

ENGINEERING AND ADMINISTRATIVE ACQUISITION SYSTEM (EADAS) DESCRIPTION

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1. GENERAL

1.01 EADAS is a near real-time data collection and surveillance system which provides an electronic, software controlled means of collecting traffic data. The EADAS central control unit is a Digital Equipment Corporation (DEC) PDP11/40

processor. The processor controls the operation of the EADAS equipment including (1) EADAS Central Unit (CU) equipment, (2) remotely located data collection devices, and (3) remotely located dial administrator teletypewriter(s).

1.02 This section is reissued to include the following:

- (1) To add the optional individual circuit usage recorder feature
- (2) To add the optional interface to EADAS/network management feature
- (3) To make a general revision of this section
- (4) To make changes on Fig. 2, 3, and 6.

1.03 An overview of EADAS is shown in Fig. 1. Data collection devices, located remotely from the EADAS CU, transmit traffic data over dedicated (data link) or dial up facilities to the EADAS CU. EADAS is a real-time traffic management system which operates in conjunction with downstream data analysis programs to provide information for load balancing, engineering, trunk servicing, and forecasting as well as immediate key real-time data. The system consists of a centralized computer which is tied to remote scanner units via dedicated data facilities or a direct distance dialing (DDD) facility (when use of pollable data terminals [PDTs] is employed), over which peg count and usage data are received. The CU collects and summarizes the data, records the data on 9-track magnetic tapes for subsequent downstream processing, makes various user-defined calculations on the data, and presents exception reports to the CU teletypewriter and the read only teletypewriter, as well as the remote dial administrator teletypewriter which are concerned with the report. The Dial Administrator may also make inquiries of EADAS concerning any served central office at any time via the same dedicated TTY link. The inquiries may request any raw data, calculation stored from the last surveillance period, or any previous calculation result for a period of approximately 24 hours (or 48 hours with 30-minute data collection intervals).

1.04 The CU maintains the current 30-minute data (active) and the previous 30-minute data (passive) or a fixed head disk which is accessible via the CU teletypewriters during the specified time interval (a 15-minute period is

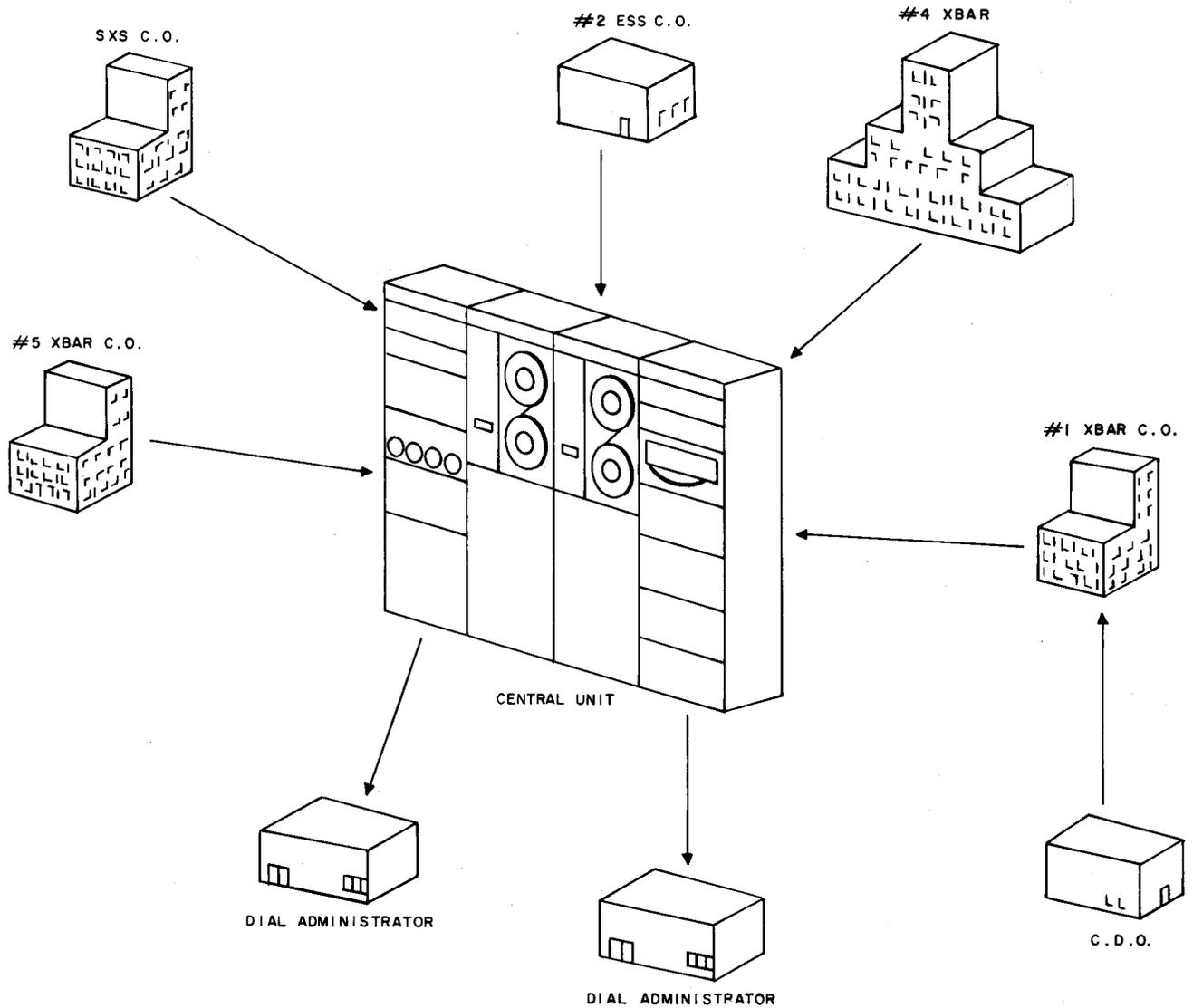


Fig. 1—Overview of EADAS

optional). The processor then performs the defined calculations on the data, storing the results on the moving head disk. These calculation results are then accessible for a period covering the previous 48 time intervals.

1.05 The major feature provided by EADAS to the availability of information on the status of the telephone network being monitored on a near real-time basis.♦

1.06 EADAS in conjunction with the downstream Traffic Data Analysis System (TDAS) provides

load balance, engineering, trunk servicing, and trunk forecasting data for telephone engineering personnel. The 15- or 30-minute data collection intervals are added as necessary by the downstream TDAS program to form hourly and multihourly data totals. If desired the EADAS system will write hourly totals on tape instead of the 15 or 30 minute data intervals. Hourly totals are selected as a system option.

1.07 ♦An option for EADAS is the individual circuit usage recorder (ICUR) feature which permits the collection of usage data for trunks on

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an individual circuit basis. The EADAS/ICUR system enhances the collection and transmission of traffic data. Administrative and diagnostic information is obtained by the individual circuit analysis (ICAN) batch computer program provided as part of the system.

1.08 Direct transmission of EADAS for downstream processing is obtained by the EADAS to EADAS network management (EADAS/NM) option. This option allows direct coupling of the two computer systems or remote coupling (data set) when the distance is greater than 50 feet.♦

2. EQUIPMENT ELEMENTS

REMOTE EQUIPMENT

A. EADAS Traffic Data Converter

2.01 The EADAS traffic data converter (ETDC) SD-3B213-01 is the primary data collection device for EADAS. The ETDC is normally located in a telephone switching office environment. One or more ETDC(s) can be associated with an office (entity). Traffic data, which normally is collected and registered on traffic registers, is collected by the ETDC and transmitted to the CU for processing. For a detailed description of the ETDC, see Section 252-115-102.

B. Traffic Data Recording System (TDRS) Traffic Data Converter

2.02 The TDRS traffic data converter (TDRS TDC) SD95968-01 is also a data collection device for EADAS. The TDRS TDC is normally located in a telephone switching office. Unlike the ETDC, the TDRS TDC is associated with either a TUR frame or pegcount but not a combination of both in the same converter. The CU accepts data from the TDRS TDC for processing. For a detailed description of the TDRS TDC, refer to Section 252-110-101.

C. Pollable Data Terminal

2.03 The capability to provide data to the EADAS CU ♦from small community dial offices (CDOs)♦ is the function of a new small, pollable device called the pollable data terminal (PDT). The PDT is able to receive and accumulate data on an hourly or half-hourly basis from traffic usage recorders (TURs), standard traffic register leads,

totalizer outputs, from any other circuit which produces pulses of -48 volts to ground, or from any contact closure to ground. For a complete description of the PDT, see Section 252-115-103.

D. Outside Vendor Data Collection Devices

2.04 The Scanner/Accumulator, manufactured by an outside vendor, must operate into a 4-wire data facility. The Y163 YK interface module is available at the CU to receive the data from the device. The device must be pollable and operate at 1200 baud in the ASCII format. The words are in even parity with 1 start bit, 7 data bits, 1 parity bit, and 2 stop bits.

E. Dial Administrators Teletypewriter

2.05 Every system period (15 or 30 minutes), exception reports are printed on all Dial Administrators teletypewriters associated with EADAS. The reports for each entity are preceded by a header consisting of the time, date and entity name followed by the reports for that entity.

2.06 The reports that are printed fall into two classes:

- (1) Those that exceed or do not reach the threshold
- (2) Those that are tagged to always print.

2.07 The Dial Administrators teletypewriter also has the capability of requesting certain types of information. These requests are as follows:

- Dump register (DU:RG)
- Output calculation (OP:CA)
- Output time (OP:TI)
- Print central unit (PR:CU)
- ♦Sum calculation (SU:CA)♦
- Verify calculation (VE:CA)
- Verify channel (VE:CH)
- ERROR MESSAGES

CENTRAL UNIT EQUIPMENT

F. Equipment Layout

2.08 A typical equipment layout for EADAS is shown in Fig. 2 through 4. Fig. 2 shows the cabinet-drawer layout as viewed from the front of the equipment. The cabinets number from 0 through 9 counting left to right. Fig. 3 shows the various circuits within the processor drawer, miscellaneous drawer No. 1, and miscellaneous drawer No. 2 as viewed from the left side. Fig. 4 is a more detailed layout of a channel interface drawer.

G. AC Power Distribution

2.09 Each equipment cabinet shown in Fig. 2 (except the TU10/TM11 and TU10-EE cabinets) has its own ac power distribution to the devices within the cabinet. The ac input power to each cabinet is 115V ac $\pm 10\%$, 60 Hz $\pm 1\%$ (maximum allowable drift of ± 1 cycle) with the ac neutral

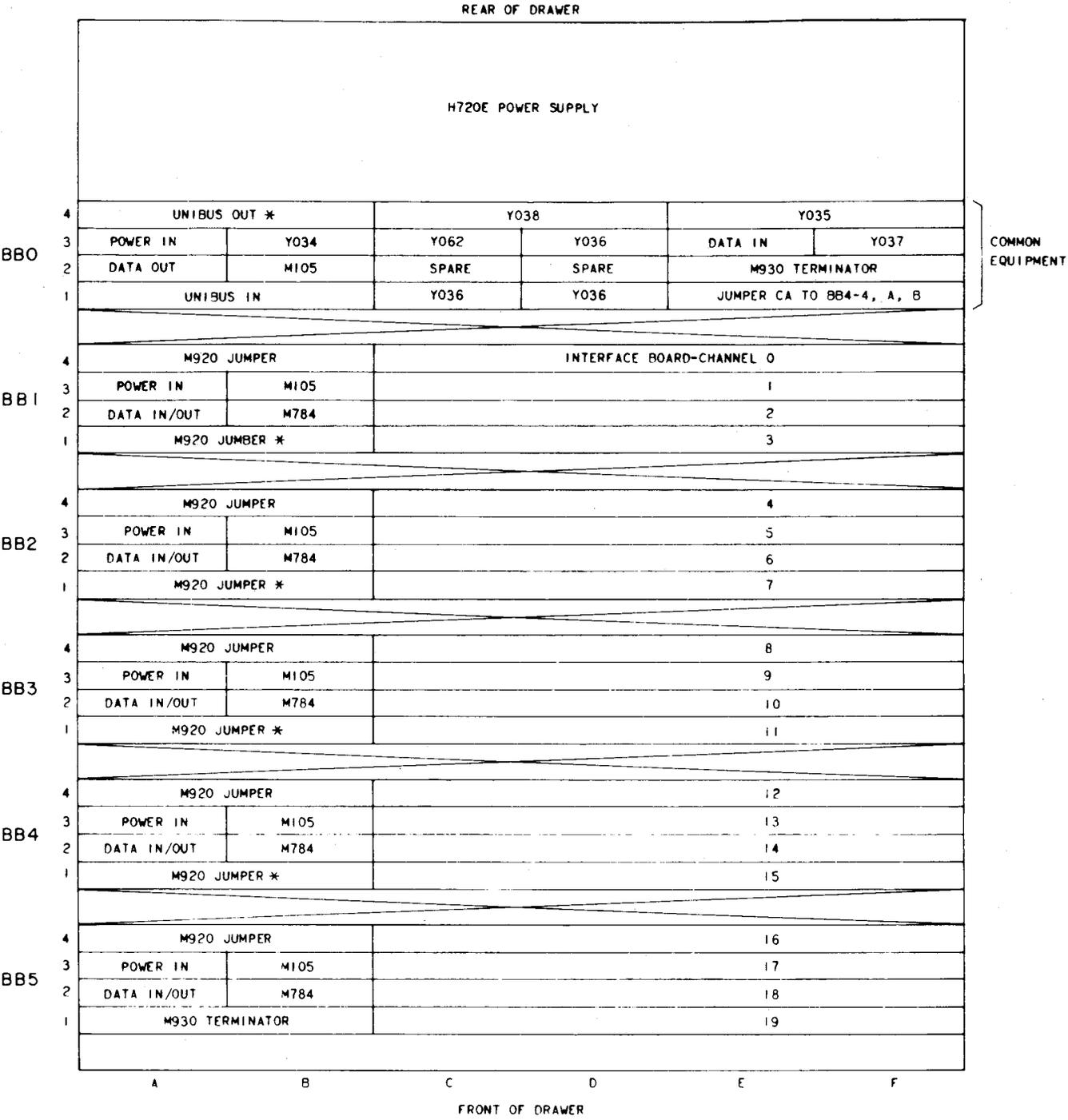
not connected to the frame of any equipment or to the protective ground. The ac neutral and protective ground shall be connected together only at the buildings main electrical service entrance. The ac input power is supplied from an external 30-amp circuit breaker via a power cord. The power controller is located in the bottom of cabinets 2, 5, and 6.

2.10 The power controller may be either locally or remotely controlled as determined by its LOCAL/OFF/REMOTE switch mounted on the controller. The recommended method as provided with the system is for the remote control (LOCAL/OFF/REMOTE switch to REMOTE) which is provided by the OFF/ON/PANEL LOCK switch on the PDP-11 processor switch register. ON-OFF control for each cabinet is only provided for the switched ac power outlets (right side) when the LOCAL/OFF/REMOTE switch is set to REMOTE.

2.11 When the OFF/ON/PANEL LOCK switch is set to the ON or PANEL LOCK position, a

EADAS DATA SETS AND MISC CIRCUITS SD-3B215-01	BD05 CHANNEL INTERFACE DRAWER NO. 0 SD-3B216-01				RS04 HIGH DENSITY FIXED-HEAD DISK D5			RF11-AA FIXED-HEAD DISK CONTROLLER	
	BD05 CHANNEL INTERFACE DRAWER NO. 1 SD-3B216-01	RK05-AA MOVING-HEAD DISK D1	MISC DRAWER NO. 1 AND SD-3B219-01		RS04 HIGH DENSITY FIXED-HEAD DISK D6	TU10-EE 9 TRACK MAGTAPE TRANSPORT	TU10-EA 9 TRACK MAGTAPE TRANSPORT		PC05 READER/PUNCH
	BD05 CHANNEL INTERFACE DRAWER NO. 2 SD-3B216-01	RK05-AA MOVING-HEAD DISK D2							
	BD05 CHANNEL INTERFACE DRAWER NO. 3 SD-3B216-01					MA11-FA MULTI PORT MEMORY 16K	TM11-EA 9 TRACK MAGTAPE CONTROLLER	RS11 FIXED-HEAD DISK	
	BD05 CHANNEL INTERFACE DRAWER NO. 4 SD-3B216-01	DH11-AA DISTRIBUTION PANEL	MISC DRAWER NO. 2 AND SD-3B218-01					RS11 FIXED-HEAD DISK	PROCESSOR DRAWER PDP-11/40
CAB. 0	CAB. 1	CAB. 2	CAB. 3	CAB. 4	CAB. 5	CAB. 6	CAB. 7	CAB. 8	CAB. 9

Fig. 2—EADAS CU Equipment Layout (Typical)



* OR M930 UNIBUS TERMINATOR

Fig. 4—Detailed Layout of Equipment for Channel Interface Drawers (2-1 through 2-5)

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any of the power controllers. Activation of any thermal overload switch (S2) will place a ground on the designated lead which is sensed by the remaining thermal overload detectors causing the power-on relays in all the cabinets to be disabled and thus shuts down all the switched ac power within the CU.

H. Alarms

2.13 The EADAS CU is equipped with an alarm circuit to indicate error conditions or possible error conditions. These error conditions are detected by monitoring various hardware and software functions which are key factors indicating the ability of the CU to execute the EADAS software system. Errors, when detected, are signified by an indicator lamp indicating the type of error (Major or Minor), the cause of the error in some cases (ie, 2600 Hz oscillator failure), and an audible alarm.

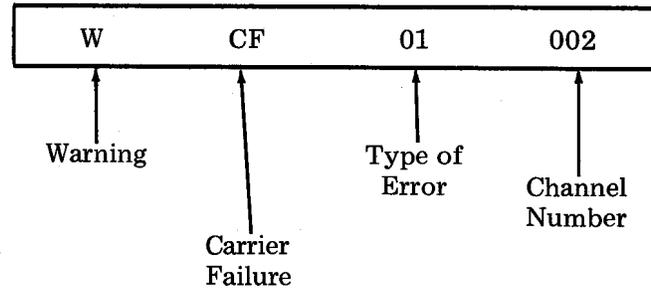
2.14 Major alarms are those which block the basic operation of the CU to a point where the CU is not functioning or where a major section of critical circuitry is inoperative. The following alarms are classified as Major alarms:

- AC Low
- DC Low
- Software failure
- 2600-Hz oscillator failure
- Software designated alarm conditions
- T & R power supply fuse alarm

2.15 Minor alarms are those which do not directly affect a major portion of the CU but which cause a malfunction within a small area of operation. A printout on the TTY will accompany any minor alarm as to its cause. The following are examples of alarms which are classified as minor alarms:

- 202T data set carrier failure on a scheduled active channel
- Magnetic tape off-line when scheduled to write
- Line printer not "On-Line"

All minor alarms are program initiated which indicates the CU is still operational. The program will, therefore, be able to indicate the cause of the alarm and thus how to remove the alarm condition. A typical TTY printout corresponding to a 202T data set carrier failure is:



2.16 All alarms are not manually resettable. All resets of both major and minor alarms are generated by the EADAS software when the condition which caused the alarm is removed, or by typing a message at the CU teletypewriter (RS:AM:). The audible alarm may be silenced immediately by momentary operation of the DISABLE switch on the alarm panel to the DISABLE position.

2.17 The alarm circuit also provides for the remote display of alarm conditions (optional). A relay contact closure is provided for each of the following when remote alarms are desired:

- Major alarm
- Major audible alarm
- Minor alarm
- Minor audible alarm

When the remote alarm feature is used, the MAJOR CUT-OFF and MINOR CUT-OFF switches on the alarm panel must be in their normal positions, or the remote alarm feature is disabled. The +24 volt T&R power supply is considered a major alarm condition because it is the source of power for the alarm circuit. A failure of the T&R power supply would not activate any audible or visual alarms unless the remote alarm feature is provided. However, for such failures the +24 volt power lamp on the power panel (1-5) would be extinguished.

2.18 An "alarm tree" as shown in Fig. 5 shows the structure of the alarm circuit. When multiple alarm setting conditions are present, refer to Fig. 5 to determine which failures have an effect on other parts of the alarm circuit. For example, if there is an AC LOW condition, AC LOW, DC LOW, and Program Timeout Alarms would be activated. Restoring the AC LOW condition to normal would clear the DC LOW and Program Time-out alarms.

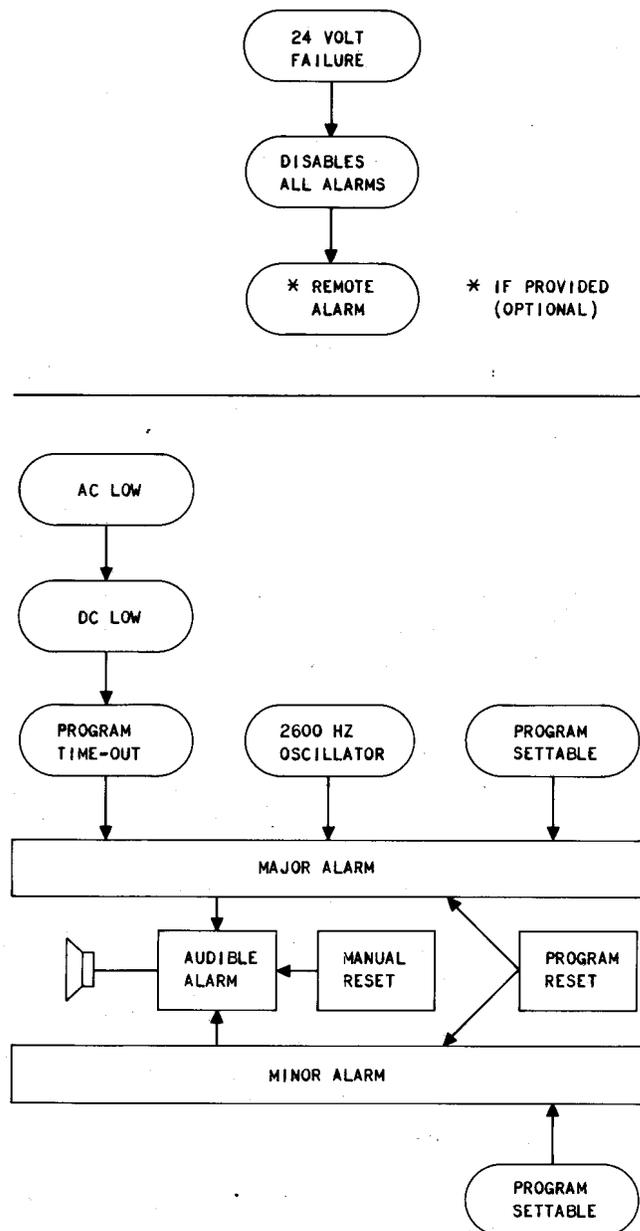


Fig. 5—Alarm Tree for Alarm Circuit

I. PDP 11/40 Processor

2.19 Operation of the data collection system is controlled by the PDP 11/40 computer and its associated software package (programs). This computer is a 16-bit word machine which is characterized by a unique common bus system termed the UNIBUS. This bus interconnects the processor with the core memory and all the peripherals, producing a high degree of flexibility and efficiency by permitting the processor to employ the same set of signals to communicate with both core memory and peripheral equipment. Therefore, peripheral devices such as the input channel interface registers are addressable in a manner identical to that of core memory.

2.20 For non-ICUR the CU provides approximately 64k words of core memory in its minimum configuration which accommodates up to 73 input channels. 80k words of core are required for a full system of 100 input channels. The ICUR option provides an additional 32k words of memory expanding the EADAS/ICUR system to a minimum of 96k words to a maximum of 112k words. If the ultimate system configuration will encompass more than 73 inputs, it is recommended that sufficient core memory be ordered initially to handle the entire projected system size.

2.21 The disk memory employed is a head-per-track (fixed head) system having a storage capacity of approximately 262,000 words per disk.

2.22 The PDP-11/40 processor performs all arithmetic and logical operations required in the system. It also acts as the arbitration unit for UNIBUS control by regulating bus requests and transferring control of the bus to the requesting device with the highest priority.

2.23 The processor contains 8 general registers which can be used as accumulators, index registers, or as stack pointers. A stack, as used in the PDP-11, is an area of memory set aside by the programmer for temporary storage or subroutine/interrupt service linkage. A program can add or delete words within the stack. The stack uses the last-in first-out concept. This means that various items may be added to a stack in sequential order and retrieved or deleted from the stack in reverse order.

J. UNIBUS Structure

2.24 The UNIBUS is a common, high-speed data path that interconnects the processor and all devices within the CU. It is a 120 conductor Flexprint cable (white in color) that is found weaving through the devices comprising the CU. The UNIBUS uses 56 lines for information with all of the remaining lines grounded to provide noise immunity. Fifty-one of the signal leads are bidirectional which includes, for example, the address lines (18), data lines (16), control lines (2), and the lines dedicated to monitoring the power supplies. The remaining 5 lines are unidirectional which encompass the bus grant (BG) lines (4), and the non-processor grant (NPG) line.

2.25 All UNIBUS bidirectional lines use negative logic and all unidirectional lines use positive logic. All other system device logic is positive.

2.26 All devices attach to the UNIBUS by paralleling off the desired signal and control lines as the lines are passed serially through the device enroute to the unibus terminator (located on the end of the UNIBUS section). The only information which is not attained in this manner comes over the BG lines which are serially passed through the devices requiring these signals as they are physically arranged on the UNIBUS in distance from the processor. Fig. 6 shows a typical EADAS CU UNIBUS structure.

2.27 The allowable length of the UNIBUS and the number of devices which are attached to it are limited by a PDP-11 system requirement of 50 feet and 20 unit loads. A UNIBUS load is defined as one UNIBUS receiver (M784) and two UNIBUS drivers (M783) which is the approximate equivalent of one device (ie, RK11 disk controller, 8K of MF11 core memory). If additional length or loading is required, as it is for EADAS, a DB11 UNIBUS extender may be added. It allows an additional 50 feet and 19 unit loads to be added to the UNIBUS structure. The DB11 UNIBUS extender, however, uses one unit load on each section of the UNIBUS which limits each section to 19 unit loads. The UNIBUS characteristics for a typical 100-channel EADAS system are as follows:

Main UNIBUS:

KD11-A PDP 11/40 Processor
DL11-A TTY Interface
80K Core Memory

PC11 High Speed Paper Tape Reader
BD04 Disk Interrupt and Alarm
RK11/RK05 Moving Head Disk
RF11/RS11 Fixed Head Disk
TM11 9-Track Magtape
DB11-A UNIBUS Extender
KE11-E Extended Instruction Set
KT11-D Memory Management Control
MA11-FA Multiport Memory
RJS04-BA Fixed-Head Disk

UNIBUS Extension:

DB11-A UNIBUS Extender
BD03 ASCII/BIN To BIN/ASCII Converter
DH11-AA 16 Line Asynchronous Multiplexer
DN11 Automatic Calling Unit
5 BD05 Channel Interface Drawers
BM792-YJ Read Only Memory
LP11-FA Line Printer Interface
CR11 Card Reader
DL11-B TTY Interface
DQ11-DA Synchronous Line Interface

2.28 The UNIBUS is an interface between devices. Each device is entirely self-sustaining and independent of other devices within the CU. Therefore, a device can be eliminated entirely from the UNIBUS structure without affecting the operation of other devices (providing the system software doesn't address the device). When system diagnostics programs are being run, removing devices from the UNIBUS structure is a controlled parameter. The isolating ability of the devices on the UNIBUS allows maintenance personnel to sectionalize troubles.

2.29 Fig. 7 shows a UNIBUS bidirectional line. All devices attach to the UNIBUS bidirectional line with either a UNIBUS receiver IC (380) or a UNIBUS driver IC (8881). On a data out (DATO) transfer, the driver of one device (ie, PDP-11 processor) and the receiver of another device (ie, 20 channel drawer) are enabled. This allows the data in the processor to be passed to where the address lines instruct it to go. The address lines basically control which device is enabled. The control lines tell whether the 380 UNIBUS receiver or the 8881 driver is enabled, indicating the direction of the data transfer.

2.30 In order to insure that the data path between devices is established and to facilitate the asynchronous method of data transfers, various control signals are used. These signals are master sync (MSYN) and slave sync (SSYN) which essentially

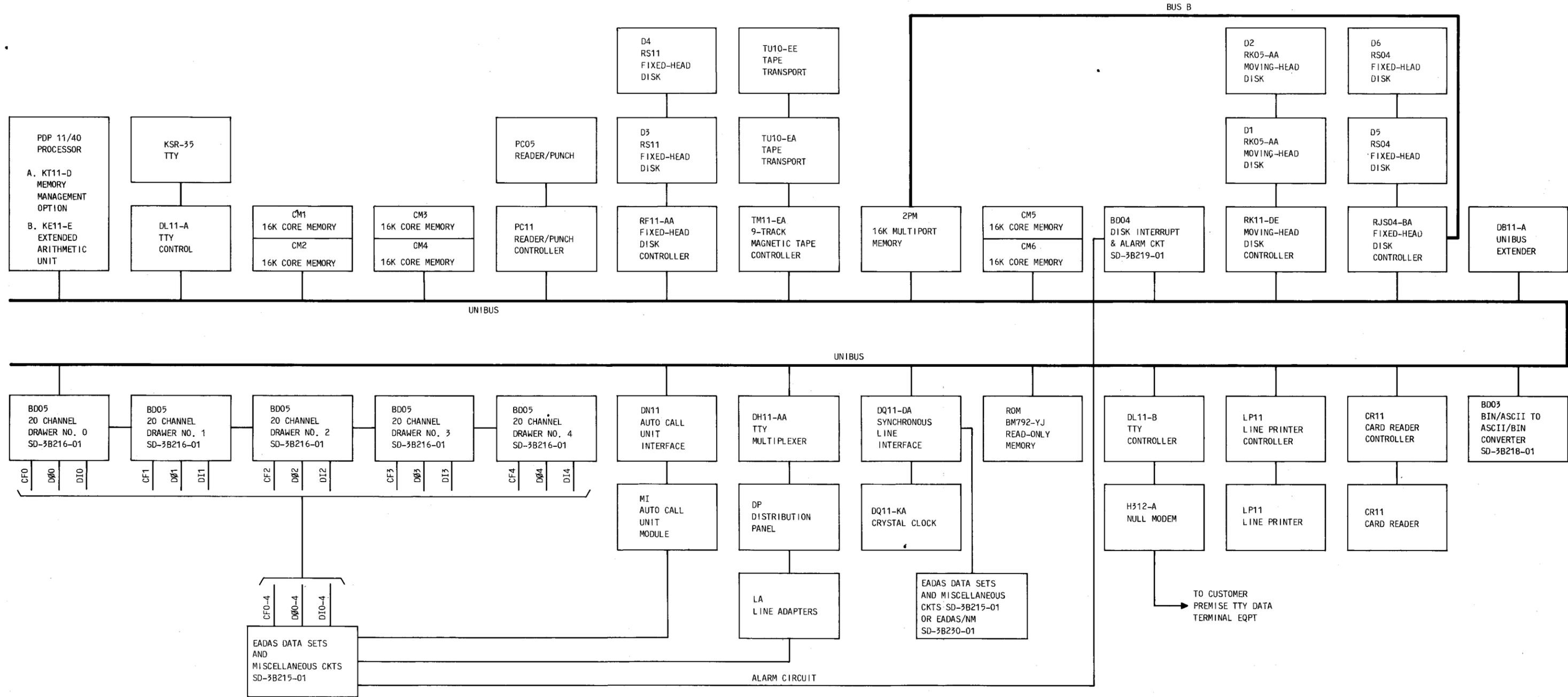
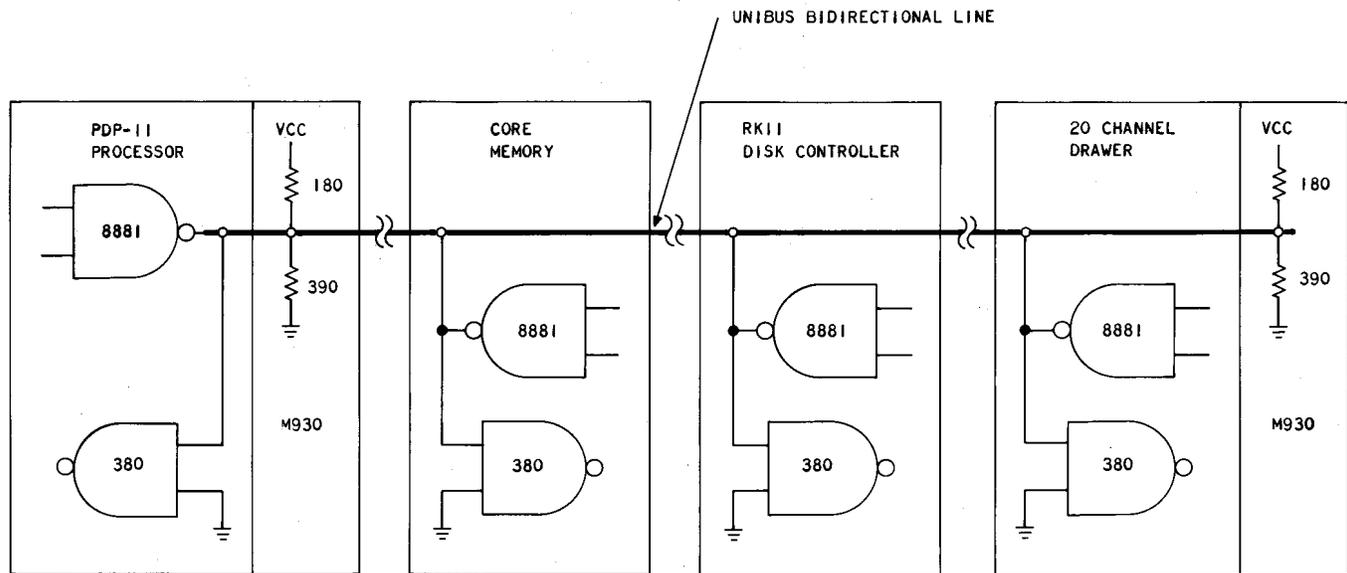


Fig. 6—Typical EADAS CU UNIBUS Structure



NOTES:

1. DATA LINE 1 (DOI) IS SHOWN ON THE ABOVE EXAMPLE OF A UNIBUS BIDIRECTIONAL LINE.
2. DATO EXAMPLE: PROCESSOR 8881 AND 20 CHANNEL DRAWER 380 ARE ENABLED.
3. DATI EXAMPLE: CORE MEMORY 8881 AND PROCESSOR ARE ENABLED.
4. CONTROL OF WHICH 380IC AND 881IC IS ENABLED IS DETERMINED BY THE UNIBUS MASTER AND WHICH ADDRESS AND CONTROL LINES ARE ASSERTED.

Fig. 7—UNIBUS Bidirectional Line

provide a hand-shaking between the two devices communicating. The master device (ie, processor) sends out MSYN and if the slave (ie, 20 channel drawer) does not return SSYN within a few microseconds, the processor traps to location 4 which indicates the data path was not established.

2.31 Table A shows a typical timing flow for a transfer between the PDP11/40 processor and a channel interface circuit contained within a 20 channel drawer. This shows a word being transferred from the processor to the interface representing reverse channel information to a data collection device (DATO).

2.32 The processor also has the ability to read data from a slave device (ie, channel interface). Table B shows the timing flow between the PDP11/40 processor and the channel interface when data is being transferred from a channel interface to the processor (DATI).

2.33 The function of the UNIBUS and the various devices comprising the CU, although briefly

described in this section, are described in greater detail in the DEC documents provided with the system. The operation of each device is explained in the manuals pertaining to it. The PDP-11 UNIBUS Interface Manual expounds greatly on the information associated with the UNIBUS. The reading of the manuals supplies with EADAS will allow maintenance personnel to become more proficient in diagnosing troubles.

K. MF11-L, MM11-L, and MF11-U Core Memory

2.34 A memory can be viewed as a series of locations, with a number (address) assigned to each location. Because PDP-11 memories are designed to accommodate both 16-bit words and 8-bit bytes, the total number of addresses does not correspond to the number of words. A 4096-word memory can contain 8192 bytes and consist of 017777 octal locations. Words always start at even numbered locations.

2.35 The PDP-11/40 word is divided into a high byte and a low byte. Low bytes are stored

TABLE A
DATA OUT CYCLE TIMING

TIME (ns)	PROCESSOR	CHANNEL INTERFACE
0	Address, data, and control lines asserted	M105 address selector decodes address & control lines UNIBUS receiver (M784) enabled
150	Master sync (MSYN) asserted	Address selector provides OUT LOW H and Select [X] H input Shift register loaded Address selector returns slave sync (SSYN)
300	Master syn (MSYN) cleared	Data clocked from shift register
325	Address, data, and control lines cleared	
375		Address selector clears SSYN
475	DATO cycle complete	

at even-numbered memory locations and high bytes at odd-numbered memory locations.

2.36 The memory provided with EADAS is magnetic read/write core memory with a 900-nanosecond cycle time. The basic 50-channel system is equipped with 64,000 words expanding to 80,000 words for 100 channels. The ICUR option provides an additional 32,000 words of memory expanding the EADAS/ICUR system to a minimum of 96,000 words, to a maximum of 112,000 words. The memory provides for storage of 44,000 words of program with the remaining area dedicated to buffering received data until it is written on the fixed-head disk.

L. KT11-D Memory Management Control

2.37 This control unit provides the hardware facilities for the management of the CU core

memory. Its basic purpose within EADAS is to allow additional words of core memory to be added to the standard 28,000-word PDP 11/40 system. Since the core memory size is greater than the standard memory size, the memory management control is required as a standard device for the EADAS application.

M. High Speed Paper Tape Reader/Punch (PC11)

2.38 The high speed reader and punch is capable of reading eight-hole anodized perforated paper tape at 300 characters per second and punching tape at 50 characters per second. The system consists of a paper-tape reader/punch and control.

2.39 When reading tape, a set of photodiodes translate the presence or absence of holes in the tape to logic levels representing 1s and 0s. When punching tape, a mechanism translates logic

TABLE B
DATA IN CYCLE TIMING

TIME (ns)	PROCESSOR	CHANNEL INTERFACE
0	Address and Control lines asserted	M105 address selector provides IN H signal
150	Master Sync (MSYN) asserted	Address selector provides Select [X] H signal
225		UNIBUS drivers (8881) enabled - data on UNIBUS.
300	Slave sync (SSYN) received Data strobed from interface MSYN cleared	Address selector returns slave sync (SSYN)
375		Select [X] cleared which: - removes data from Unibus - clears output buffer
450	Address and Control lines cleared	
525	DATI cycle complete	

1s and 0s to the presence or absence of holes in the tape. Any information read or punched is parallel-transferred through the control. When an address is placed on the UNIBUS, the control decodes the address and determines if the reader or punch has been selected. If one of the four device register addresses have been selected, the control determines whether an input or an output operation should be performed. An input operation from the reader is initiated when the processor transmits a command to the paper tape reader status register. An output operation is initiated when the processor transfers a byte to the paper tape punch buffer register.

2.40 The control enables the PDP-11 system to control the reading or punching of paper tape in a flexible manner. The reader can be operated independently of the punch. Either device can be under direct program control or can operate without direct supervision through the use of interrupts to maintain continuous operation.

N. RF11 Fixed Head Disk

2.41 The RF11 fixed head disk is a fast, random-access bulk-storage system. An RF11 provides 262,144 17-bit words (16 data bits and 1 parity bit) of storage. Up to 8 RS11 disks

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can be controlled by one RF11 controller for a total of 2,047,152 words of storage. An RF11 includes a control unit and the first disk drive.

2.42 The RF11 is unique because each word is addressable. Data transfers may be as small as one word or as large as 65,536 words. Individual words or groups of words may be read or rewritten without any limits of fixed blocks or sectors, providing optimum use of both disk storage and main memory in the PDP11/40.

2.43 The RS11 disk contains a nickel/cobalt-plated disk driven by a hysteresis synchronous motor. Data is recorded on a single disk surface by 128 fixed read/write heads.

2.44 Fast track switching time permits spiral read or write. Data may be written in blocks from 1 to 65,536 words. The RF11 control automatically continues on the next track, or on the next disk surface, when the last address on a track or surface has been used.

2.45 The disk stores words in a 22-bit format which includes guard bits and a sync bit to operate the self-clocking logic. The sync bit adjusts the timing of the data strobing to ensure proper recovery of each word of data. The RS11 has a redundant set of timing tracks, recorded exactly in phase with the primary timing tracks.

O. RK11-D DECpack Disk Cartridge

2.46 A disk cartridge holds over 1.2 million words. The DECpack is ideal where a large volume of programs and data are developed and maintained for one or more users. The system is expandable up to 9.6 million words per control (8 disks). An RK11-D includes a control unit and the first disk drive. Dust contamination is prevented by a highly-efficient continuous absolute air filtration system.

2.47 The DECpack provides accurate data storage and transfers by means of a write check function correct cylinder verification by hardware, hardware checksum, and hardware maintenance features. There are no mechanical detents; thus a major source of wear and critical adjustment is eliminated.

2.48 Average access time on each drive is 70 milliseconds. On expanded systems, operations

are overlapped for efficiency. One drive may read or write while one or more additional drives are seeking new head positions for the next transfer. All data transfers utilize the non-processor request facility during transfers.

P. KE11-E Extended Instruction Set

2.49 The Extended Instruction Set (EIS) option adds the capability to multiply, divide, and shift arithmetically. The EIS instructions are directly compatible with the PDP 11/45 processor.

Q. DH11 16-Line Programmable Asynchronous Signal Line Multiplexer

2.50 The DH11 multiplexer connects the PDP-11 with 16 asynchronous serial communications lines operating with individually programmable parameters.

2.51 The DH11 multiplexer uses 16-double-buffered MOS/LSI receivers to assemble the incoming characters. An automatic scanner takes each received character and the line number and deposits that information in a first-in, first-out buffer memory referred to as the silo. The bottom of the silo is a register which is addressable from the UNIBUS.

2.52 The transmitter in the DH11 also uses double-buffered MOS/LSI units. They are loaded directly from message tables in the PDP-11 memory by means of single cycle direct memory non-processor (NPR) transfers. The current addresses and data byte counts of the message table for each line are stored in semi-conductor memories located in the DH11. This reduces the UNIBUS time required for NPR transfers to one NPR cycle per character transmitted.

2.53 The DH11 consists of a double system unit, all modules necessary to implement a 16-line asynchronous multiplexer, an externally mounted 5 1/4 inch level conversion and distribution panel with its own power supply that is mounted on the rear of the rack, and a data cable between the logic in the double system unit and the level conversion/distribution panel.

R. Disk Interrupt Driver and Alarm

2.54 The BD04 disk interrupt driver and alarm circuitry provides a means for software

control of the setting and resetting of the major and minor alarms for the EADAS system. This circuitry also generates an alarm condition for program insanity and any ac or dc low-voltage condition as monitored by ac low and dc low signals on the PDP 11/40 UNIBUS.

2.55 The disk interrupt timing circuit divides each revolution of the fixed head disk in the EADAS system into approximately three 11-ms segments. Each interval is used to interrogate the EADAS program to start channel scanning. An interrupt is also generated at the start of each disk revolution. Since the disk is ac line synchronous, this interrupt is used for real-time record keeping. The synchronized scan program also minimizes access time.

2.56 The alarm circuit allows the processor to indicate alarm conditions detected by the software within the CU (minor or major). The circuit also monitors the program base level loop time to verify it is less than 1.5 to 2.0 second. A provision is also added for the processor to reset all generated alarm conditions by entering a command (RS: AM:) on the CU teletype. In addition to the software detected alarms, the alarm circuit has circuitry to detect any ac low or dc low asserted on the UNIBUS which illuminates the respective failure lamp on the alarm panel.

S. Read Only Memory (ROM) (BM792-YJ)

2.57 The BM792-YJ is a preprogrammed ROM consisting of 32 words and is used as a bootstrap loader. Refer to SD-3B217-01 for program of ROM.

2.58 The basic ROM module contains 32 16-bit words of diode read-only memory. The ROM is supplied with a 32 by 16 diode matrix. Diodes can be selectively cut out to yield the desired data pattern; diode in = 1, no diode = 0. The unprogrammed ROM contains all 1s; programming of the memory is accomplished by eliminating diodes for the bits that should be read as 0s. The location of the diodes with respect to word and bit number are indicated on the module.

2.59 The 32 words are in consecutive memory addresses. The address range of the lowest address is jumper selectable between 173300 and 173700. The jumper wires affect bits 6 to 8 of the address, and are indicated on the module by

the designations W1, W2, and W3. To make the jumpers correspond to the desired bit addresses, jumper in = 1, no jumper = 0.

T. LP11-FA High Speed Line Printer (Used in Early Installations)

2.60 The LP11-FA high speed line printer is an 80-column, 64-character model. The printer is an impact type using a revolving character drum and a hammer per column. Fanfold paper 9 1/2 inches wide may be used with adjustment for pin-feed tractors. The print rate is 600 lines per minute.

2.61 Characters are loaded into the printer memory via the line printer buffer serially by character. When the memory becomes full (20 characters), they are automatically printed. This continues until the full 80 columns have been printed or a special character is recognized.

2.62 The LP11-FA will accept characters at a 750-Hz rate until the character print memory is filled. There is a delay of approximately 4 milliseconds while the printing is done.

U. LP11-VA High Speed Line Printer

2.63 The LP11-VA high speed line printer is a 132-column, 64-character model. The printer contains a proper advance mechanism, a top-of-form control, self-test capability, a variable forms length switch (11 positions, 3 inches to 14 inches), a vertical spacing switch for either 6 or 8 lines per inch, a static eliminator, and a paper receptacle. The printer is an impact type printer using a revolving character drum and one hammer per two columns. Forms with up to six parts may be used for multiple copies. Included with the printer is a control unit for interfacing to the computer.

V. TM11 Magnetic Tape

2.64 The TM11 is a magnetic tape system used for writing, reading, and storing large volumes of data and programs in a serial manner. The system reads and writes in a compatible format for downstream processing. The TU10 magnetic tape unit accommodates 10-1/2 inch tape reels that contain up to 2400 feet of tape. Each reel can contain over 180 million bits of data stored on 9 tracks.

2.65 The TM11 employs read after write error checking to verify that proper data is written on the tape. Should a tape dropout be detected, appropriate action can be taken to insure no loss of data.

2.66 Tape motion is controlled by vacuum columns and a servo-controlled single capstan. Long tape life is possible because the only contact with the oxide surface is at the magnetic head and at a rolling contact on one low friction, low inertia bearing.

2.67 The 9-track system uses 1/2-inch mylar base tape which is coated on one side with an iron oxide composition. The method of recording is non-return-to-zero (NRZ). The nine-track tape includes eight data channels and a lateral parity channel at a density of 800 bits per inch (bpi). The load and end points of the tape are marked by reflective strips which are detected by photo diodes. About 10 inches of blank tape is wound on a reel and precedes the beginning of tape (BOT) and end of tape (EOT) strips; a gap of about 3 inches is left from the load point before writing can begin.

2.68 Each computer word contains two 8-bit tape characters. Record blocks are separated by 1/2-inch gaps. In the standard format, the tape contains from 18 to 2,048 characters.

W. Channel Interface Drawer

2.69 The 20-channel drawer contains 20 channel interface circuits which receive data from the various remote data collection devices. The common control circuitry within the drawer then multiplexes the interface to the UNIBUS and presents one unit load to the system structure. Also contained within the drawer are a data set carrier failure detection circuit, the active channel lamp circuit, and the interfaces to the 202T data sets in the data set cabinet.

2.70 There are different interface circuits for the different types of far-end data collection devices. They are as follows.

- Y019 interface circuit—Used with EADAS TDC
- Y049 interface circuit—Used with TDRS TDC

- Y149 interface circuit—Used with the PDT, No. 1 ESS precentrex 8 and No. 2 ESS
- Y163 interface circuit—Used with No. 2 ESS Centrex 8, PBC, and scanner/accumulator terminals

X. Modified KSR-35 Teletypewriter

2.71 The modified KSR-35 teletypewriter is modified by Digital Equipment Corporation for compatibility with the EADAS CU. The operations performed at the EADAS CU via the teletypewriter are as follows.

- Schedule changes
- Define calculations
- Add and delete system functions
- Define equipped channels
- Program outputs
- Input for maintenance tests.

Y. LA36-CA DECwriter II

2.72 Instead of a modified KSR-35 teletypewriter, a LA36-CA DECwriter II may be used to perform the same functions described in 2.71. The LA36-CA DECwriter's primary functions involve testing. It is used as the input/output terminal during the running of the off-line DEC diagnostic programs and for some on-line EADAS system tests.

2.73 The LA36-CA DECwriter II is loaded with many practical and functional operator features. It has 30-character per second throughput accomplished by a 60-Hz catchup mode which is activated any time that more than one character is in the 16-character buffer. Also featured are quiet operation, infinitely variable vertical forms adjustment, variable forms width, and multi-part forms capability.

2.74 The LA36-CA DECwriter II prints from a set of 64 characters at speeds up to 30 characters per second. It can receive at either 110, 150, or 300 baud, depending on the switch setting.

Z. Data Sets

2.75 The 202T data sets are used in the system for interfacing the EADAS CU with the various remote data collecting devices via dedicated data facilities. The 108-type data sets are used for interfacing the EADAS CU with the remote dial administrators teletypes via a dedicated facility. The 103-type data sets are provided to interface data from Direct Distance Dialing facilities for collecting data from pollable terminals.

AA. 801-Type Automatic Calling Unit and DN11 Interface Unit

2.76 The 801 automatic calling unit (ACU) and a DN11 automatic calling unit interface can dial any telephone number in the Direct Distance Dial network and establish a data link. The DN11 is a digit-buffered interface, and digits to be dialed are presented as four-bit binary numbers. The interface drives the automatic call unit with EIA-232-C voltages and is connected via a standard 25-pin plug.

2.77 The operator has access to the 801 ACU through the DN11 interface. The 801 ACU presents the following leads to the DN11: Power Indicator, Data Line Occupied, Abandon Call and Retry, Data Set Status and Present Next Digit. The DN11 provides the following leads to the 801 ACU: Digit Present, Call Request and four Digit Leads.

2.78 The PDP-11 UNIBUS serves as a multiplexer; therefore, up to six multiple automatic calling units can be added to the Central Unit. One Central Unit system unit accepts an 801 ACU interface. Each interface looks like one device to the UNIBUS.

2.79 For more information on the 801 ACU refer to Section 598-010-101 for rotary dial or Section 598-012-101 for TOUCH TONE® dial.

AB. BD03 ASCII/BIN To BIN/ASCII Converter

2.80 This unit is capable of converting binary numbers into equivalent decimal ASCII representations and of conversely converting ASCII digits to equivalent binary numbers.

2.81 In the ASCII/BIN converter, five ASCII digits are read into the converter by the

central processor unit placing the digits on the UNIBUS data lines while enabling the appropriate address lines. The resulting binary representation is placed on the data lines by the converter when the processor places the appropriate address on the address lines.

2.82 The BIN/ASCII converter reads in a binary number from the data lines when the appropriate address is present on the address lines. The converter places the resulting five ASCII digits on the data lines as the processor enables the appropriate address lines. An additional feature of the BIN/ASCII converter enables a byte of information (eight bits) to be read into a special register. This byte to output along with the least significant ASCII digit of the converter output.

AC. DL11-A and DL11-B Teletypewriter Controllers

2.83 The DL11-A interfaces the central control unit with input/output terminals (KSR-35 teletypewriters) using the standard 20-milliampere loop current control signals. The DL11-B interfaces the system with either local or remote (data only) terminals using the standard EIA-232-C control signals.

AD. H742 Power Supply

2.84 The dc power for devices which mount within the miscellaneous drawers or within the processor drawer is obtained from the H742 power supply, mounted in the rear of each drawer. The remaining devices obtain dc power from the power supplies supplied with the device. All ac and dc power failures are indicated on UNIBUS lines designated ac low and dc low, which are tied via the BD04 disk interrupt drawer and alarm circuit (SD-3B219-01) to the alarm panel, where respective indicators are provided when these conditions are asserted.

AE. KE11-E Extended Instruction Set

2.85 This unit expands the PDP 11/40 instruction set to provide hardware manipulation of integer numbers. These added instructions include the following:

- Arithmetic shift (ASH)
- Arithmetic shift combined (ASHC)

SECTION 252-115-101

- Multiply (MUL)
- Divide (DIV)

2.86 The function of the KE11-E extended instruction set is employed when performing calculations on the data received via the BD05 20-channel drawers (SD-3B216-01). However, additional use is employed by other programs.

AF. RS04/RJS04 Fixed-Head Disk and Controller

2.87 The RJS04 includes a controller and a RS04 fixed-head disk drive with a storage capacity of 512K 16-bit words. The RS04/RJS04 fixed-head disk and controller are used in the EADAS/ICUR system. The RJS04 is expandable by adding up to eight RS04 drives per controller. The RJS04 fixed-head disk system has been designed specifically for applications requiring fast, reliable, on-line storage. It has a fast access time of 8.5 milliseconds and a high speed transfer rate of 4 microseconds per word.

AG. CR11 Card Reader

2.88 The CR11 card reader is used to input circuit grouping information for ICUR. The CR11 card reader reads EIA standard 80-column punched data cards at 300 cards per minute. Cards are read by column beginning with column 1. A read command starts the card moving past the read station. Once a card is in motion, all 80 columns are read. Column information is read in one of two program-selected modes: compressed or image. In the compressed mode, the 12 information bits in one column are automatically decoded and transferred into the least significant half of the card reader data buffer (CRB2) as 8-bit compressed code. In the image mode, the 12 bits of a column are transferred directly into CRB1 so that zone 9 is transferred into CRB bit 0 and zone 12 is transferred into CRB 11. A punched hole is interpreted as binary 1 and the absence of a hole as binary 0.

AH. MA11-FA Multiport Memory

2.89 The MA11-FA multiport memory allows the computer memory and data to be shared between UNIBUS A and B in the EADAS/ICUR system. In the basic EADAS system configuration, the memory and data appear only on UNIBUS A. UNIBUS B is required for load balancing of the

additional 32K of core memory required for the ICUR feature. The MA11-FA multiport memory contains 16K of MM11-U type core memory located on UNIBUS B and a memory control circuit. The other 16K of memory is located on UNIBUS A.

AI. DQ11-AA Synchronous Line Interface

2.90 The DQ11-AA synchronous line interface is a high-speed, double-buffered interface unit used to connect the EADAS system with EADAS/NM. This allows EADAS to provide remote batched and concentrated data for downstream processing by EADAS/NM. The DQ11-AA synchronous line interface provides parallel-to-serial and serial-to-parallel data conversion, voltage or current level conversions, character recognition, error detection, and data set control for half-duplex or full-duplex operation.♦

3. PRINCIPLES OF OPERATION

A. System Features

3.01 EADAS is capable of collecting and summarizing peg count and usage data and several additional functions as follows:

- Provides key real-time traffic data validity checks and calculations to Dial Administrators on exception basis
- Reports results of calculations to dial administrators on an exception basis
- Collects data from collection devices such as ETDC, PDT, TDRS TDC, ESS offices, etc.
- Permits real-time status inquiries about the entities being measured
- Creates a data base for network management use
- Provides peg count and usage concentration to satisfy the needs of small central offices economically.

3.02 EADAS, in conjunction with the Traffic Data Analysis System (TDAS) and other downstream BIS programs, provides load balance, engineering, trunk servicing and forecasting data for the operating telephone companies, as well as immediate key real-time data. The CU collects and summarizes

peg count and usage data, records the results on magnetic tape for subsequent downstream processing, and makes certain real-time calculations and presents exceptions to the appropriate dial administrators.

B. System Operation

3.03 Traffic data is transmitted from the collection devices and received by an interface circuit at the CU and is temporarily buffered. The CU scans the input channels and transfers each new data word to a temporary buffer area in the core memory. The central processor will move the data from the buffer core area to disk where counts are totaled. This data base on disk contains the accumulated totals of each input for each collection device and is the data base on which real-time calculations are made. At scheduled intervals (15- or 30-minute interval), the accumulated data is written on magnetic tape for downstream processing. Optionally, hourly data may be written. This data is created by summing the 15- or 30-minute intervals as required. The predefined real-time calculations are performed concurrently, compared with predefined thresholds, and printed out on one of the dial administrative TTYs if the threshold is exceeded.

C. Address Structure

3.04 All CU devices, which are connected to the UNIBUS, have addresses assigned to them for communication purposes. The CU devices which are designed and manufactured by DEC (ie, TM-11 9-track magtape) have fixed addresses assigned by DEC. These addresses can be found in the PDP-11 Peripherals Handbook. The addressable CU devices which are designed by Bell Telephone Laboratories (BTL) and manufactured by DEC are as follows:

- Channel Interface Circuits
- Active Channel lamps
- Carrier failure detectors
- Binary—ASCII Converter
- ASCII—Binary Converter
- Disk Interrupt Circuit
- Alarm Circuit
- Disk Interrupt Vectors.

3.05 The addresses for the CU devices, which are designed by BTL, are within the block of addresses 764000 to 764416. This block of addresses is reserved for PDP-11 customer use. These devices are assigned interrupt vectors 170 and 174 (BD04 vectors only). The addresses and interrupt vectors which have been assigned for each BTL-designed CU device are shown in Table C.

D. Interrupts

3.06 Various devices other than the processor are capable of becoming bus master on a level of priority higher than the processor. These devices are classified as nonprocessor request devices (NPR). Once an NPR device becomes bus master, it may execute nonprocessor data transfers directly from the device on the NPR level (ie, RK11 disk) to another address location (ie, core memory). These direct data transfers are done entirely without processor control and are termed NPR transfers. The following devices in the CU operate on an NPR level:

- RK11/RK05 Disk
- RF11/RS11 Disk
- TM11/TU10 9-Track Magtape
- DH11 TY Multiplexer

3.07 Another form of interrupt is the bus-request (BR) structure which allows a device to interrupt a program being executed by the processor and force it into a routine to service the device making the interrupt. This may be done on any of the four interrupt levels (BR4-7). The processor checks for these requests between instructions and if the processor level (controlled by bits 5, 6, 7 in processor status register) is less than the level of the device requesting the interrupt, it services that device. If the processor level is equal to or greater than the device requesting service, the device must wait until the processor level is changed to such a level where it may accommodate the device. The EADAS CU is comprised of numerous devices which operate on the BR level. Examples of these devices are:

- Disk Interrupt Circuit—level 7
- Line Printer—Level 4

TABLE C

CHANNEL INTERFACE CIRCUITS

ADDRESS	
764000 to 764046	Channel Interface Drawer No. 1 (Channels 0-19)
764050 to 764116	Channel Interface Drawer No. 2 (Channels 20-39)
764120 to 764166	Channel Interface Drawer No. 3 (Channels 40-59)
764170 to 764236	Channel Interface Drawer No. 4 (Channels 60-79)
764240 to 764306	Channel Interface Drawer No. 5 (Channels 80-99)

ACTIVE CHANNEL AND CARRIER FAILURE CIRCUITS

76431X	Channel Interface Drawer No. 1
76432X	Channel Interface Drawer No. 2
76433X	Channel Interface Drawer No. 3
76434X	Channel Interface Drawer No. 4
76435X	Channel Interface Drawer No. 5

where X is:

0	Low 10 Channels - Carrier Failure
2	Upper 10 Channels - Carrier Failure
4	Low 10 Channels - Active Channels
6	Upper 10 Channels - Active Channels

BINARY - ASCII CONVERTER

	INPUT	OUTPUT
764360	Binary number to be converted	Two most significant ASCII digits
764362	Holding Register	Next two most significant ASCII digits
764364	Unused	Holding register and least significant ASCII digit
764366	Unused	Unused

TABLE C (cont)

ASCII - BINARY CONVERTER

764370	Two Least Significant ASCII Digits
764372	Next Two Significant ASCII Digits
764374	Most Significant ASCII Digit
764376	Output - Binary Number

DISK INTERRUPT CIRCUIT

764400	33 ms Interrupt Off
764402	33 ms Interrupt On
764404	11 ms Interrupt Off
764406	11 ms Interrupt On

ALARM CIRCUIT

764410	Major Alarm
764412	Minor Alarm
764414	Alarm Reset
764416	Program Time-Out

DISK INTERRUPT VECTORS

170	11 ms Interrupt Vector
174	33 ms Interrupt Vector

Note: All addresses are expressed in octal number notation.

E. Data Organization

3.08 The handling of different data types, originating from various data sources, is simplified by employing hardware options in the channel interface circuits. In this manner differences in data format, word length, transmission rate, etc, are stripped away, and most data is presented to the processor as binary-coded words.

3.09 All data received at the CU fall into one of three types:

- Single-count data: Usage and peg count information received as it occurs, a 10-bit (1 of 1024) binary address. Each address received represents a count of one.
- Accumulated data: Data such as that received from a pollable data terminal (PDT) or an

ESS office on a predetermined collection schedule. Each data word represents a register total.

- Discrete-event data: Data denoting the occurrence of a particular event or of its cancellation (ie, a contact opening or closing, alarms on or off, etc.) required for network management. This data need not be totaled nor stored, but merely identified.

F. Data Identification

3.10 All incoming data as viewed internally by the control unit appears in essentially the same form. The CU distinguishes between the accumulated- and single-count data types by knowing that the input channel number completely identifies the register being scored. Register identification of accumulated data is determined by

its position in the data stream and identified by user definition of each channel.

G. Processing Data

3.11 Data received by the control unit will be processed through the system in four steps.

- (1) The data as received is temporarily buffered in core memory until it can be written on disk.
- (2) Periodically (once every several seconds), the data is summarized by adding the buffered data to the totals already stored on the disk. Therefore, the data on the disk represents up-to-the-moment totals.
- (3) While accumulating on the disk, the register totals form a data base for near real-time calculations and validity checks, as required.
- (4) Every collection interval (15- or 30-minute), the accumulated register totals stored on disk (which are scheduled to be outputted on magnetic tape) are converted from binary to ASCII, formatted and recorded on magnetic tape for downstream processing. If 60-minute tape intervals are desired, the data are summed as required prior to tape writing. Up to 16 independent 24-hour schedules can be user defined. An input channel can be assigned to any schedule. Each schedule has 96 bits specifying whether or not to write the data on tape for each 15-minute period for a full 24 hours.

H. Near Real-Time Calculations

Calculation Type and Use

3.12 Near real-time calculations are made by the control unit to validate the incoming data and provide local dial administrators with sufficient information to determine the quality of service being provided by their offices. For these purposes a number of calculations are performed for each of the input channels. These calculations are repeated every collection interval using the data gathered during the previous collection period.

3.13 To avoid the problem of outputting large amounts of "normal" data which tend to mask trouble indications, the system will output exceptions only. That is, a threshold table is

defined by the user against which each of the calculations will be compared. Should an exception occur, the calculation identity and its results are printed out on the appropriate remote dial administrative TTY and on the central high-speed printer (if provided).

3.14 Disk storage for calculation definitions are arranged modularly in 512-word blocks (approximately 17 calculation definitions can be stored in a block). One or more blocks may be assigned to a given entity, ie, an entity may have one block (17 calculations), two blocks (34 calculations), etc. A total of 400 such blocks are allocated (approximately 6800 calculations).

3.15 Should additional data be desired at a remote TTY, a request can be made to have the data printed out for the office. A system may employ as many as 16 remote TTYs. The dial administrator may also examine any threshold value by typing an appropriate message at the remote TTY. However, threshold modifications are only allowed through the Central Unit TTY.

3.16 While there is no strict rule on the makeup of the calculations, a suggested list of typical calculations is provided on an office-type basis. These calculations will allow a reasonable amount of data validation since lower limits may also be set on calculated results. For example, missing TUR scans can be alarmed by setting a lower limit on the TUR cycle count.

Calculation Features

3.17 The user-defined calculations are defined and then entered into the computer via the central teletypewriter. The calculations are specified in an algebraic-like language in a conversational mode with the central unit.

3.18 In order to output unusual traffic occurrences only, rather than outputting a continual stream of normal data results, exception thresholds are employed. Each calculation has associated with it two threshold values. This pair of threshold values can be used in one of two modes:

- (1) The two thresholds are interpreted as a "high" and "low" value, bracketing what is considered a normal range for that calculated result. If a calculation results in a value which is not between these brackets, then it is said

to be an exception and is printed. Example—the normal TUR scan count for a 1/2 hour interval is 18. If the TUR scan count is defined as a calculation (in this case just a single register reading) and if its two associated thresholds have values of 17 and 19, then the TUR scan count will be outputted; if it is less than or equal to 17 or greater than or equal to 19 (ie, if it is not 18), then it will be printed.

(2) The two thresholds are interpreted as a busy-period and nonbusy period threshold. For each entity, up to three busy-period schedules can be defined. A calculation is associated with a schedule, and if it is the busy period, then the first threshold is used; otherwise, the second threshold is used. An example should illustrate its use.

Assume that schedule 1 for entity X defines the busy periods as 10-11 AM and 2-5 PM. Assume that the % DTSST calculation has a busy-period threshold of 3 percent and a nonbusy period threshold of 1 percent. If the % DTSST calculation performed at 9:30 AM for entity X is 2 percent, then it will be printed as an exception (since schedule 1 defines that as a nonbusy period. The low threshold—1 percent—used in this case is exceeded). On the other hand, if % DTSST equals 2 percent at 10:30, the result would not be an exception and, therefore, would not be printed. In this mode, a threshold can be treated as either a high or low threshold.

3.19 Each calculation can be either a master or slave calculation. Any calculation which is defined as a master is only printed if it exceeds its threshold. A slave calculation, on the other hand, is printed if either it exceeds its threshold or its master exceeds its threshold.

3.20 The interpretation of the result of a calculation frequently depends upon certain sub-parts of the calculation (eg, value of the numerator or denominator). In EADAS up to five separate sub-parts can be defined and labeled. A sub-part can be a register reading, a sum of register readings, or a constant. In order to increase the number of messages which can be outputted to a remote dial administrator TTY, one can optionally decide to print only the calculation name and result in which case the sub-part values are only printed on demand (requiring a TTY inquiry message).

3.21 EADAS provides the ability to define a calculation involving registers from more than one entity. This might be used, for example, to compute the actual calls handled (ACH) for a trunk group precisely by measuring the peg count at each end of that group (using the peg count measured at the entities on either end of the group).

Hourly Summary Reports

3.22 EADAS also has the ability to generate hourly summary reports. Normally, it is expected that the user will only want such reports for preselected hours during a day. Therefore, up to 16 schedules can be user defined, and each channel may be assigned a schedule for summary reports. These reports go to the appropriate dial administrators as well as being printed on the high-speed line printer. Such reports will be printed after the exception reports are printed (exception reports have priority over summary reports). The summary reports are fixed-format per office type. A maximum of 16 such reports will be available and the user needs to only specify which calculations get inserted within a given format. Summary reports will consist of a maximum of 64 calculations per report.

4. SYSTEM SOFTWARE

A. System Operation

4.01 The EADAS mission is accomplished by a series of interrelated task programs, each of which performs (or helps perform) a system function. These functions include:

- Collecting and summarizing data for up to 100,000 registers over a maximum of 100 channels from a variety of sources on both an event-by-event and accumulated total basis
- Periodically performing several thousand user defined arithmetic calculations on the summarized data
- Reporting calculation results which exceed predefined limits on up to 16 remotely-located dial administrator (DA) sites and optionally at the central site

- Recording the summarized data on a magnetic tape on a scheduled basis for downstream processing
- Issuing formatted hourly reports about each entity on a scheduled basis to the DA and central sites
- Retaining for an extended period of time the results of all arithmetic calculations performed in the system
- Accepting demand requests from all TTYs for supplementary data such as additional results and raw register totals
- Performing other ancillary functions such as administering user-defined schedules and data tables, performing remote detection tests on input channels, etc.

4.02 EADAS programs will be required to pass summarized register totals on a frequent basis to the Network Management (NM) system and to accept and execute network control information from the NM system.

4.03 The relationship between these functions is best understood by looking at an overview of the system. Traffic data, transmitted over the input channels, is received by interface circuits which temporarily places the new single-event data in core buffers associated with each channel. As the core buffers fill, the data is placed on disk as summed totals in areas dedicated to each channel. This continues for a period of time (swap period), either 15 or 30 minutes, after which the data just collected is made passive. At this point, other functions such as performing calculations, printing results and writing magnetic tape are activated to operate on the passive data. Also at this time, those channels which transmit register totals are polled. Meanwhile, the single event data is being received, buffered, and placed on a second active area of disk. After each activated function completes, it enters a quiescent stage where it is no longer running. When either 15 or 30 minutes has elapsed, the new data is frozen, the active and passive areas of the disks are swapped, the various tasks are activated again, and the cycle repeats itself.

B. Program Organization

4.03 The EADAS program operates on-line in real time in a multiprogramming environment

to perform its many tasks. It is structured so that several partially completed tasks may be processing concurrently in a main repeating loop called base level. In this base level loop, only one task is actually executing at any instant in time, but over a period of time all tasks are performed, each one alternating between using the processor and waiting for input/output requests to finish. This structure has the effect of dividing each task into sections where only one section of each task executes in a given base level loop. Thus, each task will require many sections, ie, base level loops, to complete.

4.04 Interrupts, handled by interrupt service programs, are used to temporarily suspend the execution of the base level loop. Interrupts occur when an input/output (I/O) action or file operation has been completed and on a timed basis for scanning input channels. Knowledge that the I/O action has occurred and is communicated to the concerned base level program. The base level loop is then continued at the place where the interrupt occurred. The next time the concerned base level program is executed it can continue on with the section of code that interprets the effects of the I/O action.

4.05 In addition to base level and interrupt service programs, there is a third class of programs in EADAS called service routine. These are pieces of code, needed in common by many tasks, which do not need a real-time break. Examples of this type of service routine include printing TTY messages and entering disk requests, program timing, using ASCII-to-binary and binary-to-ASCII converters.

4.06 Sequencing of base level programs is controlled by an executive program. This program causes each base level program to be called in a predefined serial order. After the last program in the sequence is executed, the executive restarts the cycle by calling the first program, thus forming a closed loop.

4.07 Most of the functions in EADAS which process collected data are periodic in nature usually occurring once per system period. These programs are initiated by a time monitor program which operates as part of the disk interrupt. The time monitor does this by comparing a system software clock to a generic time schedule and then placing the first progress mark of programs scheduled to be run in their slot in the executive table. This

causes the first segment of the program to execute within the next base level loop.

4.08 Many of the functions in EADAS do not take a full system period to complete. In fact, most are quite short, taking only a few minutes to execute and then remaining in a dormant state for the rest of the swap period. Also, some sets of functions have a natural execution sequence among themselves, ie, they are naturally executed in mutually exclusive time intervals. Other periodic functions have no restriction as to the time during a swap period that they execute and, consequently, may be engineered into mutually exclusive execution intervals. In addition to period functions, certain TTY requests are also mutually exclusive. These facts are used to reduce the amount of core occupied by programs. This is done by having programs which execute in mutually exclusive time intervals share the same core area on an overlay basis. Thus, all programs of a set will reside on disk while only the currently executing program will be in core. When it finishes the next sequential program will be read into core from disk and subsequently executed.

4.09 A common paging program is used to bring the programs from disk into core and start their execution. The same paging program is called when the time monitor program initiates a sequence and when a program to handle a TTY request is overlaid in core. All programs in a mutually exclusive set will also use the same executive table progress mark slot.

4.10 EADAS provides four distinct types of communication with its user via the dial administration (DA) TTY, the CU TTY and the line printer. Two of these consist of output initiated by EADAS to produce routine calculations which have exceeded assigned thresholds and hourly reports and EADAS error messages. The error messages are printed automatically on the CU TTY.

4.11 System error messages can be issued by any task program in the system and are printed on the CU TTY. They are divided into four categories: information, action, warning, and fatal. Some messages can call for human intervention and will discontinue a function until that action is taken. For example, if the magnetic tape is off-line at the beginning of a swap period, the program will issue an error message and cancel magnetic

tape writing until an operator places the tape on-line. The other types of communication are of an interactive nature and are initiated by the user. These are:

- modes for defining installation dependent parameters needed by the system, and
- demand requests for additional information on collected data or for verification of parameter definitions.

Five modes are implemented to specify such things as calculation definitions, hourly report formats and collection schedules. These modes may be entered only at the CU TTY and are conducted in a semi-conversational manner.

4.12 Demand requests may be made from any of the DA TTYs or from the CU TTY. Replies to requests made from a DA TTY are printed only at the TTY. These inquiries may request almost any information stored in EADAS, whether or not the information pertains to an entity normally associated with the requesting TTY. If an inquiry breaks the printing of exception and calculations or busy reports, these reports are lost. However, the current message being printed and several other queued messages could be lost. Input from a DA TTY can not alter information in the system.

4.13 Demand requests at the CU TTY may be about any information stored in EADAS. Depending on the size and the internal way in which it is constructed, the response may appear on the line printer or the TTY. If an inquiry interrupts routine printing on the line printing, this printing will not continue after the inquiry is answered. Certain commands, such as change time of day, can also alter information in the system.

4.14 Since the man/machine interface in EADAS is so diverse and involves a multiplicity of devices, many highly interrelated task programs are needed to accomplish this function. These task programs are partitioned by device and operate both at interrupt level and base level. The interrupt programs interface with the hardware, while the base level programs interpret input messages and assemble replies which are passed to the interface programs. In some cases, several base level programs are executed in order to print a single

line of output. Fig. 8 gives a general overview of the complex program structure needed to handle the man/machine interface.

C. Disk Memory Organization

4.15 The basic disk memory system used in EADAS consists of a fast access disk (fixed head) having 128 tracks of 2048 words for a total storage capacity of approximately 260,000 words. There are two disk cartridges (moving head) each having a capacity of 406 tracks of 3072 words for a total memory system capacity of around 1.2 million words. The data is subdivided into six sections:

- Program and system parameters
- A raw register accumulating area
- User defined calculation definitions
- Hourly accumulation areas for raw registers
- User defined hourly report formats
- Long term exception report calculation results.

The six major sections of data have fixed sizes and locations on the disk.

Registers

4.16 Two identically formatted sets of 50 contiguous tracks on the fixed head disk are used to store register totals. One set, known as "passive," is used to hold the data totals for the previous swap period. This includes both event-by-event data collected during the previous swap period and accumulated totals received at the beginning of the current swap period but representing the previous swap period. The other set, known as "active," is used to accumulate the data for the current swap period including both partial event-by-event totals and intermediate accumulated data totals needed for network management. The active/passive areas are swapped just prior to the beginning of a swap period by zeroing the then passive set of tracks and interchanging the starting addresses of the two sets of tracks.

4.17 Within a set of tracks, the data is organized by dedicating one half track to each one

thousand register group or fraction thereof ("software channel") from an input source. For event-by-event data sources (where the maximum input is 992 or less), the entire source corresponds to a single software channel. For accumulated data sources (where up to three thousand inputs are allowed), a single input source can correspond to up to three software channels. The numbering of software channels is in one-to-one correspondence with the contiguous track addresses in a set, ie, software channels zero and one are stored on the first track, channels two and three on the next, channels 98 and 99 on the 50th.

4.18 Software channel numbers are assigned by the program when the input sources are defined and are for internal program use only. The assignment separates the input sources into two mutually exclusive groups in which event-by-event channels are numbered contiguously in ascending order starting with zero, and accumulated total channels are numbered contiguously in descending order starting with 99. Assignment in this manner insures the most efficient processing of inputs and also expedites system growth since the software channel numbers and the channel interface slot number to which an input source is physically connected do not have to be the same.

4.19 Each track is divided into two sections, a 1000-word block for storing totals and a 24-word header. The header is used to store information related to the input source which is needed for various system functions. This includes such items as source identity, collection schedules and scaling factors. For event-by-event sources the word assignments in the 1000-word block bear a one-to-one ordered relationship to the assignments of inputs on the data collection device. For accumulated sources, the same order relationship holds within each of the associated software channels. For example, an accumulated data source with 1800 contiguous inputs would have two software channels assigned. The first would hold inputs 1 to 1000 in order; the second would have the remaining registers in words 1 to 800 in order. Hence within each set of tracks, a disk word ("software register") is dedicated for every input in the system.

4.20 In addition to the active and passive sets of raw register totals kept on the fixed head disk, a third set of "accumulated" raw register totals is kept on the moving head disk. This third set, formatted identically to the other two, holds

INTERRUPT

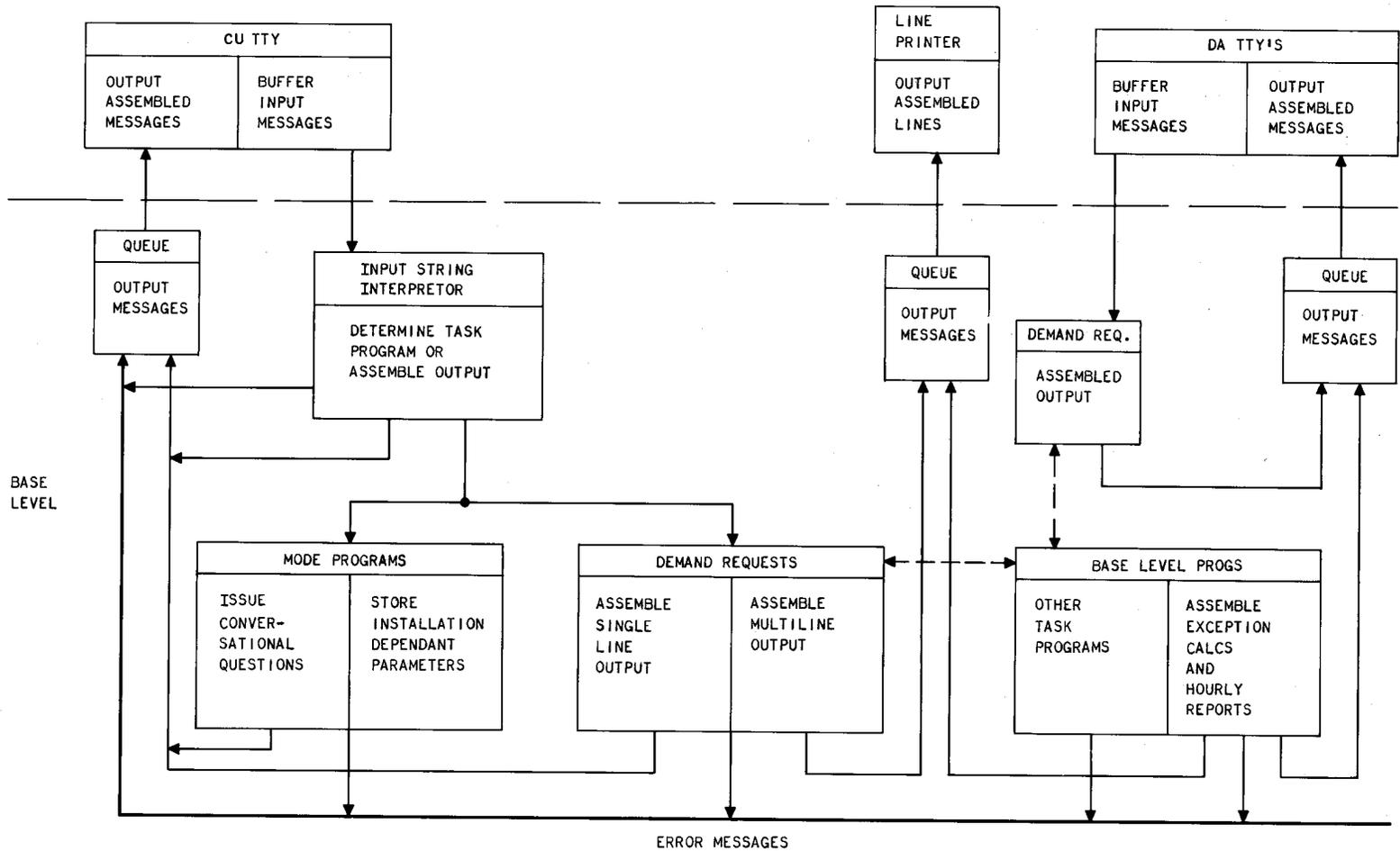


Fig. 8—EADAS Man/Machine Program Flow

the summed hourly totals. It is used both for making hourly report calculations and for writing magnetic tape if the swap period is different from the magnetic tape writing interval.

Program

4.21 The remaining area on the fixed head disk is used to store a copy of the object code of the EADAS program. This copy is used both in paging during system operation and for primary backup in case of system failures. In addition to the program image, a bootstrap loader and a system backup module are also stored. The bootstrap loader is a small program which is used to load the initial core image during system startup. It must be physically located at the beginning of track zero in order to be manually accessible. The system backup module is another small program which is used to create and access secondary system backup information on magnetic tape.

4.22 The program image is divided into a fixed area and a variable area. The fixed area consists of parameters and non-paged programs. It is stored on the disk as an exact core image of the lowest number addresses in core. Parameters consist of vector addresses needed to handle interrupts and special processor conditions and miscellaneous installation dependant information which is in core rather than on disk. Examples of such information include availability of the line printer, a table of the current status of each input channel, and supplementary data for using channels and calculation definition blocks. The variable area contains all paged programs. Except for the initial image of paged programs, all paged programs are stored in arbitrary order on the disk. A table within the common paging program maintains the location and size of paged programs on the disk.

Calculation Definitions

4.23 A modular highly-structured set of tables which contain the information needed to define exception report calculations and hourly-report calculations are stored on the moving head disk. The modular pieces, known as blocks, contain 512 words (1/6 track) and can hold up to 17 (on the average) calculation definitions about a single software channel. A multiple number of blocks, typically between one and three, may be linked together for a single channel.

4.24 In all, a maximum of 400 blocks (up to 6800 calculations) are provided. A chained list, which accords easy administrative and growth practices, is used to associate software channels with their blocks. The first block for each channel is found via an index table kept in core. Additional channel-related blocks, if any, are pointed to by linkage words stored on each block. Each block is essentially self-contained and encompasses nearly all of the data needed to define, perform, output, and administer each of its calculations. This includes an alphanumeric identification, multiple thresholds, intermediate and final results, and exception printing formats for each calculation. The actual definition is stored as a variable length string of register numbers, constants, and arithmetic operations which is interpretively processed to perform a calculation. Thus, the user has complete flexibility in defining each calculation and the output generated by it.

Long Term Data

4.25 The major portion of the moving head disk is used to store exception report calculation results over an extended period of time. This area is arranged to hold results of 96 15-minute swap intervals for a fully-equipped system (100 channels). The period of time which these 96 intervals cover varies since the user defines not only the length of a swap interval but also the continuous hours per day to store long term data. For example, if the user specifies the swap interval as 30 minutes and wishes to save results for the entire day, then at any time the data base will contain calculated results for the previous 48 hours.

4.26 Internally, the long term data is stored in a rotating buffer with 96 slots. Each slot is 34 sections in length and holds all the results for one swap period. The results from six calculation definition blocks are packed into one disk section (1/12 track). Along with the results, pass/fail indications are kept on a per calculation basis. As a check when retrieving data on demand, the time of the results is stored on each sector.

D. Interrupt Programs

4.27 A multilevel (four) interrupt system is provided in the PDP 11/40 processor to allow entry to programs immediately on demand. Interrupts have a two-dimensional priority structure such that the highest level interrupt demand is executed. In addition, for simultaneously appearing requests

within a single interrupt level, the most important device (determined by physical closeness to the processor) is executed. When an interrupt signal is generated, an interrupt service program (ISP) is entered at a fixed programmable address corresponding to that device. The ISP will execute at the processor level corresponding to the status word assigned to the vector. When the service program is finished, control is returned to the program that was interrupted. Fig. 9 depicts the interrupts assigned to each priority level and their relative importance within each level.

4.28 Most demand interrupts signal the completion of an input/output action. The action itself was performed by a direct memory access (DMA) transfer without processor supervision. For example, to perform a disk read, a program merely informs the disk controller of the location of the desired data and the location of the core buffer into which to put the data and then the program relinquishes control to the executive. After the disk has positioned itself, the actual data transfer is done via a DMA request while the processor is

executing other code. After the last word is transferred, an interrupt signal is sent to the processor causing the disk ISP to be executed. This program will communicate to the requesting program that the disk read has been completed. Interrupts are also generated on a fixed-time basis to perform frequently occurring periodic functions. For example, scanning for register data on the input channel interfaces is done on a fixed periodic basis using a timed interrupt.

Input Channel Scanning

4.29 The program (SCAN) that scans input data channels is divided into two sections, one of which handles event-by-event data, the other accumulated totals. Since most channels will be of the former type, the system software was structured to handle these as efficiently as possible.

Event-By-Event Data

4.30 Event-by-event data is transmitted to EADAS at the rate of 80 words per second per

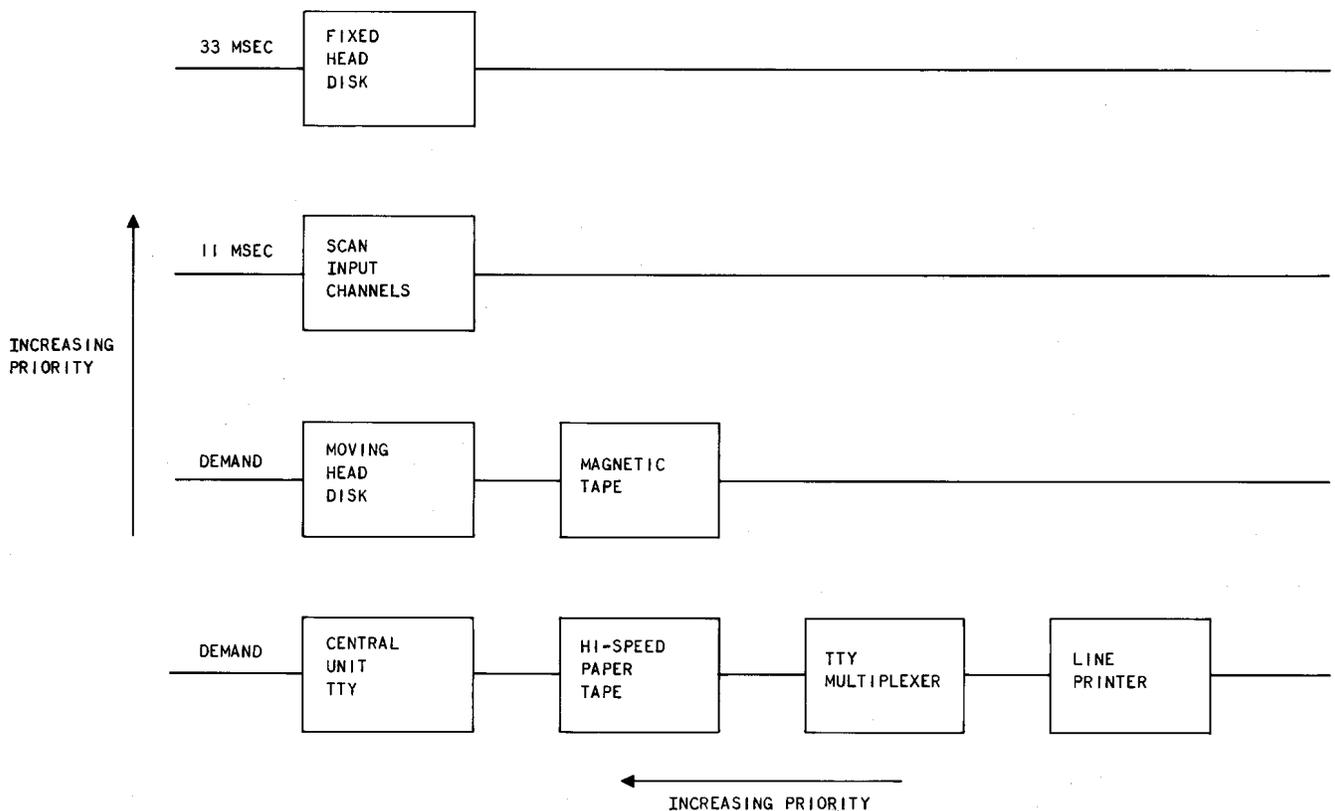


Fig. 9—EADAS Interrupts

channel and is buffered in core temporarily. The areas on disk corresponding to each channel are continuously read, one after the other, into core, updated with the new data and rewritten onto the disk. In order to reduce the amount of core memory needed, an algorithmic scheme was developed for buffering the input data. Briefly this scheme, known as "triangular buffering," eliminates core memory which would otherwise be empty when the arrival and processing of input is uniform. It does this by dynamically altering the buffer slots assigned to each input channel over time. Thus, while the total buffer space always remains full, the input channels which were recently updated will have only a few allotted slots and the channels to be updated next will have the most allotted slots. The fundamental assumption of the triangular buffering scheme is that the input scanning and disk updating process is uniform. This means that a fixed integer number of scans of the input channels must be made before each source is updated.

4.31 The fixed head disk used for storing register totals has a rotational speed of 33.3 msec. However, a word of input is transmitted over each input channel every 12.5 msec. Therefore, in order to synchronize the scanning of inputs with the disk, a fixed time interrupt of 11 msec was chosen for scanning. To guard against drifting of the interrupt, generation of the scan interrupt pulse is physically tied to the disk timing gap. The scan interrupt is offset by 5 msec from the disk timing gap so that the program that updates the disk can execute partially (and empty some of the buffer) before the scan program places more data into the buffer. Every 11 msec, the program reads each interface and places the contents into the core buffer slot determined by the triangular buffering algorithm. Every twelfth scan, after all channels have been scanned, the scan program initiates an update program.

Accumulated Totals

4.32 Devices containing their own local memory for accumulating traffic data can be polled by EADAS at regular intervals. Presently, a number of such devices exist including offices with outside vendor accumulating devices, ESS offices and pollable data terminals. Each register total transmitted from these devices is identified by its position in the data stream. The data, therefore, will be transmitted in small groups or blocks in

order to avoid loss or retransmission of large blocks of data, should synchronism be lost. Each block will contain an identifier and up to 250 register totals.

4.33 The number of accumulated sources polled simultaneously is a function of the amount of core memory allotted. This is a function of the percent of accumulated devices in the system and the importance associated with accumulated data. Between two and 16 buffers will be provided for accepting simultaneous transmission of accumulated data. Each of the buffers will be around 300 words, 250 for a block of register totals and 50 for control information.

4.34 Since each device has unique features, each must be treated differently. These differences include: the format of data transmitted, the data rate, the polling frequency, and the polling technique. The program (POLACM) which does the polling and processing is divided into two sections, base level and interrupt level. The interrupt program interfaces the software with the channel data links. The base level program deals with the differences in channels. It decides the channel and function to be worked on next, passes output messages to be transmitted to the interrupt program and processes data previously accepted by the interrupt program.

4.35 The interrupt level portion of the accumulated data program executes during the 11 msec timed interrupt after the event-by-event data channels have been scanned. It looks at each active input buffer, determines the channel using that buffer and the function currently being worked on. For example, if the channel is currently transmitting totals, it scans the input interface for data and buffers it. If transmission is an ASCII, the interrupt program assembles the characters into binary numbers. When a block has completed transmission, the interrupt program flags the base level program to process the data. A reverse process is followed when the buffer is being used to transmit a polling request to a device.

4.36 The fixed head disk is used primarily for accumulating register totals. The process of scanning inputs and updating the corresponding software registers must be done synchronously. Since input scanning is an interrupt process, updating must also be initiated by an interrupt synchronized to the scan interrupt. Since it is initiated by an interrupt, updating cannot wait for

disk accesses and hence cannot use the normal method for obtaining disk data. Therefore, a structure was developed within the framework of EADAS which maintains the proper time sequence between scanning and updating the disk and which insures that the correct software registers are in core for the update program. This structure involves both software within the disk interrupt service program and a minor variation to the standard disk interrupt arrangement.

Service Routines

4.37 There are many well defined subjects which are needed in common by many task programs. Some of these, such as using the hardware ASCII-to-binary converter, can be accomplished immediately and involve nothing more than a straightforward subroutine call. Others require a real-time break and are considerably more involved. These are generally accomplished through a series of progress marks either in common or within individual task programs.

4.38 The disk monitor program (DMONTR) is used by task programs when requesting disk accesses. It has multiple entry points, one for each type of data on the disk. When a task program needs data, it calls DMONTR at the appropriate entry point with an indication of the specific data to be accessed. Other information pertinent to the request is passed via a table in the task program.

4.39 A disk request can be in any of four distinct stages, each of which is characterized by a progress mark in the task program.

- Progress mark 1—A call to the appropriate subroutine. This is needed for retries when the queue is full.
- Progress mark 2—Request is in queue or being performed. This can be an immediate return to the executive, or timing can be performed as a defense against system malfunction.
- Progress mark 3—An error occurred on the disk request. The task program, not the monitor, now decides the action to be taken.
- Progress mark 4—Disk access was completed unsuccessfully. Task program continues.

This combination of progress marks, together with the calls to DMONTR, affords the task programs considerable flexibility when using the disk, while still placing all of the common jobs in a single program.

E. Base Level Programs Polling Accumulated

Data Devices

4.40 The base level program (POLACM) that initiates the polling of accumulated devices is activated every system period. This program looks at each accumulated data channel and determines from an internal schedule if any data is to be received. If no data is received, the channel is marked completed. If there is data to be received, a core buffer is assigned to the channel. The program then determines the size and number of blocks to be polled and formulates a polling message in the core buffer. After the message has been sent and a block of data has been received by the interrupt program, the base level program checks the data for error and, if none, decides where to store the data. If an error is determined, retransmission is requested when possible. If not possible, the data is marked as bad. This procedure continues until all blocks for a device have been transmitted. At this time, the device is marked completed, the buffer is released, and another device is processed. Input buffers can be polled in parallel for as many devices as there are. There are two exceptions to these descriptions. First, in EADASs which are passing data to a network management system, POLACM will be executed every five minutes. The number of blocks received at these five-minute intervals will usually be much less than at the swap period. When the swap period and a five-minute interval occur simultaneously, polling for all network management is completed before any non-network management data is received. Second, the swapping of active/passive memories in some devices is controlled by EADAS. Whenever entered, POLACM will swap the memories in all devices indicated for that time before polling any device for data. This insures that the data received from accumulated devices represents most nearly the same time period.

5. SYSTEM HARDWARE

5.01 The central processor and all the peripheral devices attached to it via the UNIBUS are

shown in Fig. 6. Fig. 6 represents the system UNIBUS structure.

5.02 The basic function of EADAS is to accumulate register totals from a maximum of 100,000 inputs which are received via the 20-channel drawers. The processor is interrupted every 11 milliseconds by the disk interrupt circuit which is synchronized to the revolution of the fixed-head disk. The interrupt, when generated, forces the processor into a scan routine which reads all the equipped channel interface circuits. The received data is then transferred temporarily to core memory and then written on the fixed-head disk. At predetermined intervals, the data is then used as a data base upon which calculations are performed and then stored on the moving-head disk. In addition, the data is written on 9-track magnetic tape for downstream processing.

5.03 Hardware arithmetic operations are performed by various devices within the CU which include the processor (add, subtract), extended instruction set (multiply, divide, arithmetic shifts) and the BD03 BIN/ASCII to ASCII/BIN converter.

5.04 The CU operates under control of instructions entered on the CU teletypewriter. Under this control, the modes of operation may be exercised and data may be outputted on the line printer, 9-track magnetic tape, high-speed paper tape, or CU teletypewriter. In addition, the CU has 16 remote dial administrator teletypewriters which allow access to the data retained within the CU pertinent to the location of the teletypewriter. These teletypewriters tie into the CU via dedicated data facilities and the DH11-AA 16-line programmable, asynchronous serial line multiplexer.

5.05 The bulk storage within the CU is provided by the following:

- (a) RK05 disk (1.2 million words each)
- (b) RS11 disk (262,144 words each)
- (c) Core memory (64,000 to 112,000 words).

This amount of storage provides for the retention of received data, the results of calculation, and the system software.

5.06 The EADAS CU is capable of establishing DDD facilities via the DN11 automatic calling

unit interface and the 801 automatic calling unit. This feature is required for obtaining data from devices such as PDT terminals which require polling at various time intervals.

5.07 The EADAS CU is capable of establishing an interface with the EADAS/NM CU. This feature is required for frequent data transfer during downstream data processing. The direct interface between EADAS and EADAS/NM is the DQ11 module located in either system. When the systems are further apart than 50 feet, a 209A data set and a data link facility are also required.

5.08 The EADAS/ICUR option is capable of collecting usage data on individual circuits. This feature is required to obtain additional data processing for administrative and diagnostic purposes. The ICUR data is output on a second 9-track magnetic tape, while error messages are provided on a read-only teletypewriter. The additional 32K memory and storage on RS04 disks are provided for data handling.

5.09 The system location diagram for the cabinets constituting the CU is shown in Fig. 2. Fig. 3 shows the system drawer layout. The layout was configured to adhere to the UNIBUS length, UNIBUS loading, and the NPR and BR latency requirements of the PDP 11/40 computer.♦

6. MAINTENANCE

6.01 Through careful planning and design of the CU, the maintenance problems associated with equipment having more than one manufacturer have been avoided. This has been accomplished by having Digital Equipment Corporation (DEC) manufacture and supply all equipment closely coupled with the computer operations and Western Electric Company manufacture and supply the remaining equipment such as data sets and associated equipment. As a result, DEC supplies ♦as many as eight (depending on features)♦ complete cabinets and Western Electric Company supplies two with all interconnections made through connectors.

6.02 The maintenance of the WEC Co cabinets consists almost entirely of replacing faulty circuit packs. These cabinets house relatively simple circuitry that is repeated many times and, therefore, should not be too difficult to maintain.

6.03 The DEC portion of the CU involves sophisticated, high speed electronic circuitry and mechanical equipment requiring preventive and corrective maintenance. Due to this fact, DEC offers a maintenance contract to maintain the cabinets they supply and to perform the necessary preventive maintenance.

6.04 The Telco craftperson is expected to maintain the cabinets produced by Western Electric and also perform trouble sectionalizing tests to isolate troubles to the DEC equipment. See Section 252-115-302 for trouble sectionalizing.

6.05 The electronics in the CU equipment have a high reliability compared to the mechanical subsystems. In light of this, the possibility of supplying additional or standby disk and tape drives shall be considered for periods of preventive and corrective maintenance.

7. REFERENCES

7.01 The following is a list of sections containing information on the Engineering and Administrative Data Acquisition System.

SECTION	TITLE
252-115-102	EADAS Traffic Data Converter SD-3B213-01 Description
252-115-103	Pollable Data Terminal SD-3B232-01 Description
252-115-301	Central Unit Operating Procedures Engineering and Administrative Data Acquisition System
252-115-302	Central Unit—Trouble Sectionalizing Engineering and Administrative Data Acquisition System
252-115-511	EADAS Traffic Data Converter SD-3B213-01 Remote Tests
252-115-512	EADAS Traffic Data Converter SD-2B213-01 Tests of ETDC at ETDC Location
252-115-513	EADAS Traffic Data Converter SD-3B213-01 Trouble Locating Procedures
252-115-514	EADAS Traffic Data Converter SD-3B213-01 Connection Verification Tests Using the ETDC Input Pulser SD-3B221-01
252-115-515	EADAS Traffic Data Converter SD-3B213-01 Connection Verification Tests Using EADAS Test Set SD-3B220-01
252-115-516	EADAS Traffic Data Converter Circuits SD-3B213-01 and SD-95968-01 Channel Definition and Validation
252-115-521	Pollable Data Terminal SD-3B232-01 Remote Tests
252-115-522	Pollable Data Terminal SD-3B213-01 Local Tests
252-115-523	Pollable Data Terminal SD-3B213-01 Connection Verification Tests