CHAPTER 7

NEW TECHNOLOGY IN DATA COMMUNICATIONS

INTRODUCTION

The current Link-11 and Link-4A systems are being updated with new equipments. The Data Terminal Set AN/USQ-125 is currently replacing the older Link-11 data terminals. In addition, new communications systems, such as the **Command and Control Processor (C2P)** and the **Joint Tactical Information Distribution System (JTIDS),** are quickly becoming commonplace on various platforms in the Navy. This chapter will introduce you to some of the changes taking place and the basic features of some of the new systems.

After completing this chapter, you should be able to:

- **Describe the various components of the AN/USQ-125 Data Terminal Set.**
- **Describe the operation of the AN/USQ-125 in a typical Link-11 system.**
- **State the purpose of the Joint Tactical Information Data System (Link-16).**
- **Describe the components of the Link-16 system.**
- **State the function of the Command and Control Processor (C2P) system.**
- **Describe the components of the C2P system.**

THE AN/USQ-125 DATA TERMINAL SET

The AN/USQ-125 data terminal set is the newest Link-11 data terminal set in the Navy. It is quickly replacing older DTSs, such as the AN/USQ-36 and the AN/USQ-59. There are several configurations of the AN/USQ- 125. The CP-2205(P)(V)/USQ-125 data terminal with the MX-512P/RC Remote Control Unit configuration. The other configuration is CP-2205(P)(V)2/USQ-125 data terminal with a personal computer (386 or better) running the MXPCR software. The personal computer serves the same function as the remote control indicator in this configuration. The standard interface configuration of the AN/USQ-125 is shown in figure 7-1. In this chapter, we examine the data terminal and the functions of the control indicators, either the MX-512P/RC or a personal computer.

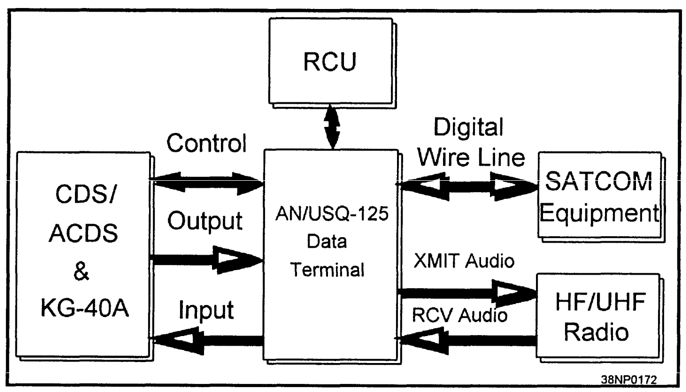

Figure 7-1.—The AN/USQ-125 data terminal set standard interface block diagram.

THE CP-2205(P)(V)/USQ-125 DATA TERMINAL

The CP-2205(P)(V)/USQ-125 data terminal is a compact, state-of-the-art data terminal that is mounted in a standard 19-inch equipment rack. The data

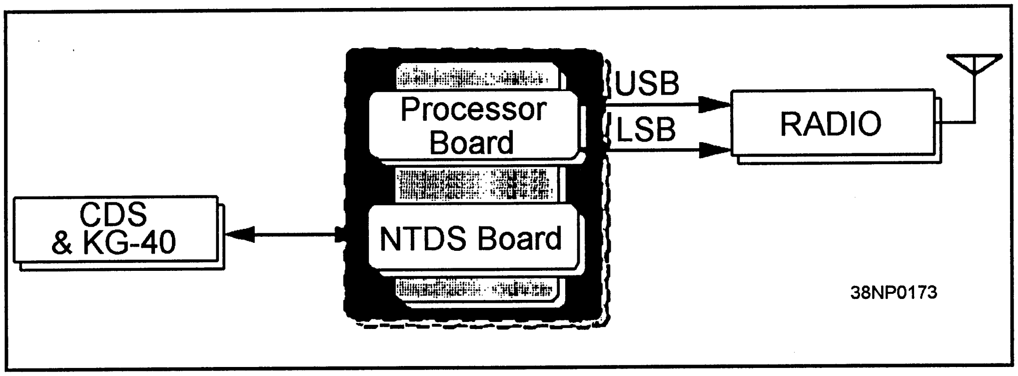

Figure 7-2.—The CP-2205(P)(V)/USQ-125 data terminal block diagram.

terminal has the following three major components: a processor board, a CDS interface board, and the power supply. Figure 7-2 is a block diagram of the CP-2205(P)(V)/USQ-125 data terminal. The processor board performs modulation/demodulation and error detection and correction, and provides the interface with the radio set. The CDS interface board provides the interface with the CDS computer. The CP-2205(P)(V)/USQ-125 data terminal performs many of the same functions as previous Link-11 data terminal sets. These functions include the following:

- Data conversion
- Data error detection and correction
- Control code generation and detection
- Synchronization
- Encryption device data transfer
- Computer and radio control signals for two-way Link-11 data transfers

In addition, the CP-2205(P)(V)/USQ-125 data terminal provides the following new features:

- Both multi-tone and single-tone waveform operations
- Enhanced Link Quality Analysis (ELQA)
- Maximum useable frequency (MUF) option
- Multi-Frequency Link
- On-line and Off-line System Test Options

Multi-Tone Waveform Link

Multi-tone link operations are basically the same as in the previous Link-11 data terminal sets and are called conventional Link-11 waveforms. The data terminal generates the 605-Hz Doppler tone and 15 data tones. The frequencies of the data tones are the same as described in chapter 4. Message formats and modes are also the same.

Single-Tone Waveform Link

Single-tone waveform link updates the 1960's technology used in data communications. The single-ton waveform is a 1,800-Hz phase-modulated waveform containing the Link-11 data in a serial bit stream. The single-tone waveform is most commonly used with the wire-line option of the USQ-125 data terminal. The CP-2205(P)(V)/USQ-125 data terminal wire-line option provides an interface port that can be used with a standard wire-line or a satellite modem. Using this option expands the means in which Link-11 data can be exchanged, overcoming the limitations of the traditional UHF and HF radio links.

Enhanced Link Quality Analysis (ELQA)

The Enhanced Link Quality Analysis option of the data terminal incorporates almost all of the functions of the LMS-11. This allows the operator to monitor and evaluate the performance of the link net. Information that can be displayed includes the following: sideband power, error rate, and percentage of interrogations answered.

Maximum Useable Frequency (MUF) Option

The maximum useable frequency option is a routine that calculates the optimum frequency for Link-11 operations. This routine calculates a frequency for each hour of the day based on geographic location, the range of other participants in the net, and sunspot activity.

Multi-Frequency Link

The multi-frequency link option improves current link operations. by simultaneously using four frequencies. The normal configuration for multi-frequency link operations uses three HF and one UHF frequency. To implement this option, three additional processor boards are installed in the data terminal. Each data terminal board is connected to a separate radio, as shown in figure 7-3.

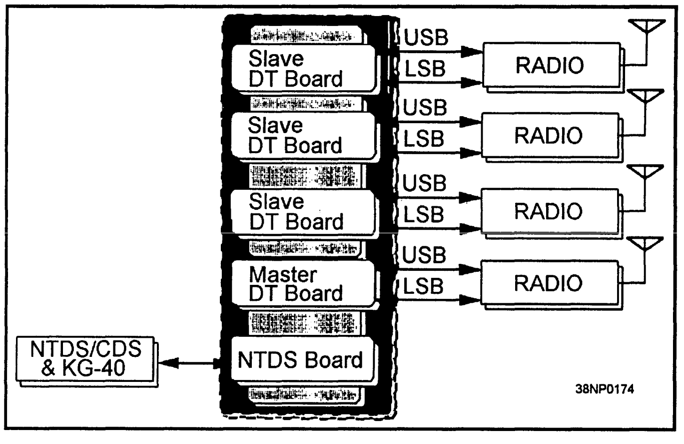

Figure 7-3.—Block diagram of the AN/USQ-125 data terminal configured for multi-frequency link operations.

During the Link-11 receive cycle, each data terminal board demodulates the link signal and sends the data to the master processor board. The master processor compares the received data and selects the signals with the fewest errors to send to the CDS computer. Although this mode is normally used with three HF frequencies and one UHF frequency, there is no set limitation of the radio configuration.

On-line and Off-1ine System Test Options

The data terminal provides several options for both on-line and off-line testing. These include the following: radio echo test, loopback tests 1, 2, 3, and 4, and DTS fault isolation tests. The radio echo test, loopback test 1, and loopback test 4 are on-line tests, while loopback test 2, loopback test 3, and the DTS fault isolation tests are off-line tests.

RADIO ECHO TEST. —When this option is selected, the data terminal is placed in full-duplex mode. This option is selected when a single station POFA is run with the radio and checks the operation of the computer interface, the crypto device, the data terminal, and the radio.

LOOPBACK TEST 1. —Loopback test 1 is selected when running a single station POFA without the radio. When you select this test option, the audio lines are internally disconnected from the radio and the audio outputs are connected to the audio inputs. Full-duplex operation is also enabled. This test checks the operation of the computer interface, the crypto device, and the data terminal.

LOOPBACK TEST 2. —Loopback test 2 configures the data terminal for an off-line self-test. The audio lines are disconnected from the radio and the audio output lines are internally jumpered to the audio input lines. A test message is internally generated and sent through the audio circuits. The receiver output is monitored for data errors, parity errors, control code errors, and preamble recognition. Any errors detected will cause the LOOPBACK FAIL indicator to be displayed.

LOOPBACK TEST 3. —Loopback test 3 is a data terminal to radio test. Normal audio connections are maintained, while the computer interface is disabled. A test message is internally generated and repeatedly sent through the radio. As with loopback test 2, the receiver output is monitored for data errors, parity errors. control code errors, and preamble recognition. Any errors detected will cause the LOOPBACK FAIL indicator to be displayed.

LOOPBACK TEST 4. —Loopback test 4 is used to check the operation of the computer interface, the crypto device, and the data terminal interface circuitry. When this test is selected, the audio circuits are disabled and the data from the computer is sent to the memory in the data terminal. Upon receipt of the end of transmit signal, the data in memory is sent back to the computer for evaluation.

DTS FAULT ISOLATION TESTS. —The DTS fault isolation tests are built-in tests (BIT) designed to test and isolate a fault to a particular circuit board.

REMOTE CONTROL UNIT

The C-12428/USQ-125 remote control unit (CU) enables the operator to control the data terminal from a remote location. The control unit, used with the data terminal, forms the data terminal set (DTS). The control unit is used by the operator to enter operating parameters, start and stop link operations, and change link modes. One model, shown in figure 7-4, consists of a 486DX2/66 MHz AT compatible personal computer in a rugged chassis for shipboard operation. The keyboard/trackball unit is in a special detachable enclosure that also serves as a front cover for the CU. A 386 or better personal computer maybe substituted for the control unit when loaded with the proper software and connected to the data terminal.

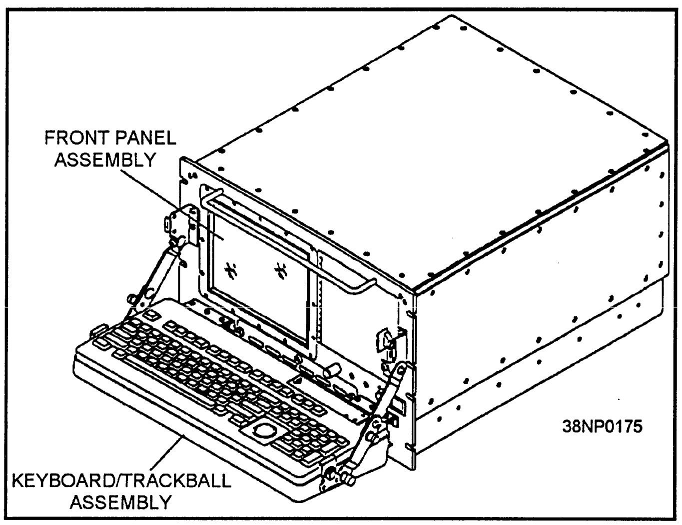

Figure 7-4.—The C-12428/USQ-125 Control Unit.

THE JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (LINK-16)

The Joint Tactical Information Distribution System (Link-16) is a new tactical data link that was introduced to the fleet in 1994. Link-16 has been referred to by several names and acronyms. The Tactical Digital Information Link (TADIL) is a term used by the U. S. Joint Services. The TADIL designation for Link-16 is TADIL J. The Joint Tactical Information Distribution System (JTIDS) refers to the communications component of Link-16. The communications component includes the terminal software, hardware, RF equipments, and the waveforms they generate. The NATO terms for JTIDS is the Multifunctional Information Distribution System (MIDS). For our purposes, we will use the term Link-16 when referring to this system.

FEATURES OF LINK-16

Link-16 allows for the exchange of real-time tactical information between units of the Navy, the Joint Services, and the members of NATO. Although some of the functions are identical to the functions of Link-11 and Link-4A, Link-16 also provides data exchange elements that the other link systems lack. These include the following:

- Nodelessness
- Jam resistance
- Flexibility of communication operations
- Separate transmission and data security features
- Increased numbers of participants
- Increased data capacity
- Network navigation features
- Secure voice capabilities

Transmission Protocols

Since Link-16 exchanges much of the same data that is used in both Link-11 and Link-4A, a brief comparison of the architectures, the capacities, and the data rates of the three systems is useful.

During normal operation, Link-11 operates using the protocols of the Roll Call mode. In this mode, each participating unit is polled by the NCS to transmit data. On completion of data transmission, the unit returns to the receive mode and the next unit is polled until all units have been polled. This cycle is continuously repeated. Link-11 messages are called **M series** messages.

Link-4A uses the time-division multiplexing principle with a command-and-response protocol to enable the operator to control multiple aircraft independently on the same frequency. Link-4A messages sent to the controlled aircraft are referred to as **V series** messages and messages received from the controlled aircraft are called **R series** messages.

Link- 16 uses the **Time-Division Multiple Access (TDMA)** principle of data communications. Using this architecture with time interlacing provides the system with multiple and apparently simultaneous communications nets. Instead of assigning each unit a PU number, Link-16 assigns each unit a **JTIDS Unit** number, or **JU.** The JU identifies the units and determines a preassigned set of time slots that designate when the unit transmits and receives data. Each time slot is 1/128 of a second, or 7.8125 milliseconds, in duration.

When a JU transmits data, the frequency that the data is transmitted on is changed every 13 microseconds (µsec), according to a predetermined pseudo-random pattern. Link-16 uses 51 different frequencies for data exchange. This **frequency hopping** adds to the security and integrity of the system by making it nearly impossible to jam.

Link-16 Nets

Link-16 has the capability to handle multiple nets. A Link-16 net is a group of participants sharing mutually beneficial tactical information. For example, using the Link-11 system, a net is formed by a group of participants. These participants operate on the same frequency. A separate net is formed when another group of participants operates on a different frequency. The second net would be used by participants involved in a fleet exercise that wouldn't want the exercise data to interfere with the normal tactical net. The controlling station and aircraft using Link-4A is also a net.

Link-16 has the ability to form multiple nets. The Link-16 system has 128 numbers used to designate particular nets (00-127). Net number 127 is reserved to indicate a stacked net. A **stacked net** is formed by setting up the time slots so that they have the same set, initial slot number, and recurrence rate. When the system is initialized, the use of net number 127 indicates a stacked net is to be used and the operator can then specify locally which net to use for operations. Figure 7-5 illustrates the concept of a stacked net used for air control. Net 1 is a group of aircraft controlled by the ship, while Net 3 is a group of aircraft controlled by an E-2. If the E-2 requires additional aircraft, the ship can direct the aircraft under its control to the E-2. As the aircraft approaches the E-2, the pilot can switch to Net 3 and immediately become an active participant in the new net. Even though the operator has several nets available to monitor or use, a single terminal can transmit or receive on only one of them for each time slot. Stacked nets are possible because the frequency-hopping pattern is different for each net. Examples of stacked nets are voice nets and control nets.

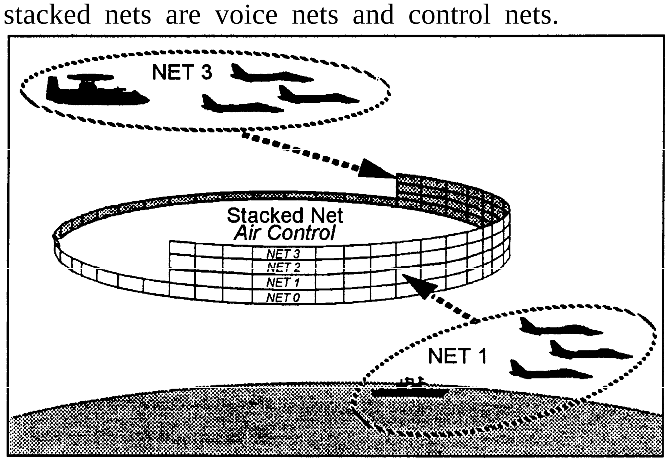

Figure 7-5.—Stacked nets using Link-16.

Link-16 Data Exchange

Link-16 transmits data serially using 70 bit data words. During the transmit time slot, either three, six, or 12 data words can be transmitted. The number of words transmitted depends on whether the standard, packed-2, or packed-4 data packing structure is used. The number of words that composes a Link-16 message is variable but is normally 1, 2, or 3 words. There are three types of messages: fixed format, free text, and variable format. The fixed format messages are called J-series messages and are used to exchange tactical information. Free text messages are used for voice communications, while the variable format messages are user defined in length and content. Variable format messages are not used by the Navy.

JTIDS Architecture

There are several features of the JTIDS architecture that have resulted in improved communications of the Link-16 system. These features include the following:

- Nodelessness
- Security
- Network participation groups

NODELESSNESS. —A **node** is a unit required to maintain communications of a data link. In Link-11, the NCS is a node. If the NCS goes down, the entire net is inoperative. Link-16 does not need a dedicated station. When the Link-16 net is established, a single JU transmits a **Network Time Reference (NTR).** The time established by this unit is the network system time. All other units in the net use the NTR message to synchronize with the network. Once the NTR and the network have been established, the network can continue to operate regardless of the participation of any particular unit.

SECURITY. —The security of the Link-16 system is vastly improved over that of the Link-11 system. In Link-16, both the data and the transmissions are encrypted. Data is encrypted by a cryptovariable for message security. The security of the data transmission is provided by the use of a second cryptovariable that controls the transmitted waveform. Frequency hopping to prevent jamming is one of the features of the security system. The transmission security also provides for the introduction of jitter and a pseudo-random noise to be added to the waveform. The addition of jitter and noise, along with the frequency hopping, makes the transmitted signal extremely difficult to detect and jam.

NETWORK PARTICIPATION GROUPS. —The time slots of a Link-16 network can be broken down into separate **Network Participation Groups (NPGs).** An NPG is defined by its function and determines the types of messages that are transmitted on it. Some of the NPGs used by the Navy are as follows:

- Surveillance
- Electronic Warfare
- Mission Management
- Weapons Coordination
- Air Control
- Fighter-to-Fighter
- Secure Voice
- Precise Participant Location and Identification (PPLI) and Status

By dividing the net into NPGs, each JU can participate on only the groups that support the mission of the unit. Most Navy Command and Control (C^2) units, both ships and aircraft, operate on all the defined NPGs except the Fighter-to-Fighter NPG.

Link-16 New Capabilities

The increased size of the Link-16 enables the reporting of up to three times as much tactical information as was available under the Link-11 system. Areas that have been improved under the Link-16 system include the following:

- Number of Participants
- Track Numbers
- Track Quality
- Track Identification
- Friendly Status
- Granularity of Measurement
- Relative Navigation
- Electronic Warfare
- Land Points and Tracks

NUMBER OF PARTICIPANTS. —The number of units that can participate in a Link-16 net has been increased dramatically over that of Link-11. The JTIDS Unit number, or JU, is a five-digit octal number from 00001 to 77777. This allows for a maximum of 32,766 possible JUs. Addresses 00001 to 00177 are normally assigned to units that have the need and capability to participate in both Link-16 and Link-11. When a unit participates in both Link-11 and Link-16, it must use the same address on both links. For example, Link-16 JU 00043 is the same as Link-11 PU 043.

TRACK NUMBERS. —Link-l6 replaces the old four-digit (octal) Link-11 track numbers with a five-character alphanumeric track number. The track number can be within the range 00001 to 77777 (octal) or 0A000 through ZZ777. This allows for a maximum of 524,284 track numbers, compared with the 4,092 available with Link-11. One reason for the need for the additional track number is that Link-16 cannot operate in the track number pool mode, in which a common pool of track numbers is shared by several PUs. Every JU must be assigned a unique block of track numbers.

To maintain interoperability with Link-11, Link-16 track numbers 00200 through 07777 designate the same track as Link-11 track numbers 0200 through 7777.

TRACK QUALITY. —The Track Quality (TQ) value used by Link-16 relates to the accuracy of the reported position of the track. The TQ has a range of 0 to 15. To achieve the highest track quality, the track must be within 50 feet of the reported position. Link-11 uses the update rate to determine track quality. Using Link-11, a track that is reported by a PU at every interrogation is usually assigned a TQ of 7. Therefore, a Link-11 air track with a TQ of 7 can be more than 3 nautical miles from its reported position.

TRACK IDENTIFICATION. —The Link-16 system greatly expands the information that is reported with Track Identification (ID). The new ID reports include fields for platform, activity, specific type, and nationality of the track. Additional provisions have also been added to identify a track as “Neutral,” and the Unknown Assumed Enemy ID is changed to “Suspect.”

FRIENDLY STATUS. —The Link-16 system also provides for more detailed status reports from friendly aircraft. The following fields are added to Link-16 friendly status reports: equipment status, ordnance inventory, radar and missile channels, fuel available for transfer, gun capability, and station ETA and ETD.

INCREASED GRANULARITY. —Granularity refers to how precisely an item is reported in the link message. Link-16 has made major improvements in the granularity of reports concerning track position, air track speed, altitude, and lines of bearing.

LINES AND AREAS. —The Link-16 system allows the reporting of multi-segment lines and areas of all sizes and descriptions. Link-11, for comparison, only allows reports of areas that are limited in size and are circles, ellipses, squares, or rectangles. Link-11 does not have the capability to report lines.

GEODETIC POSITIONING. —The Link-16 messages use the geodetic coordinate system to report positions. This system uses latitude, longitude, and altitude to report positions anywhere in the world. Link-11 uses the Cartesian coordinate system, which requires the reporting unit to be within a certain range when reporting positions.

RELATIVE NAVIGATION. —The Relative Navigation (RELNAV) function of the Link-16 system is automatically started by every Link-16 participant and is constantly operating. The RELNAV function determines the distance between reporting units by measuring the arrival times of transmissions and correlating them with the reported position of the unit. This information is required by each terminal in the network to maintain synchronization. The RELNAV data can also improve a unit's positional accuracy. Also, if two or more units have accurate geodetic positions, RELNAV can provide all other units with accurate geodetic positions.

ELECTRONIC WARFARE. —The Link-16 system increases the types and amount of electronic warfare information that is exchanged between units.

LAND POINTS AND TRACKS. —The Link-16 system adds Land as a track category, and allows the reporting of land objects, such as buildings or vehicles.

EQUIPMENT CONFIGURATION

Currently, Link-16 will be installed onboard aircraft carriers, cruises, destroyers, and amphibious assault ships. Two phases of shipboard installation, designated Model-4 and Model-5, are planned.

Model-4 is being installed on ACDS and AEGIS platforms in conjunction with the installation of the Command and Control Processor (C2P). Model-4 does not implement any of the expanded data exchange capabilities of Link-16. Instead, it supports existing Link-11 and Link-4A with its jam-resistant, increased capacity waveform. Platforms with the Model-4 Link-16 system will retain their original Link-11 and Link-4A systems, and can use these systems by placing the C2P in bypass. Model-4 is being installed on very few ships, most of which will be upgraded to Model-5; therefore, our discussion of Link-16 equipment will concern the Model-5 system.

Link-16 Model-5

The major components of the Link-16 system are the Tactical Data System (TDS), the C2P, and the JTIDS terminal, as shown in figure 7-6. The TDS and C2P provide the JTIDS terminal with tactical data to be transmitted. The Link-16 Model-5 fully implements all the capabilities of Link-16. For this implementation to take place, major software changes must be made to the TDS and C2P programs. Also, the OJ-663 console replaces the current display

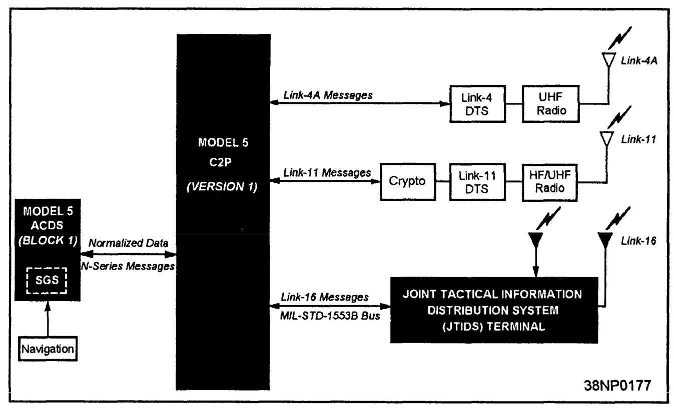

Figure 7-6.—The Link-16 Model-5 ACDS system block diagram.

Data flow to the Link-16 JTIDS terminal is from the ACDS computer, through the C2P computer, to the Link-16 computer. Link data generated by the ACDS computer is now *normalized* to be independent of any one particular link system. The C2P computer reformats the normalized data into the format necessary for transmission over Link-16. The C2P computer can also format the normalized data for transmission over Link-11 and Link-4A. If necessary, all three link systems can be in operation at the same time.

The JTIDS Terminal

The JTIDS terminal used in Link-16 is the AN/URC-107(V)7. This is an advanced radio system that provides secure, jam-resistant, digital data and voice communication among a large number of users. This radio system combines the functions performed by the Link-11 crypto device, data terminal set, and radio into one cabinet. Many other capabilities are also incorporated in the radio. These added capabilities include the following:

- Precise participant location and identification
- Relative navigation
- Synchronization
- Secure voice
- Relay
- Built-in test

Shipboard Terminal

The AN/URC-107(V)7 JDIDS terminal is a single five drawer electronics cabinet, as shown in figure

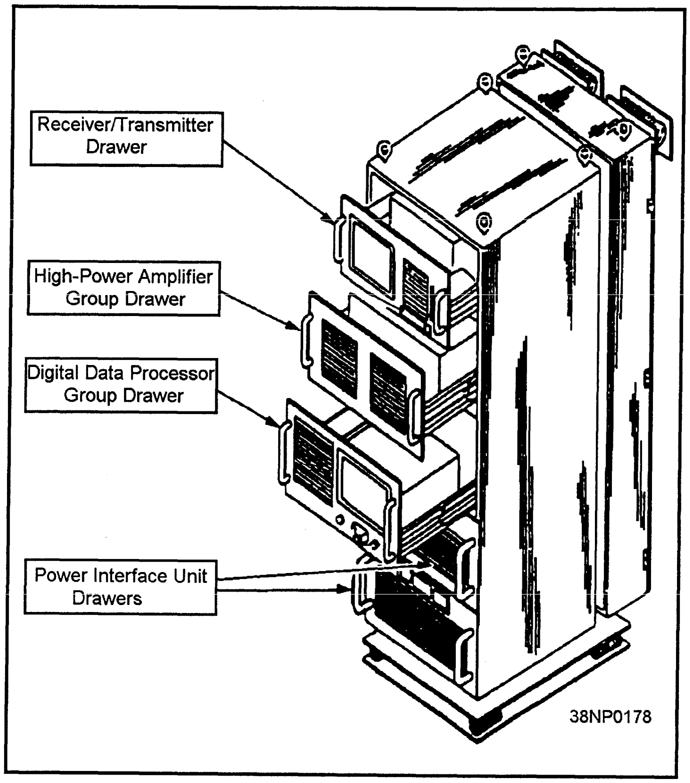

Figure 7-7.—The AN/URC-107(V)7 JTIDS data terminal.

7-7. The components of the JTIDS terminal include the **Digital Data Processor Group** (DDPG), the **Receiver/Transmitter Group** (R/T), the **High-Power Amplifier Group** (HPAG), and the **Power Interface Unit** (PIU). The **Secure Data Unit** (SDU)

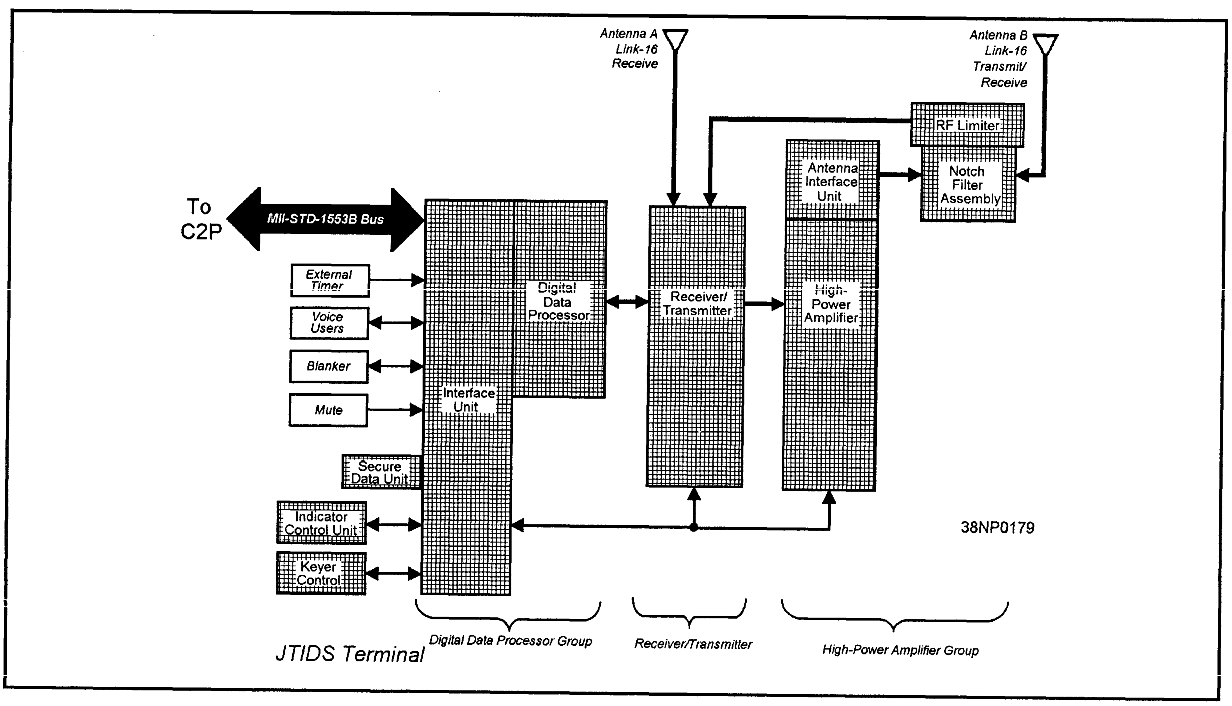

Figure 7-8.—The JTIDS terminal functional block diagram.

is a separate assembly that is mounted to the Digital Data Processing Group. Figure 7-8 is the functional block diagram of the JTIDS terminal.

DIGITAL DATA PROCESSOR GROUP. —The third drawer of the terminal houses the digital data processor group. The two major components are the **interface unit** (IU) and the **digital data processor** (DDP). A battery assembly is mounted to the front of the DDPG drawer. This assembly consists of one nickel cadmium (NiCad) battery and two lithium sulphur dioxide cells. The NiCad battery will provide power to critical components during short power failures. The lithium sulphur dioxide cells supply power to the chronometer.

The Interface Unit controls the communications between the JTIDS terminal and the host computer and provides amount for the Secure Data Unit (SDU). On shipboard systems, the C2P is the host computer. The **Subscriber Interface Computer Program** (SICP) is a software program that controls the communications with the host computer and provides the data processing necessary to integrate the terminal and the host computer. The IU and SICP also provide the following functions: analog-to-digital and digital-to-analog conversion of voice signals, feed through interface between the DDP and the SDU, and primary and backup power interface. The IU also provides the interface for receiving and supplying the TACAN blanking pulses. These blanking pulses prevent the TACAN and the JTIDS terminal from transmitting at the same time.

The Digital Data Processor (DDP) controls the receiver/transmitter and the high-power amplifier groups. The DDP performs the processing required for transmitting and receiving Link-16 messages. This processing includes the following:

- Data encryption and decryption
- Error detection and correction encoding and decoding
- Generation of the frequency-hopping pattern
- Selection of the carrier frequency
- Measurement of time of arrival data for position and synchronization calculations

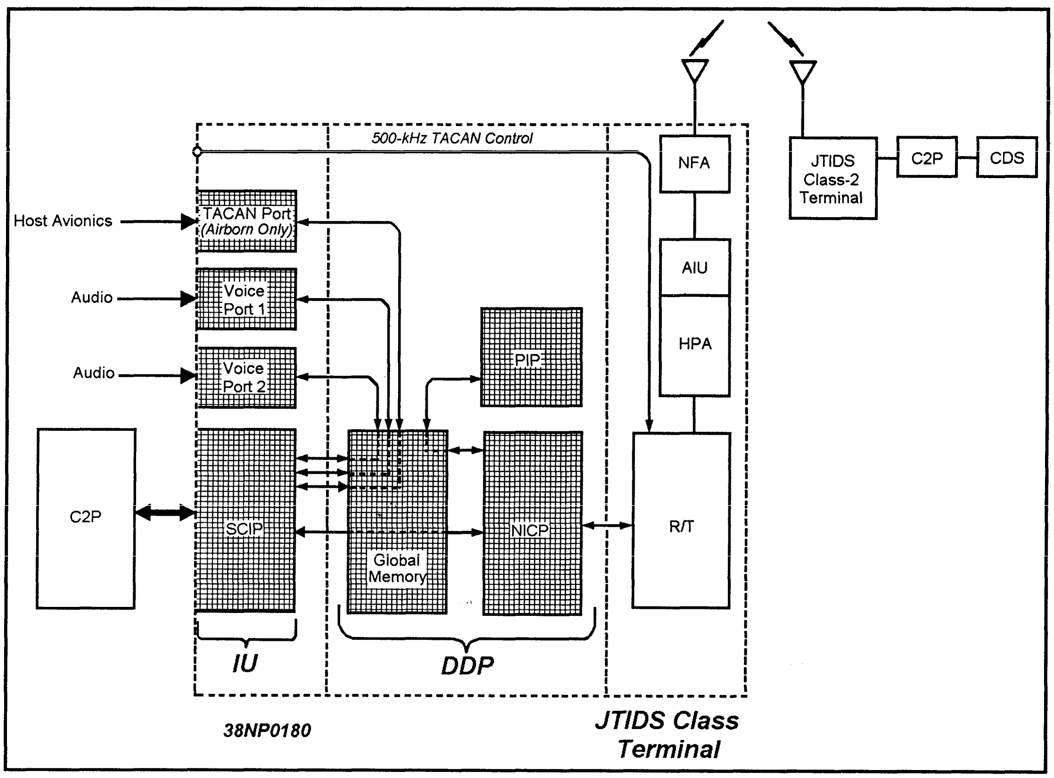

Figure 7-9.—The Digital Data Processing Group functional block diagram.

- Execution of the Built-in Tests (BIT) for fault isolation

- Generation of alerts

The **Network Interface Computer Program** (NICP) is the software that runs in the DDP and is responsible for the communications with the JTIDS RF network. The NICP controls message transmission and reception processing, coarse and fine terminal synchronization, relative navigation processing, and terminal and network monitoring.

Figure 7-9 is the block diagram for the DDPG. The global memory in the DDP is shared by all the processors in the terminal. Communications between the processors is over an internal bus called the plain text bus. All transactions on the plain text bus are either read or write commands to the global memory or port-to-port transfers. When the SICP, running in the IU, needs to communicate with the NICP, it does so by using the shared global memory in the DDP. A port-to-port transfer is a transfer of data between ports, such as when communicating with the host external timer (see fig. 7-9).

SECURE DATA UNIT. —The SDU is a removable assembly that is mounted to the IU. It stores the cryptovariables that are loaded during initialization. The SDU provides for both message security and transmission security. Message security is provided by the encryption of the data, while transmission security is provided by the pseudo-random frequency-hopping pattern and the introduction of a pseudo-random pattern of noise and jitter on the RF signal.

RECEIVER/TRANSMITTER GROUP. —The R/T is in the top drawer of the equipment cabinet and processes the radio frequency signals. The R/T also generates a 75-MHz intermediate frequency signal used for internal communication between the R/T and DDPG. When a Link-16 message is received, the R/T converts the RF to the intermediate frequency and sends it to the DDPG for processing. When the terminal transmits a Link-16 message, the R/T receives a Continuous Phase-Shift Modulation (CPS) IF signal from the DDPG. The R/T then converts it to a 200-watt RF signal that is sent to the high-power amplifier group.

HIGH-POWER AMPLIFIER GROUP. —The HPAG is in the second drawer of the equipment cabinet and consists of a high-power amplifier and the antenna interface unit (AIU). The signal from the R/T group is received by the HPAG and amplified from 200 to 1,000 watts. The HPAG can also operate in a low-power mode, in which case the output signal is about 200 watts. The AIU provides the interface between the output of the HPAG and the antenna.

POWER INTERFACE UNIT. —There are two Power Interface Units (PIUs) in the equipment cabinet. The fourth drawer is the HPAG PIU and the bottom drawer is the PIU for the R/T and DDG. The two PIUs are identical. The three-phase, 115-VAC, 60-Hz input power is converted to two outputs: three-phase, 115-VAC, 400-Hz, and one-phase, 115-VAC at 400 Hz.

THE COMMAND AND CONTROL PROCESSOR

The Command and Control Processor (C2P) is a message distribution system designed to control and manage the interfaces between the three tactical data links (Link-4A, Link-11, and Link-16), the operator, and the hardware.

PURPOSE OF THE C2P

The C2P controls and manages the interfaces between the various data links on major surface and aircraft Command and Control (C2) platforms. The surface platforms that will have the initial installations of the C2P system are aircraft carriers (CV, CVN) and AEGIS cruisers (CG), followed by installation on amphibious assault ships (LHA, LHD), and AEGIS destroyers (DDG). There are two configurations of the C2P, one tailored for ships with the Advanced Combat Direction System (ACDS) Block 0 configuration and one for ACDS Block 1 configurations. On AEGIS ships, AEGIS Model 4 is similar to ACDS Block 0, and AEGIS Model 5 is similar to ACDS Block 1. The C2P system installed

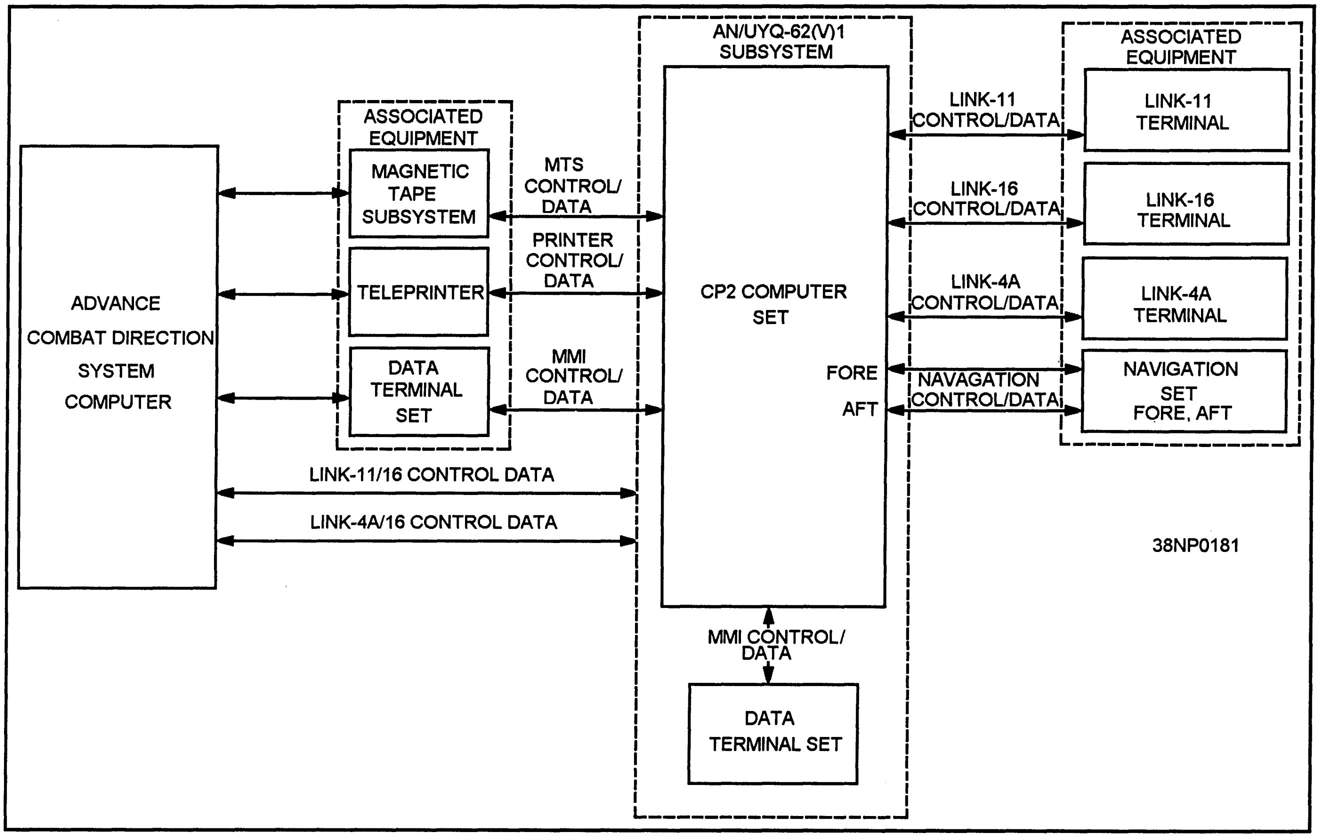

Figure 7-10.—The C2P system block diagram for ACDS Block 0 platforms.

on an ACDS Block 0 platform is very similar to the system that is installed on an AEGIS Model 4 platform. Figure 7-10 illustrates the system block diagram of the C2P for ACDS Block 0 platforms.

Link messages generated in the ACDS computer are sent to the C2P computer where they are formatted for transmission on the proper link (Link-4A, Link-11, or Link-16). Depending on the mode of operation and operator entered parameters, some messages may be sent over two or more data links. For example, it is not uncommon for Link-11 messages to be transmitted over Link-11 and Link-16. The C2P computer stores the data in a central database, called the normalized data base, and then formats the data in the proper message format for the link system(s) being used.

Messages received by the various data links are processed for errors by the C2P computer and sent to the proper destination. Received messages can also be reformatted for retransmission on a different link. A Link-11 or Link-4A message received by a C2P platform can be reformatted into a Link-16 message and retransmitted on Link-16.

SYSTEM CONFIGURATION

The hardware block diagram of the equipment used in the C2P system is shown in figure 7-11. The AN/UYK-43(V) is a general-purpose, large scale, tactical computer used to store and execute the C2P software. The C2P configuration of the AN/UYK-43 consists of the following major modules:

- Two central processor units
- Two input/output controllers and adapters
- Six expanded time volatile memory units
- One embedded memory subsystem (EMS) with two embedded mass memory storage devices (EMMSD)

A major change in the configuration of the AN/UYK-43A(V) is the EMS and its associated EMMSDs. The EMS consists of two 383 megabyte

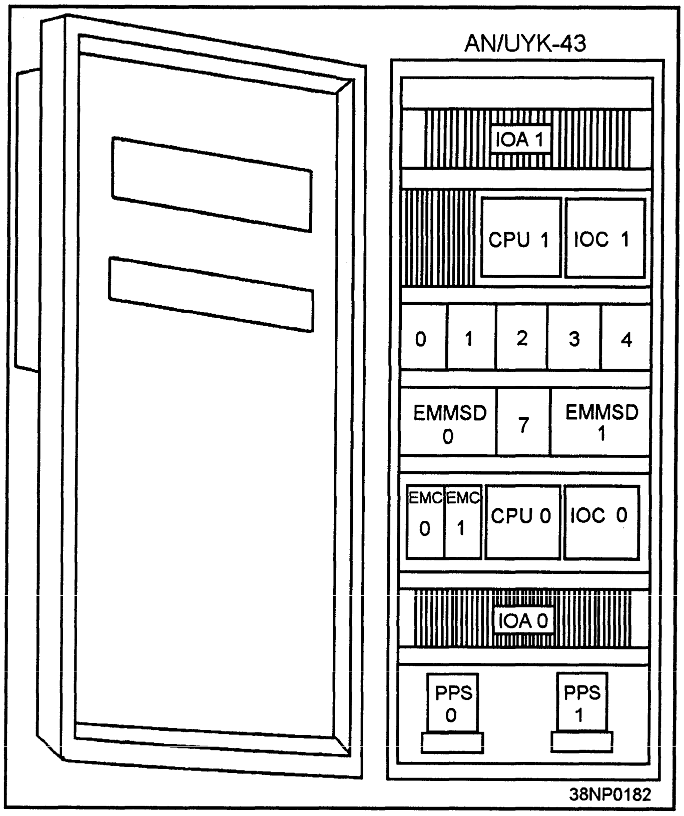

Figure 7-11.—The C2P system hardware configuration.

hard drives installed in the AN/UYK-43(V) cabinet. Even though these disk drives are internally installed in the computer, the software accesses them as if they were external disk drives.

The AN/USQ-69(V) data terminal set is used to provide the man-machine interface (MMI). It is installed next to the Track Supervisor in CIC.

Several equipments are shared between the ACDS system and the C2P system. These include the magnetic tape unit, a teleprinter, and a second AN/USQ-69(V) data terminal set. The magnetic tape unit is used for initial program loading (to EMS), data extraction, and reading and writing JTIDS information to and from tape. It is also a backup load device when the EMS is down. The teleprinter provides hard copy printouts of C2P system status, error codes, and data dumps. The second AN/USQ-69(V) is used as a backup.

Shared equipments are switched to the desired systems through the Combat Systems Switchboard. The switchboard also provides switches to connect Link-4A and Link-11 directly to the CDS computer, bypassing the C2P system.