175-9. Table 3-2 shows the different parameter codes. Table 3-3 shows the typical format in 300-175-9 for determining circuit parameters.

Once you know the parameter codes, you can determine what tests are required by using the circuit quality control test schedule, found in DCAC 310-70-1, Volume 11, Procedures. DCA lists these 13 critical parameters for analog circuits:

(1) Frequency response.
(2) Envelope delay distortion.
(3) Net loss (maximum and variation).
(4) Maximum change in frequency.
(5) Minimum longitudinal balance.
(6) Idle channel noise.
(7) Maximum single-tone interference.
(8) Impulse noise.
(9) Terminal impedance.
(10) Composite data transmission level.
(11) Harmonic distortion.
(12) Phase jitter.
(13) Intermodulation distortion.

Once you have determined what tests are necessary, you need to know the parameters the circuit must pass before it can be activated. The specifications for these parameters can be found in DCAC 300-175-9. Table 3-3 is an excerpt from this circular. Although all of the above tests are not listed, each must meet certain specifications.

The results of these tests must be recorded and filed along with the TSO in the circuit's history file. These files are kept for the life of the circuit by you, the circuit actions NCO.

Quality Control Schedules. Quality control schedules (for out-of-service tests) should be set up at the time of the first test and acceptance of a new circuit by the CCO. The tests that must be performed, and the frequency of these tests, are contained in table 3-4 (in three parts). Notice that all the tests required for the first test and acceptance are annotated according to their parameter codes. Also, notice the frequency the parameters must be tested (M - monthly, Q - quarterly, A - annually, and AR - as required).

Let us assume that the quality control NCO asks you to make up a test schedule for an S1-type circuit. Your first step would be to look at table 3-4 (which has been extracted from DCAC 310-70-1, Volume 11) to determine which tests are required. Next, you would need to know the activation date. For example, use 10 September. Now, to schedule the quarterly tests, just add 3 months (90 days) to the 10 September date and you come up with 10 December. This is the date (give or take several days, as workload dictates) that the quarterly tests will be due.

To schedule annual out-of-service tests, simply use the activation date for the circuit. Again, workload determines the exact date, but run the test as close to the activation date as possible. Remember, annual tests include the monthly and quarterly tests. Some tests are not scheduled but are completed as required. An example of an as-required test is the terminal impedance test, which is used in troubleshooting other problems.

460. Reports that may be transmitted to DCA when testing and accepting a circuit or trunk

Test and Acceptance Procedures. Each circuit installed in the DCS must be tested according to the criteria specified in the DCA technical schedule for the type of circuit in the

TSO. The CCO designated in the TSO is responsible for circuit activation to include the scheduling, supervising, and reporting of circuit tests. The CCO ensures that each segment of the circuit is properly aligned and tested against applicable standards before conducting end-to-end testing. Intermediate TCFs on the circuit path follow directions issued by the CCO.

DCS users help DCS TCFs do test and acceptance (T&A) and scheduled or unscheduled circuit testing. The extent of user participation depends on the availability of test equipment and qualified people at the user location.

Initial acceptance of Government service circuits composed of Government-owned facilities. Circuits composed entirely of Government-owned facilities must meet each parameter for the type of service specified in the TSO. Circuits unable to meet DCS parameters, even with optimum transmission adjustments, must meet the requirements specified by DCAC 300-175-9.

Initial T&A data are used as the base line for circuits that are unable to meet all parameters specified in the appropriate technical schedule. Whenever a major realignment of facilities that the circuit traverses is accomplished or when measured performance of facilities is obtained as a result of a technical evaluation visit, the new data obtained for circuit performance is used as the base line.

TABLE 3-2
DESCRIPTION OF DCS SERVICE (EXCERPT FROM DCAC 300-175-9)

DESCRIPTION OF DCS SERVICE		
ITEM NUMBER	DESCRIPTION OF SERVICE	CIRCUIT PARAMETER CODE
	Category 1: Voice Switch Service	
	Defense Switched Network/AUTOVON	
1A	Voice grade access line.	C1
1B	Special grade, alternate voice/record access from AUTOVON switch.	C3
1C	Interswitch trunk voice grade.	C1
1D	Interswitch special grade, alternate voice/record, not transocianic.	CT
1E	Interswitch special grade, not transoceanic (regenerators at both ends).	C2
1F	Interswitch special grade, not transoceanic (regenerators at one end).	C4
1G	Interswitch service PCM-24.	Y2 CONUS Lease
1H	Interswitch service PCM-30.	Y4 Gov't Owned
1I	Interswitch trunk international voice grade.	Y3
1J	Interswitch trunk international special grade.	M1
1K	Digital data service (access).	J1
	Note: Technical Schedules pertinent to services not mentioned herein will be developed on a case-by-case basis as requests for these services are received by the responsible DCA Circuit Allocation and Engineering Organization. When warranted by the degree of usage, an appropriate Technical Schedule for that particular service will be published by DCA.	

Circuits that fail to meet all parameters specified in the appropriate technical schedule when T&A is done may not be accepted for service by the TCF without the express approval of the TSO issuing authority.

On completion of initial T&A, the TCF designated in the TSO as the station responsible for accepting service informs the TSO issuing authority (DCA) of parameters failing to meet required tolerances.

The TSO issuing authority determines or requires the TCO to determine if the measured parameters are adequate to meet user requirements. If the parameters are adequate, the TCF may be directed to accept service; if the parameters are not adequate, the circuit is held in abeyance until satisfactory user service can be provided.

The TSO issuing authority keeps current listings of circuits accepted for service that do not meet required parameters and ensures that outstanding exceptions are cleared at the earliest possible date.

Initial acceptance of leased service. The TSO designates a DCS facility to accept leased service on behalf of the U.S. Government. This facility (usually the CCO) must:

a. Ensure that leased circuit segments meet all circuit parameters for the type of service specified in the TSO.

b. Contact the TSO issuing authority when the carrier fails to meet all required circuit parameters. The TSO issuing authority determines whether service is accepted or obtains such a determination from the TCO or TSR issuing authority.

Test Reporting. A completion report is required for every TSO issued, unless specified differently in the TSO. In the

TABLE 3-3
CIRCUIT PARAMETERS (EXCERPT FROM DCAC 300-175-9)

CHARACTERISTICS	UNIT OF MEASURE	C1	C2	C3 ACCESS	CT (C3)	C4
a. Frequency Response kHz	dB					
0.3 - 2.7		-2 to +6				
0.3 - 3.0		-3 to +12	-2 to +6	-0.8 to +3.0	-0.8 to +2	
0.3 - 3.2						-2 to +6
0.3 - 2.8						
0.5 - 2.8			-1 to +3	-0.5 to +1.5	-0.5 to +1	
0.5 - 3.0						-2 to +3
1.0 - 2.4		-1 to +3				
b. Envelope Delay kHz	micro-seconds					
0.5 - 2.8			3000	650	500	3000
0.5 - 3.0						
0.6 - 2.6			1500	300	260	
0.6 - 3.0						1500
0.8 - 2.6		1750				
0.8 - 2.8						500
1.0 - 2.4		1000				
1.0 - 2.6		500	500	110	80	300
c. Signal to C-Notched Noise Ratio	dB	$\geq$24	$\geq$24	$\geq$28	$\geq$30	$\geq$24
d. Maximum Change in Audio Frequency	Hz (max)	$\pm$3	$\pm$3	$\pm$2	$\pm$2	$\pm$3

NOTE: The above is an example of an extract from DCAC 300-175-9 and shows the typical format for determining circuit parameters.

TABLE 3-4
CIRCUIT QUALITY CONTROL TEST SCHEDULE

PARAMETERS	V1, V2, (2)				D1, D2, S1, S2, S3			
TYPE TEST	Test & Acceptance	In-Service	Out-of-Service	Initial Trouble Report Test	Test & Acceptance	In-Service	Out-of-Service	Initial Trouble Report Test
1. Transmission Level	I	72 (3)		Yes	I	72 (3)		Yes
2. Test Tone Level	I (4)		M (4)	Yes	I (4)		M (4)	Yes
3. Net Loss Variation	I		Q	Yes	I		Q	Yes
4. Idle Channel Noise	I		M	Yes	I		M	Yes
5. Impulse Noise					I		Q	Yes
6. Frequency Response	I		Q	Yes	I		Q	Yes
7. Envelope Delay Distortion					I		Q (5)	Yes
8. Maximum Change in Audio Frequency	I		A	(6)	I		A	(6)
9. Single Tone Interference	I		A		I		A	
10. Minimum Longitudinal Balance	I		AR		I		AR	
11. Harmonic Distortion	I		A	Yes	I		A	Yes
12. Phase Jitter					I		Q	(7)
13. Terminal Impedance	I		AR	(6)	I		AR	(6)
14. Nonlinear Distortion					I		A (8)	Yes (7)
15. Dropouts					I		AR	(6)
16. Phase Hits					I		AR	(6)
17. Gain Hits					I		AR	(6)
18. Bit Error Rate	I		AR	(6)	I		AR	(6)
19. Signaling Test	I		AR		I		AR	
20. Signal to C Notched Noise Ratio					I		A (8)	(7)
21. Echo Return Loss & Singing Point	I (9)		AR (9)	Yes (6)	I (9)		AR (9)	Yes (6)

See footnotes

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TABLE 3-4 (CONT'D)

PARAMETERS		N1, N2, N3			
TYPE TEST		Test & Acceptance	In-Service	Out-of-Service	Initial Trouble Report Test
a.	Total Peak Telegraph Distortion	I	72 (10)	Q	Yes
b.	Mark or Space Bias Distortion	I		Q	Yes
c.	Voltage Level	I		Q	(6)
d.	Mark/Space Current Level	I		Q	(6)

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1. I = Initial Test and Acceptance (T&A)
   D = Daily
   72 = Every 72 hours
   W = Weekly
   M = Monthly
   Q = Quarterly
   A = Annually
   AR = As required

2. V2 parameters will be used for out-of-service testing of spare, unconditioned VF channels and circuits—unless otherwise specified.

3. Certain voice circuits use tone-on-while-idle supervisory signaling and will normally have a signal, with speech or tone, present. Measurements will be made at the monitor jack as false rings will be caused by breaking the supervisory tone. The normal speech level is –12 VU at the 0dBm TLP. The normal tone-on-while-idle signal level is –20 dBm0.

4. Test tone measurements will be made before any other out-of-service test measurements. Test tone level measured during scheduled out-of-service QC test must be adjusted within plus or minus 1 dB of the level expected at the TLP where the measurement is made. Test tone level on circuits that traverse multiple links will be adjusted to within plus or minus 2 dB of the expected level.

5. Envelope delay distortion generally has little or no effect on narrowband VFCT operation (i.e., AN/FCC-19, AN/FGC-67, etc.). TCF's may elect not to perform periodic delay distortion measurements on those circuits used exclusively for narrowband VFCT operations.

6. This test should be accomplished if other measured circuit parameters are within limits and/or troubles persist.

7. Initial trouble report test for circuits operating at 7200 b/s or higher.

8. This test required in lieu of other parameters on circuits operating at 7200 b/s or higher.

9. Applies to circuits that have two to four wire conversion equipment.

10. Normal day-to-day technical control actions may satisfy in-service test requirements for active DC circuits. Spare DC circuits will be tested for total peak distortion at least once every 72 hours. Use of a spare DC channel for reroute or establishing an on-call circuit may satisfy this requirement.

case of TSRs for leased equipment only, TSOs are not issued. In these cases, completion reports are submitted by the DECCO as a commercial leased acceptance message (CLAM). The report tells the issuing office that action has been completed or that additional action may be required. Three different reports have been devised to cover all situations for the CCO. These reports are formatted so that they may be processed by computer. The formats must be followed precisely. These three reports are: in-effect report, exception report, and delayed service report. The reports must be transmitted to all addressees of the TSO, normally by the CCO.

In-effect report. The station or activity designated in the TSO as the CCO must, within 72 normal duty hours of completion action on the TSO, send an in-effect report to the originator and all addressees of the TSO. This report is submitted when the service is provided and accepted at the time and date specified, meeting all requirements of the TSO. The technical parameters discussed earlier must also be met before an in-effect report may be sent.

Exception report. If the circuit does not meet all required parameters and the TSO issuing authority advises that the circuit is accepted for service, an exception report is submitted. Until the exception report is cleared (i.e., the circuit is corrected of all deficiencies), the circuit meets the initial T&A parameters. The TSO issuing authority is responsible for necessary action to ensure that the exception report is subsequently cleared. Once all exceptions are cleared, an in-effect report is submitted.

When an exception report must be submitted, the CCO includes in the message, as a part of the statement of the problem, extracts from the appropriate parts of the DD Form 1697, Circuit Parameter Test Data. Extracts must include identification of any tests where a parameter failed specifications, specific measurements obtained, and other appropriate comments.

When it is determined, as a result of out-of-service quality control testing that circuit or equipment parameters cannot be brought within T&A specifications, the CCO or affected TCF sends this information to DCA, and O&M elements ensure required technical help is provided to return the circuit or equipment to T&A specifications.

a. Identification of circuit or equipment.

b. T&A measurements for parameters that fail to meet specifications.

c. Out-of-service quality control test measurements for parameters that fail to meet specifications.

d. Remarks, as appropriate.

Delayed service report. If the circuit does not meet all required parameters and the TSO issuing authority advises that the circuit must meet these parameters before accepting the service, a delayed service report is transmitted. If a circuit or trunk is not going to meet the activation date required in the TSO because of commercial leasing problems, a delayed service report is sent to the TCO. The TCO issues an amending TSR showing the new activation time to all addressees of the TSO. If the delay is caused by some other reason, the CCO sends a delayed service report to the issuing authority of the TSO.

Keep in mind, however, that an in-effect report must follow an exception or delayed service report. These reports, along with the first test data, are kept in the circuit history file.

461. Trunk identifiers

A DCA office writing a TSO must be able to identify each circuit, trunk, link, or system by a single identifying number. This assures that accurate records are kept on the history of the activated circuit, trunk, or link. To accomplish this task, DCA has established guidelines on constructing link, trunk, and circuit identifiers.

DCAC 310-65-1, *Circuit and Trunk File Data Elements and Codes Manual of the Defense Communications System (DCS)*, lists the methods used to identify systems, links, trunks, and circuits. Since system and link identifiers are straightforward, we only discuss trunk and circuit identifiers in this section. If you have any problems with system or link identifiers, ask your supervisor for help.

In our communications systems, there must be some way of telling one trunk from another for reporting purposes. This is done with a trunk identifier. Trunk identifiers identify a communications path between two stations. They are composed of six characters. Each character has a particular meaning. Our intent is not to have you memorize the codes, but for you to be able to go to the reference and find out what they mean, when required.

The first character in the trunk identifier (see example below) shows the geographical area code of the "from" station (sending terminal). The second character shows the "to" station (receiving terminal). These character codes are always numbers except when the trunk originates and terminates in the continental United States. In this case, letters are used for the "from" and "to" codes. The area codes are derived from a geographical breakdown of the world. Again, these area codes may be found in DCAC 310-65-1. The third position of this trunk number indicates the O&M agency providing the Government-owned or leased communications facilities used by the trunk. The fourth position indicates the type of trunk, and the fifth and sixth positions are the individual trunk numbers identifying the exact trunk.

Example:

3	5	D	Q	A		1
1	2	3	4	5	&	6

Position 1:	"From" area 3
Position 2:	"To" area 5
Position 3:	D - Commercially leased by DCA
Position 4:	Q - Submarine cable
Position 5 & 6:	A1 - Trunk number

462. How to identify circuits in the DCS and the meaning of each position of circuit identifiers

There are thousands of circuits in the DCS. Each circuit must have a specific identity. This identification is furnished by the command communications service designator (CCSD). The CCSD tells the technical controller much information about a circuit. For example, it shows the type of circuit and who uses it. Above all, it identifies a particular circuit. DCA assigns a CCSD to each circuit in its TSO. This CCSD is used for status keeping and reporting purposes. CCSDs are divided into two classes: permanent and temporary. Permanent CCSDs are assigned by DCA in the TSO for the life of a circuit, or until it is deactivated.

Each CCSD, whether permanent or temporary, must have eight characters. Each character is a code symbol for certain information on the circuit. The first character (see example below) shows the military department or agency requiring the service. The second and third characters identify the purpose or use of the circuit. The fourth shows the type of service provided. The fifth through eighth characters identify the individual circuit, and may be all letters, numbers, or a combination of both. For example, the fifth through eighth characters of a temporary CCSD are composed of letters only, while a permanent CCSD usually has a combination of letters and numbers.

Again, the codes used in making up a CCSD may be found in DCAC 310-65-1, Circuit and Trunk File Data Elements and Codes Manual of the Defense Communications System (DCS).

Example:

	D	U	U	C	9CMN
Position:	1	2	3	4	5,6,7,8

1st Position:	D - Military department or agency requiring service. In our example, D = DOD or DCA.
2nd and 3rd Position:	U - Purpose and use of circuit. "UU" stands for DCS AUTOVON.
4th Position:	C - Indicates type of service. Our example "C" is AUTOVON interswitch trunk circuit.
5th thru 8th Position:	9CMN - Identifies the individual circuit number.

Special temporary CCSDs are activated and assigned to overload circuits to support on-call patches for a period not to exceed 72 hours. When a user requests an on-call patch, technical control needs this information:

a. Precedence of on-call request (Flash, Immediate, Priority, Routine).

b. Type of patch required-voice, data, facsimile (purpose and use, type of circuit).

c. Originator of the request and destination (military department or agency).

d. Operating speed in baud or bit rate.

e. Type of security equipment required, if applicable.

f. Time the on-call patch is required.

g. Estimated duration of the on-call patch.

The technical controller uses this information to determine the CCSD of the on-call patch. The first four positions indicate the using military department or agency, purpose and use, and the type of service, the same as a permanent CCSD. The last four include the number and priority of the temporary circuit. The letters PA - PZ designate an on-call patch or circuit. The letter A is the first patch, B the second, C the third, and so forth. The last two letters assign the priority of the on-call patch. For example:

Precedence	*DCS Designator*	*Restoration Priority*
Flash	FL	1G
Immediate	MM	2D
Priority	PR	3C
Routine	RT	00

JUAAPAFL is an example of a complete temporary CCSD. Remember that a temporary CCSD has no numbers, while a permanent CCSD may contain both. Also, remember that DCA assigns permanent CCSDs, while the technical controller assigns temporary CCSDs. Information on temporary CCSDs may be found in DCAC 310-70-1 and DCAC 310-55-1.

463. Restoration priority system

When circuits fail, you must restore service to your users as quickly as possible. When several circuits are involved, restore them on a first-come, first-served basis. In a situation such as this, some circuits are more important than others. Therefore, the National Communications System (NCS), through DCA, assigns a restoration priority code to each circuit. Using these, you know which circuits are to be restored first.

Description of Restoration Priority Codes. A National Communications System Restoration priority (NCS RP) is assigned to each circuit. The TCO sends a copy of the TSR to the NCS for a confirmation of a restoration priority. The NCS either confirms the requested RP or assigns a realistic one for the circuit and advises DCA. DCA inserts the NCS RP in the TSO when it is issued. If an activation TSO has already been sent out as one RP and NCS downgrades it, a second (change) TSO reflecting the RP change must be issued. If the code should change at some time during the life of the circuit, DCA issues another TSO reflecting the change.

A restoration priority code is a combination of a number and a letter; for example, 1A. It establishes a sequence for restoring communications circuits. In other words, an RP code tells us how important a circuit is compared to other circuits. The RP codes in use are listed below. The list is from DCA Circular 310-65-1. They are listed by group, in descending order of importance, from top to bottom, left to right.

RP1 Category	*RP2 Category*	*RP3 Category*	*RP4 Category*
1A	2A	3A	4A
1B	2B	3B	4B
1C	2C		
1D	2D		
1E	2E		
1F	2F		
1G	2G		
	2H		
	2I		

An exception to the number/letter rule occurs when no restoration priority is assigned, Some minor circuits, such as teletypewriter news, fall into this group. In this case, a 00 code is assigned. Also, note that spare channels are assigned restoration priority code 00. But, there is a big difference between a spare channel and a user circuit that has an RP 00 code. The difference is pointed out in the discussion of circuit restoration which follows.

Circuit Restoration. Generally, we restore circuits by using spare channels and equipment. This is called rerouting. It is the primary means of restoring circuits when channel trouble is the problem, and it is exclusively your job.

You must restore faulty circuits even if you have no spare channels. You do this by preempting other circuits. But, which circuits do you restore first? The NCS RP system will tell you.

The number part of the RP shows the order of importance, according to major categories. For example, a 1G circuit is a category RP1 circuit. It is higher on the priority scale than any RP2, RP3, or RP4 circuit. You must remember this when you restore circuits by reroute. Restore highest priority circuits first. But this does not mean that you can disregard low-priority circuits that have failed. DCA directs us to restore all circuits as fast as possible, with primary emphasis given to restoring RP1 circuits. All other circuits should be restored as fast as possible according to their restoration priority and the availability of facilities.

When you must restore circuits, use the following list as a guide. It tells what facilities to use, in order of preference.

(1) Spare channels.

(2) Channels containing on-call circuits when the circuits are not activated.

(3) Circuits having no assigned restoration priority code.

(4) Circuits in ascending order of restoration priority, commencing with the lowest priority circuit you have; for example, 4B.

Use all available spares first. Then, if you still need reroute facilities, go to the next item on the list and so on. In addition to the list, remember these important points. Don't restore a circuit by preempting a higher priority circuit, unless DCA directs you to do so. A teletypewriter tone pack is restored according to its NCS RP code except when it is out at the same time as a voice circuit. In this case, the tone pack is usually restored first. Reroutes for high-priority circuits must be maintained until the normally prescribed route is again usable. Last, whenever a circuit is preempted, the user being denied service must be advised of the time, reason, and expected duration of loss of service.

Now consider a final question. Which is more important—individual circuit or trunk? By definition, a trunk is a single or multichannel communications medium between two stations. Since a trunk may be multichannel, it can represent many circuits. Even a single-channel trunk can carry many circuits. If that single channel carries a VFCT tone pack, it equals, perhaps, 16 or more teletypewriter circuits. So, a trunk is more important than a single circuit. In most cases, a trunk failure means outage of many individual circuits.

A trunk failure is a major outage, But trunks do not have restoration priorities! Nevertheless, when a trunk fails, you must take immediate and decisive action to restore it or to reroute its circuits. Trunk identifiers do not include RP codes. Only circuits and spare channels have RP codes.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

457. The telecommunications service request, and how to process a user's request for service

1. What is an RFS?
request for service from user to TCF.

2. What is a TSR?
Prepares TSR to go to DCA from the TCO

3. What reference defines the procedure for processing a TSR?
DCAC 310-130-1

458. The telecommunications service order, and how the TSO numbering system works

1. What is the purpose of a telecommunications service order (TSO)? Authorize activations, deactivations, changes.

2. Who normally receives TSOs?
All DCS stations

3. Given a TSO number E10250/9CMN-03, explain each part. E-DCA Europe
1-1981
0250 - TSO #250 for 1981
9CMN - CCSD of TSO
03 - Third action taken on CCSD 9CMN

459. DCS technical schedules and the use of quality control test schedules

1. Where should you look to determine the parameter code of a DSN voice-grade access line?
DCAC 300-175-9 DCS Technical Schedules

2. What parameter code would you use for the above circuit?
C1

3. What are the specifications for frequency response of a circuit with a parameter code of C2?
300 - 3,000 Hz -1 - +3
-2 - +6
500 - 2800 Hz

4. What determines which test to pull for an C2-type circuit?
Ckt quality control test schedules

460. Reports that may be transmitted to DCA when testing and accepting a circuit or trunk

1. Who is responsible for circuit activation, to include the scheduling, supervising, and reporting of circuit tests?
   CCO

2. What data is used for a base line when a circuit fails to meet all of the parameters set forth in the technical schedule and when the system it transverses is operating at its optimum?
   initial T&A

3. What type report is issued to activate a commercially leased circuit?
   C/AH

4. List the three types of reports used by the CCO for circuit activation.
   in-effect exception & delayed service

5. On the test and acceptance of a new circuit, it fails frequency response. The system it transverses is operating at its optimum. What action would the CCO take?
   CCO sends exception report to originator of TSO

461. Trunk identifiers

1. How many number positions are there in a trunk identifier?
   6

2. Which position of a trunk identifier would indicate the receive side area of a trunk?
   2nd position "To" area

3. What publication may be used to locate the codes of trunk identifiers?
   DCAC 310-65-1

4. When will letters be used in the first two positions of a trunk identifier?
   when trunk originates or terminates in states

5. Which position indicates the type of trunk or media?
   4Th

462. How to identify circuits in the DCS and the meaning of each position of circuit identifiers

1. What is the purpose of a CCSD?
   provide ckt with identity

2. How many positions does a CCSD contain?
   8

3. How many parts are contained in a CCSD?

4

4. What position and part of a CCSD contains the type of circuit identified? 4th position, 3rd part

5. What are the two classes of CCSDs?

Permanent + temp.

6. Who has responsibility for constructing and assigning temporary CCSDs?

Tech. control

463. Restoration priority system

1. What is the highest restoration priority code?

1A

2. What is the lowest restoration priority code?

00

3. List the order of the preemption preference.

spare
on call ckts
cks having no RP
cks in ascending order of RP

4. What agency certifies and assigns restoration priorities? NCS

5. What is required in order to change a restoration priority? confirmation from NCS & TSO from DCA

3-4. Miscellaneous Plans and Outages

There is a constant need for the upgrading of each DCS facility. Operations planning should be based on historical data coupled with new technologies. It is important to optimize the use of scarce resources and provide well thought out guidance to all people in advance of the need. In the following text we discuss some programs you may encounter and have direct involvement with.

464. Restoral and contingency plans

Restoral Planning. Restoral plans are developed and distributed by the DCA areas IAW DCAC 310-55-2. On development of these plans, they are available immediately to shift people and are implemented on a "no notice" basis under the direction of the ACOC responsible for the area. Each DCS station supplements the DCA restoral plans whenever possible and establishes reroutes for the maximum number of circuits. Each DCS station must be prepared to respond to the operational direction of the DCA area that has the authority over their control facility. The DCA area does have the authority to temporarily change the NCS restoration priority of circuits and systems in their areas. Generally, this is done only in support of a commander-in-chief requirement during a stressed condition.

Contingency Planning. The reliability and survivability of the communications capability of any DCS station depends to a great degree on the skill and knowledge of the technical control people. Contingency operations must be planned to maximize their effectiveness in maintaining service continuity for as many users as possible. Preplanned actions permit people to practice and develop skills and knowledge required to achieve efficiency under adverse conditions.

Planning. The TCF chief helps the unit operations staff in preparing detailed plans for contingency operations. The plans must also be developed for emergency additions of equipment, expanded circuitry, and emergency operations of reduced plant capability. Reduced capability may he caused by fires, flooding, winds, civil disorder, jamming, or sabotage. Special attention must be given to ensure that all plans take into consideration the NCS restoration priority of all station circuits.

Implementation. Authority must be delegated to the TCF shift supervisor to implement contingency plans when conditions require such action. All plans must be immediately available in the TCF area. Assignments of additional functions are made to specific TCF positions for:

a. Coordination of line maintenance.

b. Coordination of equipment maintenance.

c. Acceptance testing of repaired or newly installed equipment.

d. Coordination of cutover requirements for new equipment.

e. Coordination of patching requirements for maintenance of service to priority users.

Continuity of communications service is the primary mission of the TCF without exception, and that's another reason that these plans are so important.

Training. Training of people and practical exercises are done to ensure that all TCF people can perform duties assigned under contingency plans. Practical exercises either are dry run (simulated) or use spare equipment. User traffic is not subjected to such exercises unless prior approval is obtained from the user and the ruling DOCC element.

465. Authorized outages

DCA policy requires that the best possible communications service be provided to users commensurate with available equipment and facilities. Maintenance of this service may, at times, require removal of equipment from service or, in cases of major engineering changes, may require the complete shutdown of a communications facility. These outages, which must be held to a minimum, are known in advance, and every effort must be made to provide continuity of service during the time a facility is out of service. Whenever possible, user service is maintained using available reroute capabilities under the NCS RP system. When it is absolutely necessary to remove communications equipment, facilities, or a DCS station from service, the planning, notification, and restoral of service must be thorough.

Authorized Outages. An authorized outage is a service interruption that normally is scheduled when minimum communications impact will occur to the users, and it provides, where possible, for maximum circuit restoration via reroutes. Planned actions are time-phased to allow control to be maintained at all times and to ensure that communications capabilities are maximized. This planning includes recovery actions should an emergency arise that would prevent the completion of the planned actions.

In addition, the planning organization considers the leasing of additional circuits, as necessary, to provide uninterrupted service. However, funding must normally be certified in advance by the responsible O&M agency.

This may all sound too official for you, and you're probably saying, "Well, how does this involve me?" You are, or will be, responsible for the communications equipment at your station one day, so to whom does maintenance go when they need to take a system down to do maintenance on it? You! This is when the wheels start turning, and you start planning the authorized outage.

Notification. It is of the utmost importance that all users of the DCS be informed of any action that will or may degrade their service. Particular emphasis must be placed on the notification of higher headquarters, CINCs, JCS, DOD, NSA, and any other federal agencies whose service will or may be degraded. O&M agencies developing plans that require user service interruption must also follow this procedure, and, also advise the appropriate DOCC elements of the planned service interruption at the earliest possible date. Failure to provide advance notification may result in denial of the service interruption and increased costs to the O&M agency. This is especially true when O&M agencies enter into contractual agreements.

If there will be no interruption of user service and if sufficient spare and backup equipment are not available during the affected period, the TCF tells the appropriate DOCC element and O&M agency of this hazardous condition in the format mentioned earlier in the text. If warranted, any DOCC element is authorized to cancel or direct rescheduling of this type of interruption. Further, any DOCC element is authorized to require the technical control facility to tell users about the hazardous condition.

Reporting Procedures. When there will be an interruption of user service caused by an outage of an entire DCS station or other facility, the following must be done:

No later than 21 days before a scheduled service interruption, tell the appropriate DOCC element of the requirement for the outage and request preliminary approval for the outage. This 21-day time factor may be waived by the appropriate DOCC element to correct hazardous conditions when the capability exists at the station to accomplish the required repair action. If no waiver is required, all affected DOCC elements and O&M agencies must be information addressees on this request and all subsequent communications regarding downtime. Requests must include this information:

a. The date and inclusive times of the scheduled interruption and an alternate date and time.

b. The purpose of the scheduled interruption. Provide detailed information to explain fully the purpose of the interruption.

c. A statement that all required parts or equipment are on hand to complete the repair action or the expected delivery date for the parts or equipment.

d. A statement that all avenues of bypass capabilities have been considered.

e. Identification of people who will accomplish repair actions.

f. Identification of specific links, trunks, and circuits that will be disrupted and the point where they will be disrupted.

g. Name and telephone number(s) of the station project officer for the outage.

h. Estimated maximum recovery time.

The DOCC element evaluates the impact of the service interruption on the DCS considering such things as contingency requirements, exercises, and other schedule interruptions. Within 4 days of receipt of the request, the DOCC element tells the station of its tentative approval or disapproval. When disapproved, a recommended alternate date must be provided. When the request for a scheduled service interruption is conditionally approved, the DOCC element helps the station in preparation for the outage.

No later than 14 days before the outage, the station requesting the outage must send a message request to the TCF serving each user that will be affected by the outage. When such a request for user release is received by a TCF, the TCF coordinates with all affected users within its area of responsibility. The users affected by the scheduled service interruption are advised to contact the distant end of the circuit for verification of concurrence to release the circuit and, if required, the concurrence of higher headquarters before user certification of circuit release. Nonreceipt of a message granting user release from a serving TCF must not be construed as a concurrence. Within five calendar days, the serving TCFs must tell the TCF requesting the outage of:

a. The circuits that have been released by the user.

b. The circuits that have not been granted a release by the users. When such nonconcurrence is received, the serving TCF provides the CCSD, NCS RP, and a summary of user comments regarding refusal to release the circuit, including alternate date and times provided by the user.

Each user nonconcurring with the DCS station request for service interruption must advise the requesting DCS station of the CCSD, NCS RP, the reason the circuit cannot be released, and an alternate date and time when the user will release the circuit.

Five to 7 days before the actual outage, the last request for a scheduled service interruption must be submitted to the appropriate DOCC element. The request must specify if the users have released all circuits affected by the outage. When user nonconcurrence is indicated, the nonconcurrence information must accompany this request.

On receipt of the last request and after review of the current situation, the DOCC element provides the TCF with approval or disapproval of the requested scheduled service interruption by message.

User release of circuits with NCS RP 3C and lower is not required for DOCC approval for a scheduled service interruption of less than 24 hours.

The serving TCF tells the users of circuits with NCS RP 3C and lower of the scheduled loss of service when these circuits cannot be rerouted during the scheduled interruption.

Thirty minutes before the initiation of the actual outage, the station requiring the outage must contact the appropriate DOCC element. The DOCC element has the authority to cancel a scheduled interruption at any time before or during the actual outage.

When necessary, the DOCC element may require the DCS station to prepare and send a written plan which would include the reroutes to be made, temporary lease requirements, and other reroute requirements that cannot be satisfied and require the help of the DOCC. All service interruptions, regardless of duration, are recorded in the master station log or on a trouble and restoration record. This is just some of the paperwork that is required by the station initiating this action, and depending on your station configuration, you could be required to submit even more.

Please write your response to unit self-test questions and then check the text answers at the end of the unit.

SELF-TEST QUESTIONS

464. Restoral and contingency plans

1. What two plans must be developed during the operations planning of a facility?
   Restoral & contingency plans

2. Who has the overall authority to develop and distribute restoral plans? DCA Areas

3. When developing a contingency plan, what do we mean when we say "that the contingency operations must be planned to maximize their effectiveness?"
   plan must maintain service continuity for as many users as possible

4. Who is tasked to assist the unit operations section in the development of contingency plans?
   TCF Chief

465. Authorized outages

1. What means should be exhausted before user service is denied during an authorized outage?
   reroute capabilities

2. Why are planned actions of an authorized outage time-phased? refer to page 3-37

3. Why must the O&M agency advise the appropriate DOCC element of a planned service interruption at the earliest possible date? Prevent incurred

4. You are planning an authorized outage at your station. When does the DOCC element need to be notified? No later than 21 days

ANSWERS TO SELF-TEST QUESTIONS

446

1. A narrative journal of all significant events that occur on a daily basis at your technical control facility.
2. It is an official log used as a reference for a controller's actions and opinions during significant occurrences.
3. Classified information and derogatory remarks that are not fully supported.

447

1. To serve as a locator card for quick reference on circuits. The circuit data form contains terminal, routing, and equipment information to assist the TCF in troubleshooting and circuit restoration.
2. The technical controller uses the DD Form 1441 for location, troubleshooting, and restoration of circuits or channels.
3. Telecommunications service order (TSO).
4. Because very often it shows the end-to-end circuit configuration along with input and output levels at each PTF and TCF.

448

1. Yes.
2. Provides a complete record of circuit, channel, or trunk outages, along with reroute action. It also provides details in order to prepare DCS status report.
3. In the outage ticket section, on the line marked "A".

449

1. Used to notify maintenance of failure or substandard equipment, and provides a record for technical control.
2. DD Form 1445.
3. The identification of the equipment requiring repairs.

450

1. Used to record all circuit AC test information, specifications, and results.
2. The technical controller performing the AC test.
3. The column marked "Receive initial."

451

1. DD Form 1698, Wideband Outage Record.
2. Record wideband outages for record keeping and DCS reporting.
3. REC.

452

1. DD Form 1441, DD Forms 1697, telecommunications service orders, and history folders.
2. The facility assigned the circuit control office or intermediate control office responsibilities and all servicing TCFs, PTFs, and MTCs.
3. Until the condition causing the report to be rendered is cleared and an in-effect report is submitted.
4. Waiver subject, file location, date granted, and granting authority.

453

1. So that, if there is a computer failure, it will not prevent the maintenance of the required records or the retrieval of information.
2. The information that is required on DD Forms 1441 must be available at all times to the operating area of the technical control.
3. Only if the ADP system can be protected from alteration after the radio day is closed.
4. Hard page copies are required to be retained in the TCF for the calendar month, then they must be maintained in the current files area for 11 months before destruction or disposition.

454

1. A DCS station that reports to another DCS station.
2. The DCS reporting guide prepared by ACOCs.
3. DCS reporting guide.

455

1. Nonformatted and formatted reports.
2. Nonformatted report.
3. DCAC 310-55-1.
4. Nonformatted report.

456

1. Special interest items, high interest telecommunications items, and hazardous conditions.
2. HQ DCA, DCAOC, ACOC, and RCF.
3. For trending purposes, to facilitate providing operational direction, or to provide command attention.
4. Links and facilities where the loss and severe degradation of communications is probable unless preventive action is taken.

457

1. A request for service (RFS) is a request for communications service from a user to its serving TCF.
2. There are actually two types of telecommunications service requests. The first, a feeder TSR, is submitted by the serving TCF to the TCO, requesting a communications service. The TCO then prepares another TSR, which is forwarded to DCA.
3. DCAC 310-130-1.

458

1. To authorize activations, deactivations, or changes to circuits, trunks, links, or systems. It also gives the O&M agencies authority to procure equipment.
2. All DCS stations that a trunk or circuit traverses, the designated DCS control office, the leasing agency (if applicable), and other DCA area offices if the trunk or circuit enters their area. Information copies of the TSO are sent to the O&M agency, the TCO and the user of the circuit or trunk.
3. E - DCA Europe; 2 - 1081; 0250 - TSO #250 for the year 1981; 9CMN - CCSD of TSO; 03 - Third action taken on CCSD 9CMN.

459

1. DCAC 300-175-9, DCS Technical Schedules.
2. C1.
3. 300 to 3,000 Hz -2 to +6; 500 to 2,800 Hz -1 to +3.
4. The circuit quality control test schedules.

460

1. The CCO.
2. The initial T&A data.
3. A commercial leased acceptance message (CLAM).
4. In-effect, exception, and delayed service.
5. The CCO sends an exception report to the originator of the TSO listing the frequency response measurements that failed to meet the parameters.

461

1. Six.
2. Second position, the "To" area.
3. DCAC 310-65-1.
4. When the trunk originates or terminates within the continental United States.
5. Fourth.

462

1. To provide each circuit a specific identity for reporting and status keeping.
2. Eight.
3. Four.
4. Fourth position, third part.
5. Permanent and temporary.
6. Technical control.

463

1. 1A.
2. 00 (when no RP is assigned by NCS).
3. a. Spare.
   b. On-call circuits (when not activated).
   c. Circuits having no assigned RP (code 00).
   d. Circuits in ascending order of RP.
4. The National Communications System (NCS).
5. Confirmation from NCS and a new TSO from DCA.

464

1. Restoral and contingency plans.
2. The DCA areas.
3. The plan must maintain service continuity for as many users as possible.
4. TCF chief.

465

1. All available reroute capabilities.
2. To allow control to be maintained at all times to ensure that communicative capabilities are maximized.
3. To prevent incurred costs for broken contractual agreements on denied service interruptions.
4. No later than 21 days prior to the scheduled authorized outage.

Do the Unit Review Exercises (URE) then complete ECI Form 34, Field Scoring Answer Sheet. ➡

UNIT REVIEW EXERCISES

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to ECI Form 34, Field Scoring Answer Sheet. **DO NOT RETURN YOUR ANSWER SHEET TO ECI.**

85. (446) Who must make the first entry and sign the DD Form 1753?
    a. The coordinator.
    b. The shift supervisor.
    c. The NCOIC of technical control.
    d. The senior ranking person on duty.

86. (446) What form is used for the official narrative log that is often used to brief unit commanders?
    a. DD Form 1441.
    b. DD Form 1443.
    c. DD Form 1698.
    d. DD Form 1753.

87. (447) The Circuit Data Record (DD Form 1441) serves
    a. as the primary source document of data in preparing TSOs.
    b. as a wire record and equipment file for maintenance people.
    c. primarily to assist the TCF in troubleshooting and circuit restoration.
    d. as a source document for the data base file in the technical control facility.

88. (447) How long should a Circuit Data Record (DD Form 1441) be retained after a circuit has been deactivated?
    a. One year.
    b. One month.
    c. Six months.
    d. Indefinitely.

89. (447) You should use the telecommunications service order as a primary source document when filling out which form?
    a. DD Form 1441.
    b. DD Form 1443.
    c. DD Form 1445.
    d. DD Form 1697.

90. (448) What form is used as the primary source of information when preparing DCS status reports?
    a. DD Form 1441.
    b. DD Form 1443.
    c. DD Form 1445.
    d. DD Form 1753.

91. (448) What portion of the DD Form 1443 should be used for recordkeeping purposes on send circuit outages?
    a. User outage.
    b. Trunk outage.
    c. Channel outage.
    d. Amplifying remarks.

92. (449) Which form is used to notify maintenance people of failure or substandard operation of equipment?
    a. DD Form 1441.
    b. DD Form 1443.
    c. DD Form 1445.
    d. DD form 1697.

93. (449) What does the Time Required block on the DD Form 1445 signify?
    a. The time that maintenance arrived on station.
    b. The time the request for maintenance was made.
    c. The amount of time required to complete repairs.
    d. The earliest time that maintenance action can be done.

94. (450) What DD Form is used to record quality control information and test and acceptance data?
    a. 1697.
    b. 1698.
    c. 1753.
    d. 1443.

95. (450) A telecommunications service order (TSO) has been received at your technical control to move a circuit to another channel. What form must be filled out and put in the circuit history folder along with the TSO?

a. DD Form 1441.
b. DD Form 1443.
c. DD Form 1697.
d. DD Form 1698.

96. (450) Which test results are recorded on the reverse side of the DD Form 1697?

a. Terminal impedance and impulse noise.
b. Frequency response and envelope delay.
c. Idle channel noise and test tone levels.
d. Net loss variation and single tone interference.

97. (451) The length of time that DD Forms 1698 are kept on file is

a. 1 month.
b. 3 months.
c. 11 months.
d. to the close of the raday.

98. (451) How is the direction of a circuit outage designated on a DD Form 1698?

a. By using the command service designator.
b. By placing the CCSD in a specific order.
c. By annotating the direction in the Received From block.
d. By placing the three-letter designators in the terminal blocks.

99. (452) How long must an exception report be maintained in the circuit history folder at an intermediate facility?

a. Until an in-effect report is submitted.
b. For the entire duration of an active circuit.
c. Until a delayed service report can be submitted.
d. Until the condition causing the report to be rendered is isolated.

100. (453) How long must detailed computerized outage records be retained on file to reconstruct events of an outage?

a. 90 days.
b. 60 days.
c. 30 days.
d. 7 days.

101. (453) Which DD Form must be maintained separately if an automatic data processing (ADP) system is used.

a. 1441.
b. 1443.
c. 1753.
d. 1698.

102. (454) What will happen to a status report submitted to DCA if it contains a circuit identifier not listed in the DCS Reporting Guide?

a. The information submitted will be accepted.
b. The information submitted will be rejected.
c. The information will be retained on an error file.
d. The information will be routed to an alternate printer.

103. (455) Which DCAC governs DCS reporting?

a. 310-70-1.
b. 310-65-1.
c. 310-55-1.
d. 300-175-9.

104. (455) What type of report is submitted if an outage requires immediate notification to the next higher echelon?

a. Periodic.
b. Formatted.
c. Real-time.
d. Nonformatted.

105. (456) Who does *not* have the authority to designate special interest items?

a. Site commanders.
b. HQ DCA.
c. DCAOC.
d. RCF.

106. (456) Which of these conditions is considered a HAZCON and requires reporting IAW DCAC 310-55-1?

a. One tower light burned out.
b. Partial loss of a supergroup.
c. No cool/no heat station status.
d. Loss of diversity on a radio link.

107. (457) Who is authorized to submit a telecommunications service request (TSR) to DCA?

    a. The user.
    b. The TCF.
    c. The CCO.
    d. The TCO.

108. (457) Where can a technical controller find guidance for completing a feeder TSR?

    a. DCAC 310-55-1.
    b. DCAC 310-65-1.
    c. DCAC 310-130-1.
    d. DCAC 300-175-9.

109. (458) Which of these TSO numbers is correct?

    a. C10019/B350-01.
    b. D73520/C319-01.
    c. P10131-01.
    d. E1B256/0321-02.

110. (458) What does the first position of a telecommunications service order (TSO) number represent?

    c. The CCSD.
    b. The issuing office.
    a. The year the TSO was issued.
    d. The sequential action on the circuit.

111. (459) Which of the following provides guidance for circuit quality control parameters?

    a. DCAC 310-70-1.
    b. DCAC 310-65-1.
    c. DCAC 310-55-1.
    d. DCAC 300-175-9.

112. (459) What determines the date annual out-of-service tests are performed on a circuit?

    a. The activation date on the in-effect report.
    b. The date annual tests were last performed.
    c. Your station's quality control schedule.
    d. DCA's station quality control schedule.

113. (460) Within how many hours of completion action on the TSO must the CCO submit an in-effect report?

    a. 72.
    b. 48.
    c. 24.
    d. 12.

114. (460) What report must be sent if a circuit does not meet all required parameters and the TSO issuing authority advises that the circuit must meet these parameters before accepting the service?

    a. In-effect report.
    b. Exception report.
    c. Acceptance report.
    d. Delayed service report.

115. (461) What publication gives codes and guidelines for trunk identifiers?

    a. DCAC 310-70-1.
    b. DCAC 310-65-1.
    c. DCAC 310-55-1.
    d. DCAC 300-175-9.

116. (461) What does the first position of a trunk identifier indicate?

    a. The "From" (sending) station.
    b. The "To" (receiving) station.
    c. The responsible O&M agency.
    d. The type of trunk.

117. (462) How many temporary circuits were activated if circuit DUUCPCMM was the last activation?

    a. 1.
    b. 2.
    c. 3.
    d. 4.

118. (462) Which DCA publication contains information needed to assign a temporary CCSD?

    a. DCAC 310-70-1.
    b. DCAC 310-65-1.
    c. DCAC 300-175-9.
    d. DCAC 330-175-1.

119. (463) When you must restore user service by rerouting, what is the *second* type of circuit you should preempt?

    a. Spare channels.
    b. Circuits with 00 RP codes.
    c. Nonactive on-call circuits.
    d. Circuits with lowest RP codes in ascending order.

120. (464) What plan is initiated by DCA to reroute high priority circuits during a major communications failure?

a. Backup plan.
b. Altroute plan.
c. Restoral plan.
d. Contingency plan.

121. (464) Who, at the lowest level of authority, can implement the contingency plans at your station?

a. DCA ACOC.
b. TCF chief.
c. Squadron commander.
d. TCF shift supervisor.

122. (465) Who has the authority to approve funding for the leasing of additional circuits during an authorized outage?

a. HQ DCA.
b. O&M agency.
c. DOCC element.
d. Local site commander.

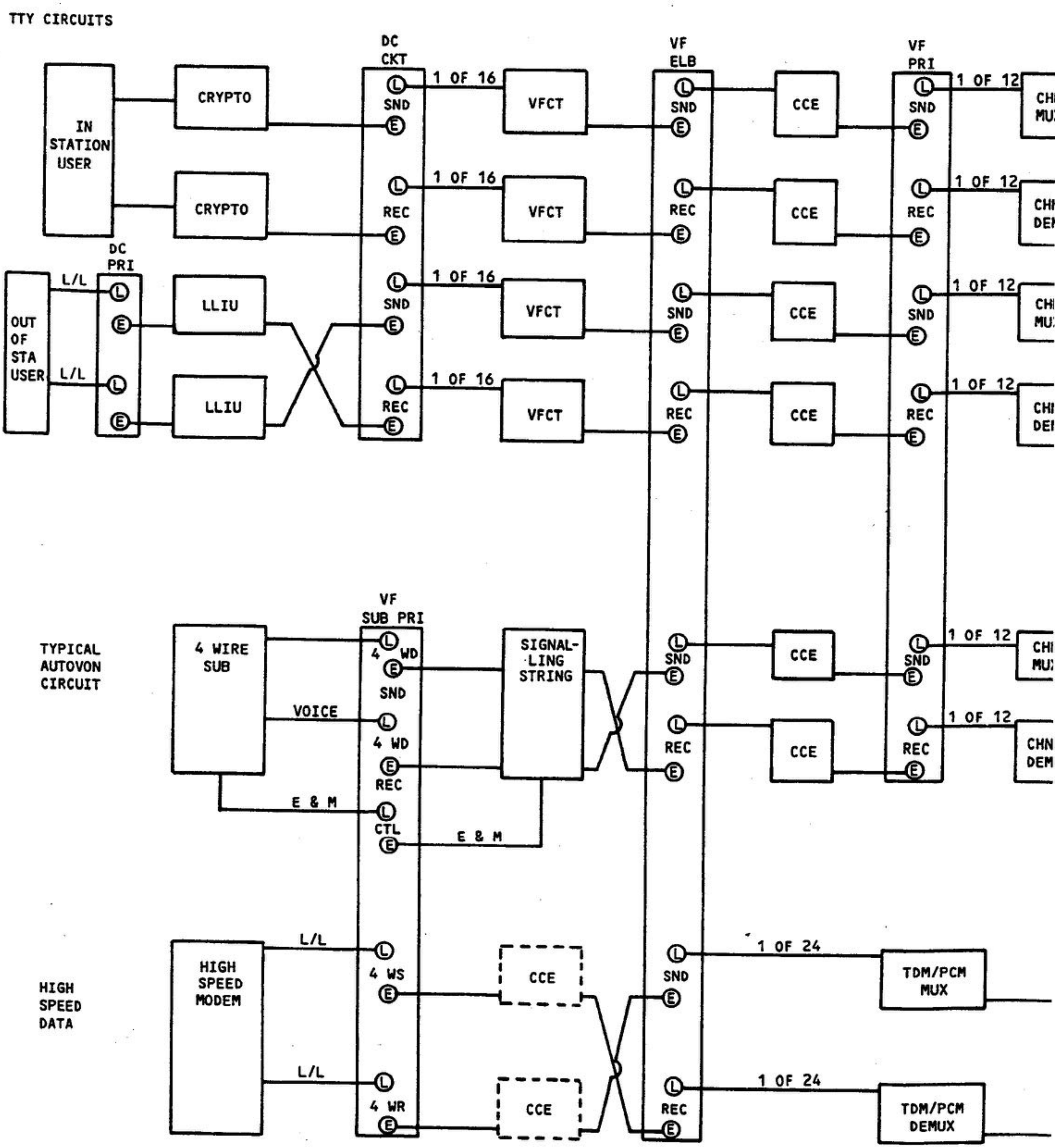
123. (465) How many days before an authorized outage must the station requesting the authorized outage forward a message request to the TCF serving each user?

a. No later than 21 days before the outage.
b. No later than 14 days before the outage.
c. No later than 7 days before the outage.
d. No later than 4 days before the outage.

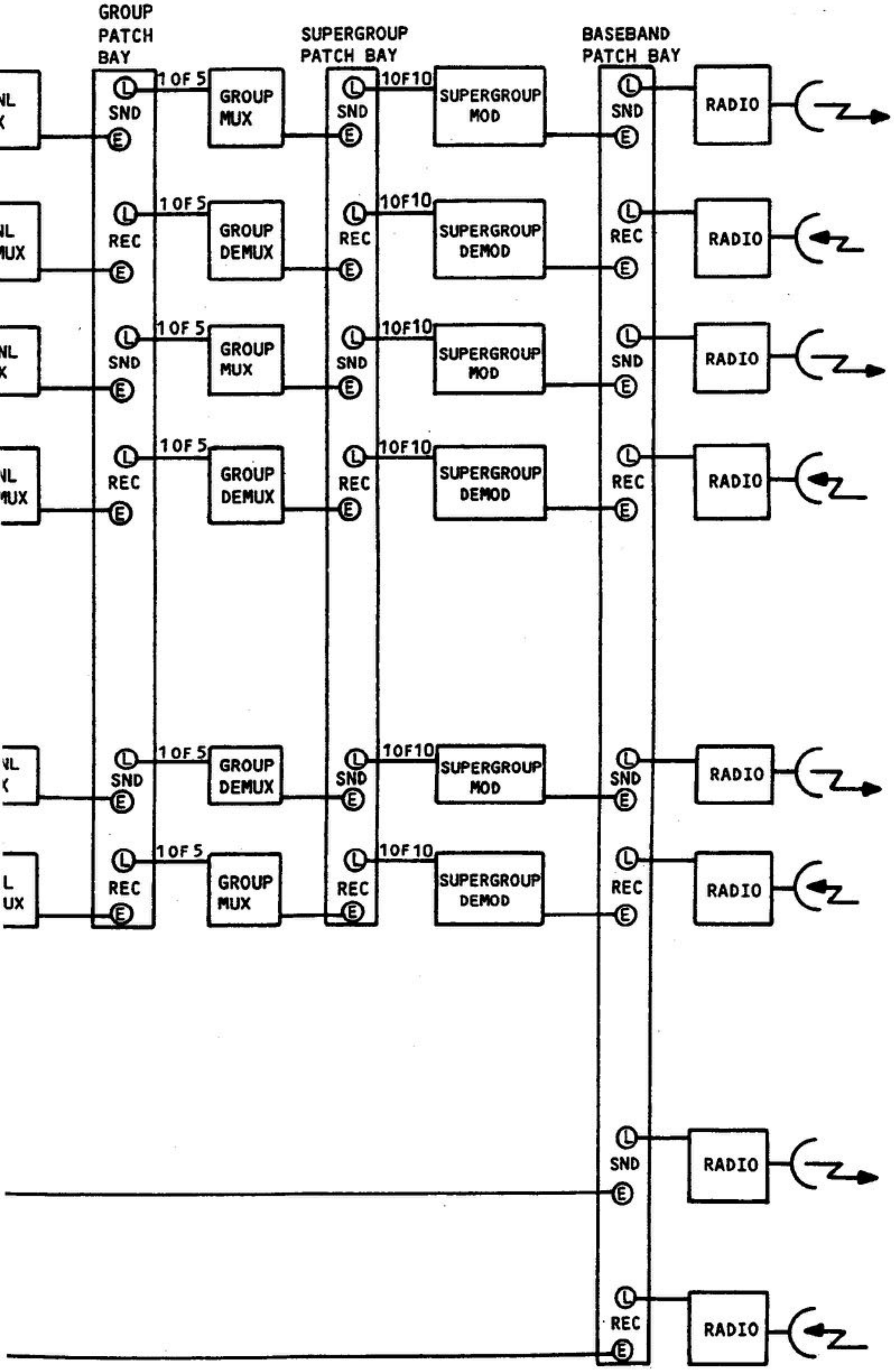
124. (465) The DOCC element does not require user release on circuits with an RP 3C and lower if the duration of scheduled service interruption is less than

a. 21 days.
b. 14 days.
c. 4 days.
d. 1 day.

1992-631-256/61634 DPSGAFB,AL(92100946)1900

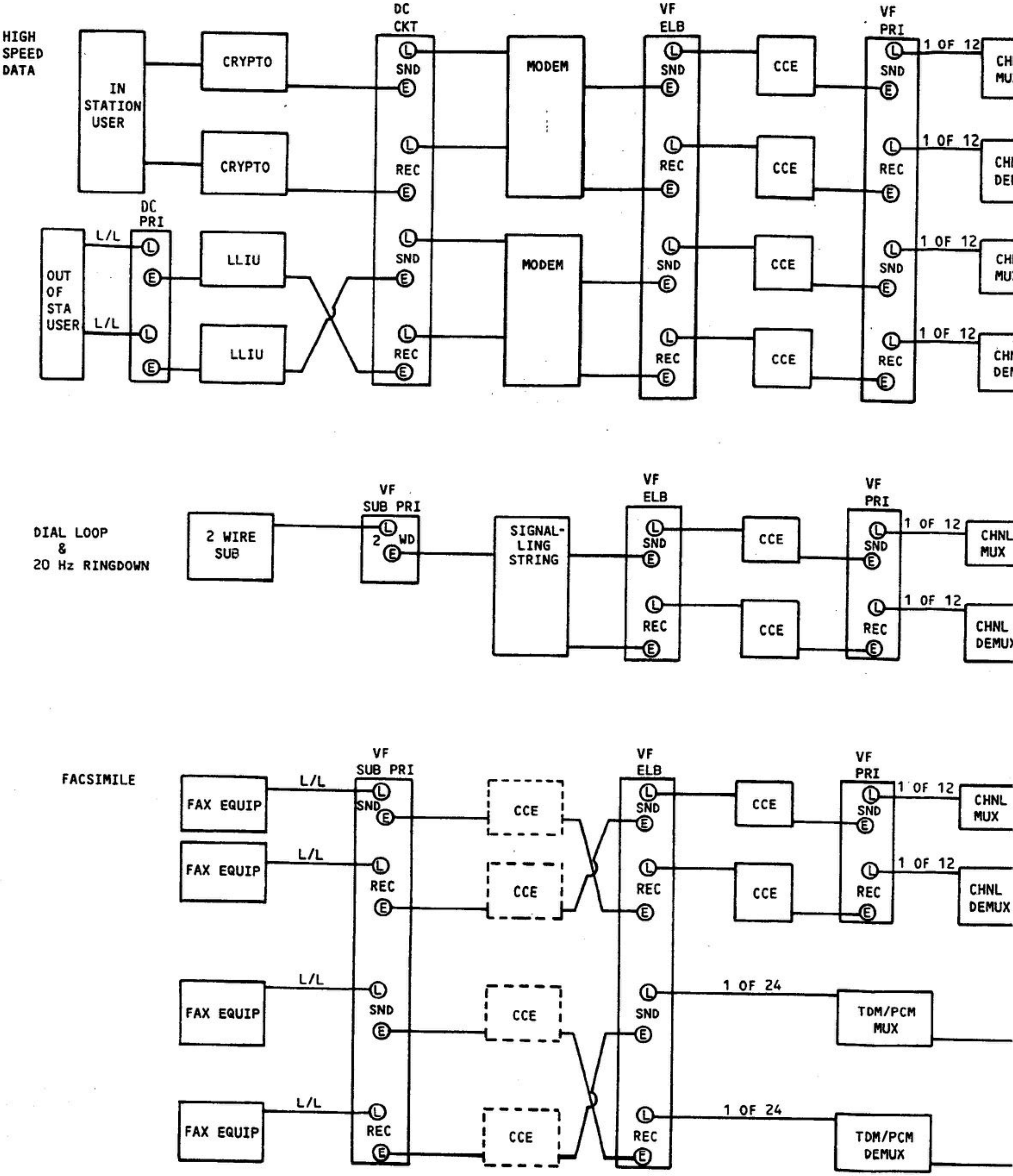


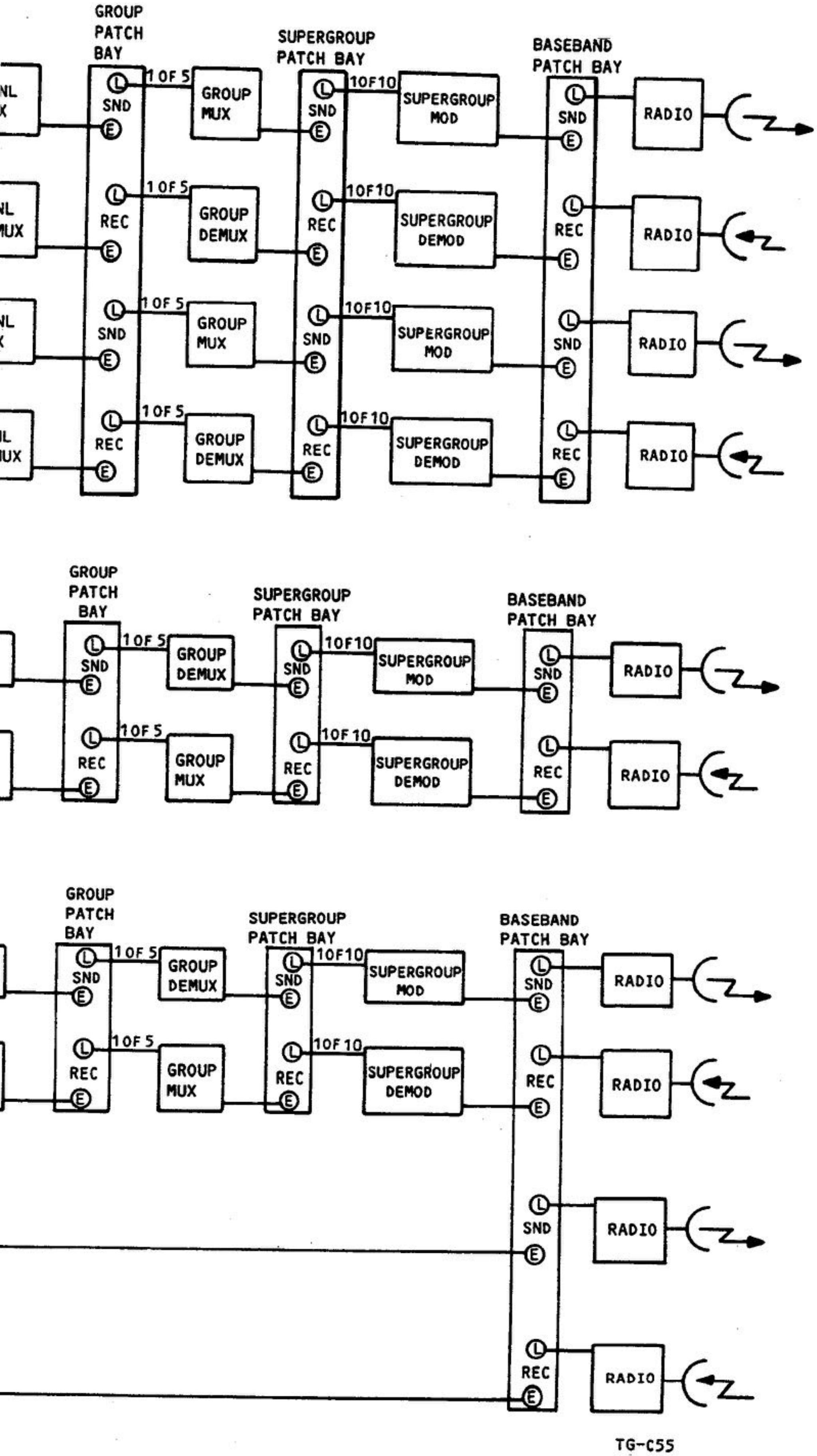
TTY CIRCUITS
IN STATION USER
CRYPTO
CRYPTO
DC CKT
1 OF 16
SND
REC
VFCT
VF ELB
CCE
VF PRI
1 OF 12
OUT OF STA USER
L/L
DC PRI
LLIU
TYPICAL AUTOVON CIRCUIT
4 WIRE SUB
VF SUB PRI
4 WD
VOICE
E & M
CTL
SIGNAL-LING STRING
HIGH SPEED DATA
HIGH SPEED MODEM
4 WS
4 WR
1 OF 24
TDM/PCM MUX
TDM/PCM DEMUX



TG-C54

Foldout 1. TTY, AUTOVON, and high speed data signal train.


HIGH
SPEED
DATA
IN
STATION
USER
CRYPTO
CRYPTO
DC
CKT
SND
REC
SND
REC
MODEM
MODEM
VF
ELB
SND
REC
SND
REC
CCE
CCE
CCE
CCE
VF
PRI
SND
REC
SND
REC
1 OF 12
1 OF 12
1 OF 12
1 OF 12
DC
PRI
L/L
L/L
OUT
OF
STA
USER
LLIU
LLIU
DIAL LOOP
&
20 Hz RINGDOWN
2 WIRE
SUB
VF
SUB PRI
2 WD
SIGNAL-
LING
STRING
VF
ELB
SND
REC
CCE
CCE
VF
PRI
SND
REC
1 OF 12
1 OF 12
CHNL
MUX
CHNL
FACSIMILE
FAX EQUIP
FAX EQUIP
FAX EQUIP
FAX EQUIP
L/L
L/L
L/L
L/L
VF
SUB PRI
SND
REC
SND
REC
CCE
CCE
CCE
CCE
VF
ELB
SND
REC
SND
REC
CCE
CCE
VF
PRI
SND
REC
1 OF 12
1 OF 12
CHNL
MUX
CHNL
DEMUX
1 OF 24
1 OF 24
TDM/PCM
MUX
TDM/PCM
DEMUX



High speed data circuits, dial loop and 20-Hz ringdown circuits, and facsimile circuits.

STUDENT WORK SPACE