iRMX™ 86 I/O

SYSTEMS WORKSHOP NOTEBOOK

REV. 1.0

OCTOBER 1981

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INTRODUCTION

COURSE OVERVIEW

1. BASIC I/O SYSTEM REVIEW
2. BASIC I/O SYSTEM CONFIGURATION
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4. FILES UTILITY
5. DEVICE DRIVERS
6. O.S. EXTENSIONS
7. EXTENDED I/O SYSTEM
8. HUMAN INTERFACE
9. START UP SYSTEM

CHAPTER 1

BASIC I/O SYSTEM REVIEW

THE FILE

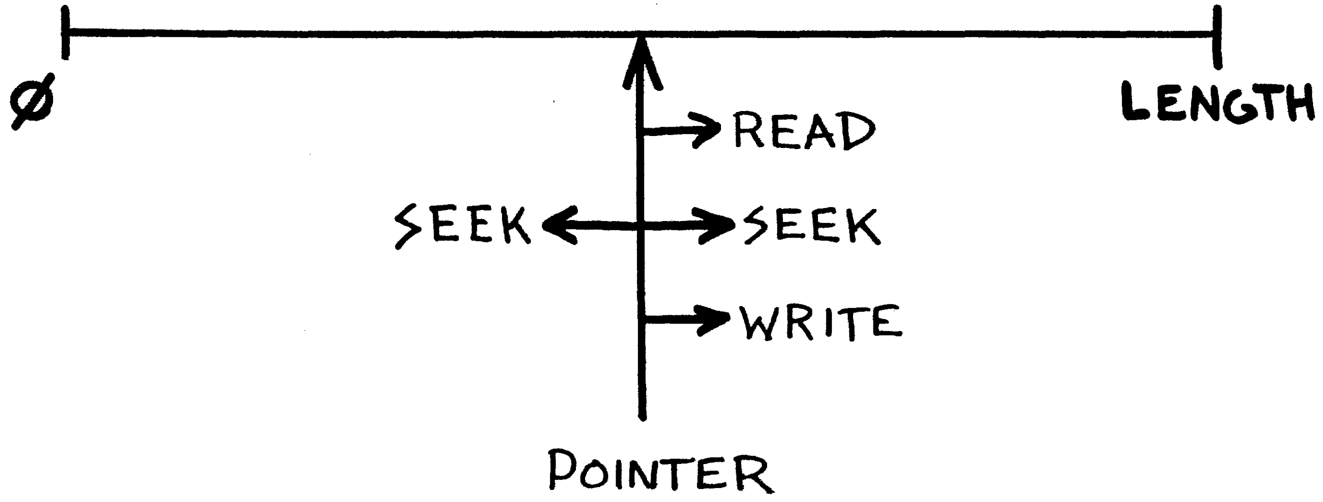
- A COLLECTION OF DATA
- ORGANIZED AT BYTE LEVEL
- MEDIA INDEPENDANT (AT FILE LEVEL)

THE FILE

- A COLLECTION OF DATA
  - DATA FROM PROCESS CONTROL
  - TEXT (LETTER, REPORT, ETC.)
  - INFORMATION PASSED FROM TASK TO TASK
  - REFERENCE INFORMATION (INVENTORY, PAYROLL, ETC.)

THE FILE

- ORGANIZED AT BYTE LEVEL
  - LENGTH
  - POINTER



THE FILE

- MEDIA INDEPENDENT (AT FILE LEVEL)

  - DESIGN FLEXIBILITY
  - TEST FLEXIBILITY
  - RUN TIME FLEXIBILITY

ACCESS METHODS

- SEQUENTIAL ACCESS
- RANDOM ACCESS

RMX-86 FILE TYPES

- PHYSICAL
- NAMED
- STREAM

FILE TYPES VS. ACCESS METHOD

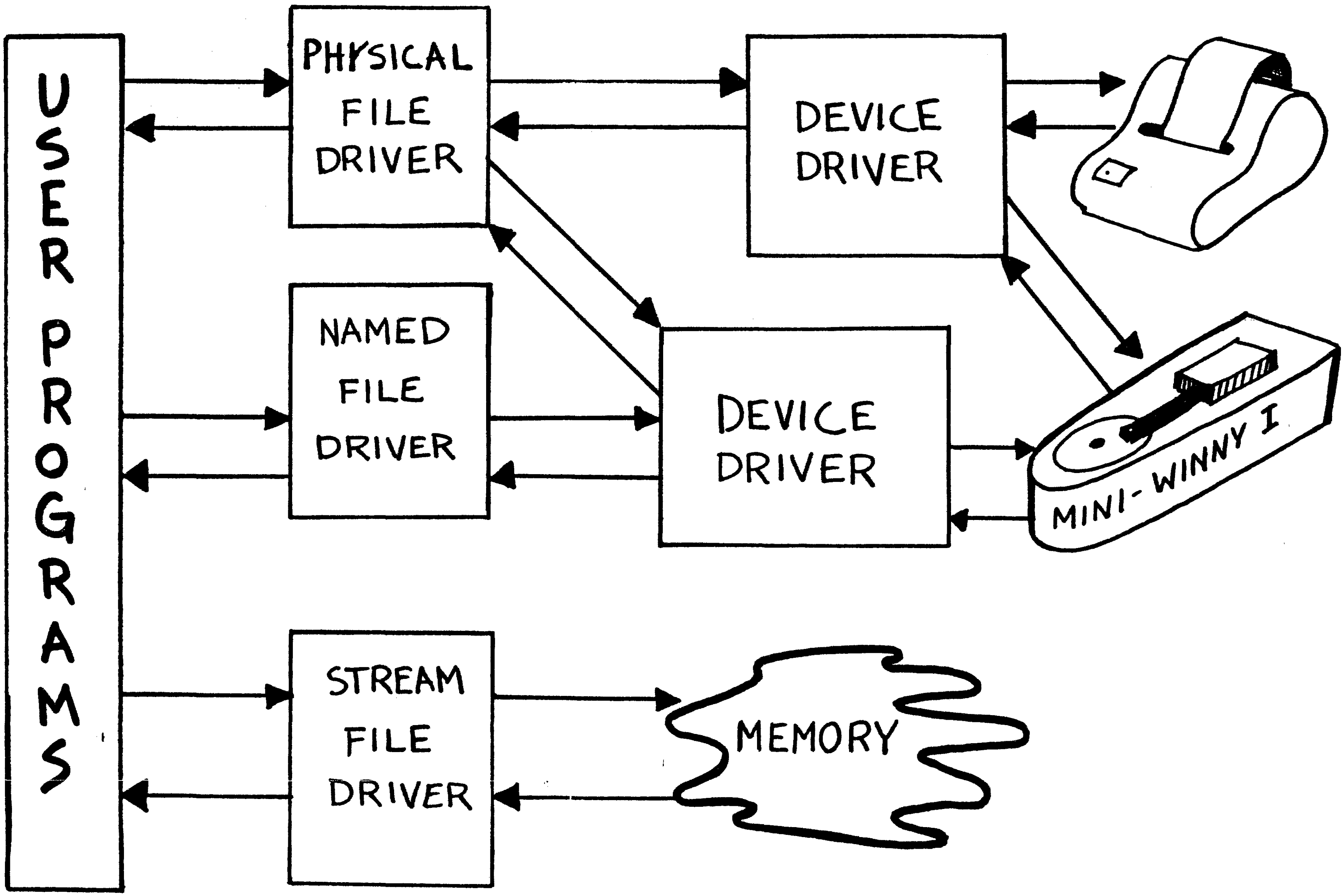
ACCESS METHOD FILE TYPE	RANDOM	SEQUENTIAL
PHYSICAL	✓ NOTE	✓
NAMED	✓	✓
STREAM		✓

NOTE: DEVICE MUST SUPPORT RANDOM ACCESS.

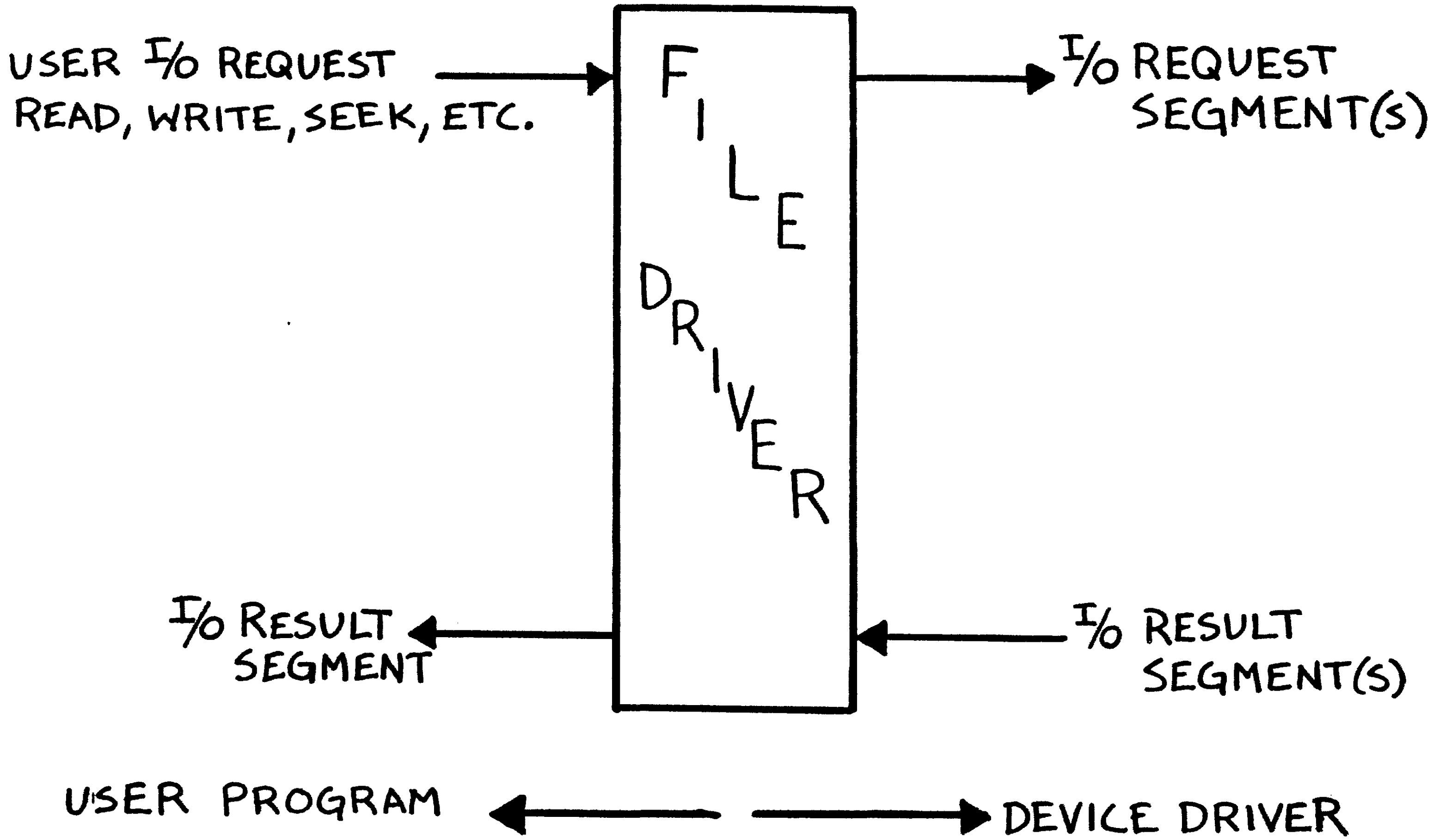
SOME EXAMPLES

SEQUENTIAL/PHYSICAL	–	THE TELETYPE THE LINEPRINTER, ETC.
RANDOM/NAMED	–	RMX DISK OR DISKETTE OR BUBBLE
SEQUENTIAL/STREAM	–	INTERTASK DATA TRANSFER
RANDOM/PHYSICAL OR SEQUENTIAL/PHYSICAL	–	READ OR WRITE ANY FORMAT DISKETTE OR TAPE

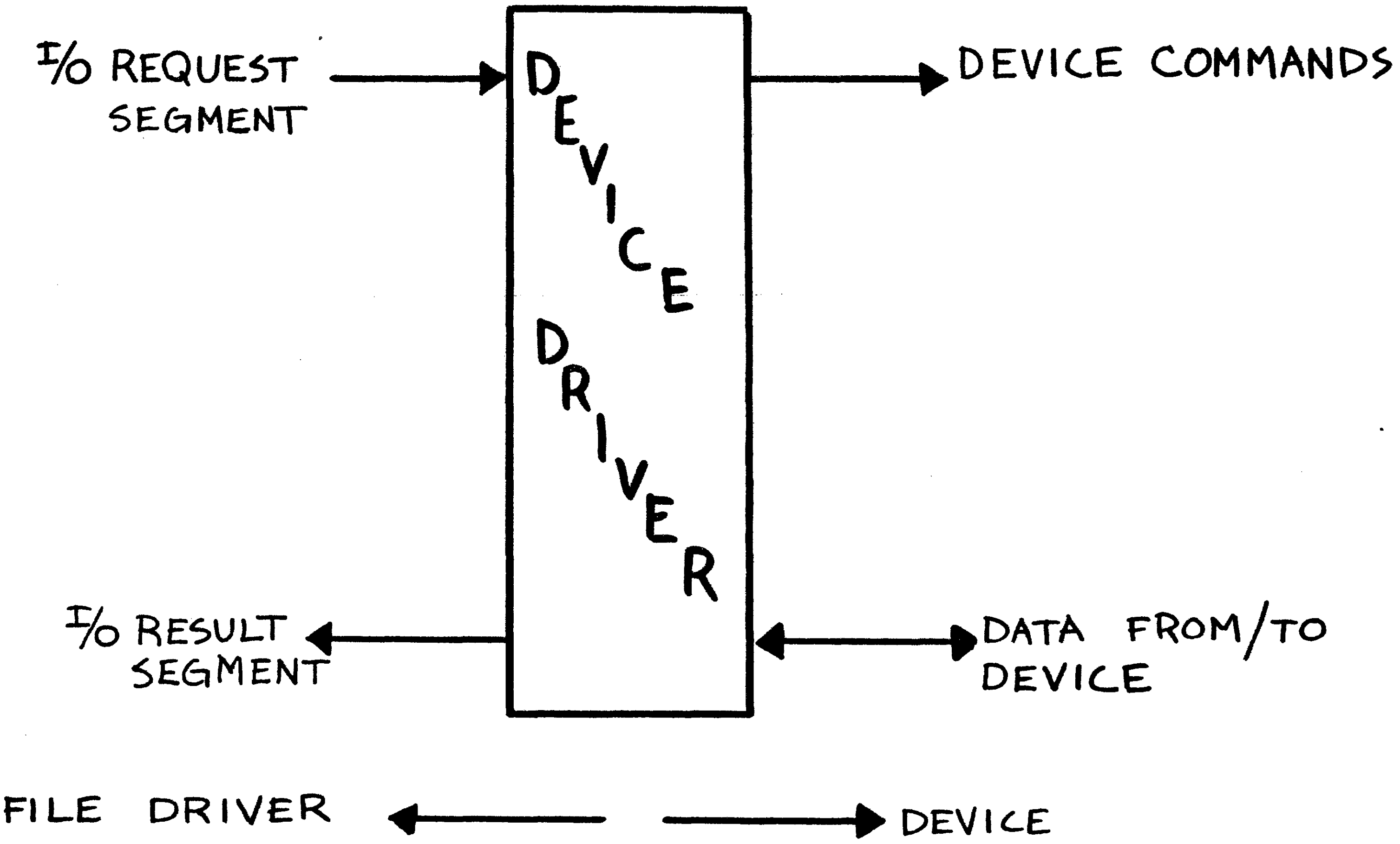
RMX-86 I/O SYSTEM



THE FILE DRIVER



THE DEVICE DRIVER



BASIC I/O SYSTEM

"MOST INTIMATE FORM OF I/O SYSTEM INTERACTION."

ADVANTAGES

- ASYNCHRONOUS (ALLOWS OVERLAPPEP I/O AND USER PROCESSING)
- MOST COMPACT VERSION OF I/O SYSTEM.

DISADVANTAGE

- FAIRLY COMPLICATED USER INTERFACE

BASIC I/O SYSTEM
INTERACTION EXAMPLE

```
/* NOW START  I/O PROCESSING */
CALL RQAREAD(     ,     , @ RESPMBX, @ STATUS);
/* TEST RESULT OF CALL ITSELF */
IF (STATUS < > Ø)  THEN
/* BAD CALL */
    BAD_CALL: DO;
                /* HANDLE PROBLEM WITH CALL */
    END BAD_CALL;
ELSE
/* O.K. SO FAR */
   GOOD_CALL: DO;
```

BASIC I/O SYSTEM
INTERACTION EXAMPLE (CONTINUED)

```
/* DO CONCURRENT PROCESSING */
/* NOW GET RESPONSE FROM I/O SYSTEM */
MSGTKN = RQRECEIVE MESSAGE (RESPMBX, , ,@STATUS);
/* CHECK CALL */
IF (STATUS < > Ø) THEN
/* BAD SYSTEM CALL HANDLED HERE */
ELSE
/* WE CAN PROCEED */
    GO_ON: DO;
        MSGPTR = POINTERIZE (MSGTKN);
```

BASIC I/O SYSTEM

INTERACTION EXAMPLE (CONTINUED)

```
/* CHECK STATUS FIELD I/O RESULT SEGMENT */
IF (MSG. STATUS < > Ø) THEN
        /* BAD I/O, HANDLE IT AND DELETE IORS */
ELSE
        /* FINALLY PROCESS DATA IN THE BUFFER */
```

EXTENDED I/O SYSTEM

"THE USER FRIENDLY I/O INTERFACE"

ADVANTAGES

- SIMPLE INTEFACE - SINGLE CALL
- AUTOMATIC BUFFERING - READ AHEAD, WRITE BEHIND

DISADVANTAGES

- MORE MEMORY REQUIRED (ABOVE BASIC I/O SYSTEM)
- NOT EFFICIENT FOR RANDOM ACCESS

EXTENDED I/O SYSTEM

INTERACTION EXAMPLE

```
/* READ DISK FILE AND PLACE DATA IN BUFF */
NUMBYTES = RQS READMOVE (     , BUFF PTR, BYTES REQ, @STATUS);

/* CHECK STATUS */
IF (STATUS < > Ø)  THEN
      /* PROCESS  ERROR */
ELSE
/* PROCESS DATA */
```

WHICH WAY TO GO?
BASIC
EXTENDED

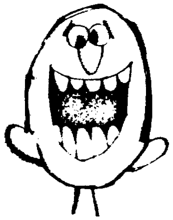
WHY USE THE BASIC I/O SYSTEM?

- I NEED EXTREME FLEXIBILITY

- I NEED EFFICIENT RANDOM ACCESS

- I MUST CONSERVE MEMORY

- I WANT TO OVERLAP MY PROCESSING WITH I/O PROCESSING

- I'M MASOCHISTIC 

WHY USE THE EXTENDED I/O SYSTEM?

- I LIKE THE EASY INTERFACE
- I CAN AFFORD THE MEMORY
- I'M PRIMARILY USING SEQUENTIAL ACCESS SO AUTOMATIC BUFFERING HELPS THRUPUT
- I DO NOT NEED OVERLAPPED I/O AND USER PROCESSING

CHAPTER QUIZ

1. WHAT ARE THE THREE ATTRIBUTES OF A FILE?

   a.________ b.________ c.________

2. WHAT ARE THE THREE RMX-86 FILE TYPES?

   a.________ b.________ c.________

3. CAN I TREAT A STREAM FILE DRIVER IN A RANDOM ACCESS MANNER? ________.

4. WHAT COMBINATION OF FILE TYPE AND ACCESS METHOD WOULD I USE TO READ AN ISIS FORMAT DISKETTE?

   ________ AND ________.

CHAPTER QUIZ (CONT.)

5. WHAT KIND OF INFORMATION PASSES BETWEEN THE FILE DRIVER AND THE DEVICE DRIVER?

____

6. LIST AN ADVANTAGE OF THE BASIC I/O SYSTEM.

____

7. LIST AN ADVANTAGE OF THE EXTENDED I/O SYSTEM.

____

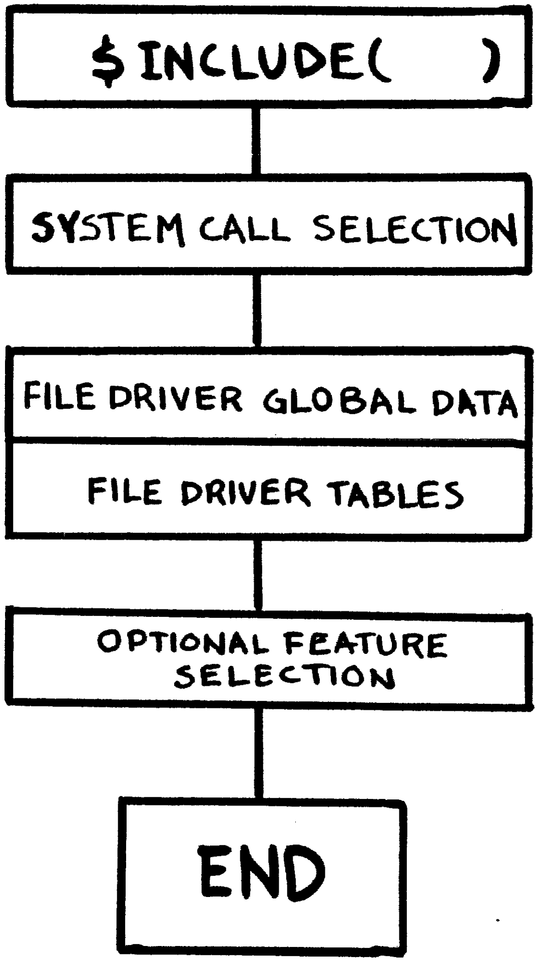
CHAPTER 2

BASIC I/O SYSTEM CONFIGURATION

BASIC I/O SYSTEM CONFIGURATION

- SELECT FEATURES DESIRED (I TABLE.A86)
- DESCRIBE THE I/O DEVICES (IDEVCF. A86)

I TABLE . A86


$ INCLUDE(   )
SYSTEM CALL SELECTION
FILE DRIVER GLOBAL DATA
FILE DRIVER TABLES
OPTIONAL FEATURE SELECTION
END

I TABLE.A86

SYSTEM CALL SELECTION
NON-FILE INTERFACE

- PARAMETER INTERFACE

  LOCAL PARAMETERS

- CONFIGURATION INTERFACE

  ATTACH - DETACH

- POWER-FAIL INTERFACE

  POWER-UP, POWER-DOWN

- DATE/TIME INTERFACE

  DATE AND TIME INFORMATION

ITABLE.A86
FILE DRIVER GLOBAL DATA

- NUMBER OF FILE DRIVERS
- ATTACH DEVICE PRIORITY
- TIMER TASK PRIORITY

ITABLE.A86

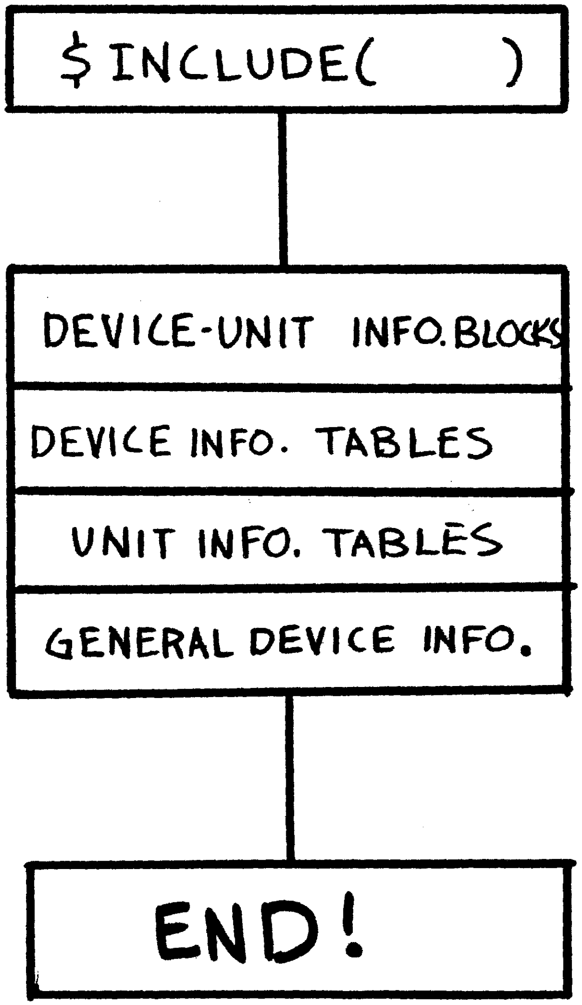
FILE DRIVER TABLES

- DO NOT TOUCH!

ITABLE. A86
OPTIONAL FEATURE SELECTION

- DUMMY_TIMER
- NO_CREATE_FALSE
- NO_TRUNCATE
- NO-ALLOCATE

I DEV CF. A86



$INCLUDE(   )

DEVICE-UNIT INFO. BLOCKS

DEVICE INFO. TABLES

UNIT INFO. TABLES

GENERAL DEVICE INFO.

END!

IDEVCF.A86

DEVICE-UNIT INFORMATION BLOCKS

COMPONENTS

- DEVICE NAME (UP TO 14 CHARACTERS)
- FILE DRIVERS (SUPPORTED)
- FUNCTIONS (SUPPORTED)
- FLAGS (DISKETTES ONLY, TYPE OF DRIVE)
- DEVICE GRANULARITY (RANDOM ACCESS USUALLY)
- LOW/HIGH SIZE (DEVICE STORAGE CAPACITY)
- DEVICE NUMBER (PER DEVICE (OR CONTROLLER))
- UNIT NUMBER (PER UNIT ON A GIVEN DEVICE)

I DEVCF. A86

DEVICE-UNIT INFORMATION BLOCKS

• DEVICE-UNIT NUMBER	(UNIQUE IN THE SYSTEM)
• INIT_IO	(INITIALIZE I/O DEVICE DRIVER)
• FINISH_IO	(FINISH I/O DEVICE DRIVER)
• QUEQE_IO	(QUEUE I/O DEVICE DRIVER)
• CANCEL_IO	(CANCEL I/O DEVICE DRIVER)
• DEVICE_INFO	(ADDRESS OF DEVICE INFO. BLOCK)
• UNIT_INFO	(ADDRESS OF UNIT INFO. BLOCK)
• UPDATE_TIMEOUT	(FREQUENCY OF UPDATE)
• NUM_BUFFERS	(NUMBER OF BUFFERS FOR RANDOM ACCESS DEVICES)
• PRIORITY	(SERVICE TASK PRIORITY)

DEVICE INFORMATION TABLES

• COMMON OR RANDOM DEVICE TABLE

• LEVEL	(INTERRUPT LEVEL)
• PRIORITY	(DEVICE INTERRUPT TASK)
• STACK_SIZE	(USER WRITTEN INTERRUPT PROCEDURE)
• DATA_SIZE	(USER PORTION OF DEVICE DATA OBJECT)
• NUM_UNITS	(NUMBER OF UNITS SUPPORTED)
• DEVICE_INIT	(USER WRITTEN DEVICE INITIALIZATION)
• DEVICE_FINISH	(" " " FINISH)
• DEVICE_START	(" " " START)
• DEVICE_STOP	(" " " STOP)
• DEVICE_INTERRUPT	(" " " INTERRUPT)

UNIT INFORMATION TABLES

- NORMALLY RANDOM ONLY

RANDOM_UNIT_INFO

- TRACK_SIZE (ONE TRACK, Ø IF CONTROLLER CAN CROSS TRACK BOUNDERIES)
- MAX-RETRY (NUMBER OF ATTEMPS)
- Ø

IDEVCF.A86

GENERAL DEVICE INFORMATION

DEVICE_TABLES

- TOTAL NUMBER OF D.U.I.B.'s
- NUMBER OF DEVICE UNITS DEFINED
- NUMBER OF DEVICES DEFINED

ASSEMBLING, LINKING AND LOCATING THE BASIC I/O SYSTEM

- MODIFY ITABLE.A86 AND IDEVCF.A86 TO YOUR TASTES
- SET UP SUBMIT FILE TO MATCH YOUR DEVELOPEMENT RESOURCES
- SUBMIT :fx:IOS(DATE,LOC_ADR)

CHAPTER QUIZ

1. T-F I CAN MODIFY THE FILE DRIVER TABLES.

2. WHICH FILE CONTAINS THE DUMMY TIMER?

3. WHAT ARE THE 3. TABLES FOR A RANDOM DRIVER?

   A. ____________ B. ____________ C. ____________

4. IN WHICH FILE DO YOU FIND THE ADDRESS OF THE DEVICE START PROCEDURE?

   ____

CHAPTER QUIZ
(CONTINUED)

5. IF I HAD 3 iSBC 204 CARDS AND 1 iSBC CARD IN ADDITION TO THE TERMINAL IN A SYSTEM, HOW MANY DEVICES WOULD I HAVE? ____________

6. EACH DISK INTERFACE CARD HAS 2 DRIVES ASSOCIATED WITH IT. HOW MANY DEVICE·UNIT NUMBERS WOULD I HAVE? ____________

CHAPTER 3

THE BOOTSTRAP LOADER

WHAT IS IT?

THE BOOTSTRAP LOADER IS A PROGRAM WHICH ALLOWS AN RMX-86 SYSTEM TO BE LOADED INTO MEMORY FROM SOME PERIPHERAL DEVICE.

BOOTSTRAP LOADER FEATURES

- AUTOMATIC OR CONTROLLED LOADING
- AUTOMATIC OR USER SELECTABLE DEVICE
- AUTOMATIC OR USER SELECTABLE FILE NAMES

DEVICES CURRENTLY SUPPORTED

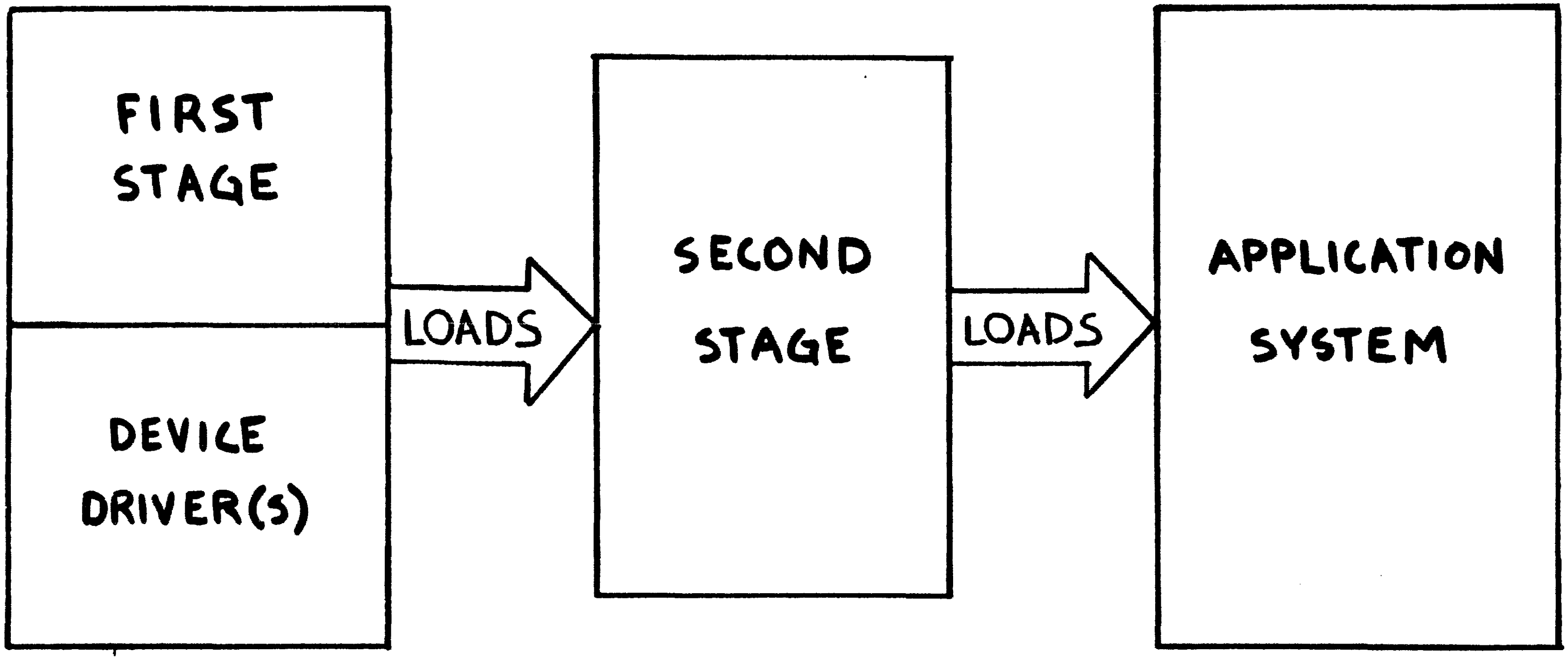
- iSBC 204 SINGLE DENSITY FLOPPY DISK
- iSBC 206 CDC HAWK HARD DISK
- iSBC 215 WINCHESTER DISK
- iSBX 218 SINGLE DENSITY FLOPPY DISK (WHEN USED WITH iSBC 215)
- iSBC 254 BUBBLE MEMORY CONTROLLER

BOOTSTRAP LOADER STRUCTURE

ROM

PERIPHERAL DEVICE

PERIPHERAL DEVICE



FIRST STAGE

DEVICE DRIVER(S)

LOADS

SECOND STAGE

LOADS

APPLICATION SYSTEM

100 TO 500 BYTES
+ DRIVER

≈6K BYTES

?

FIRST STAGE OPTIONS

- LOCATION OF FIRST STAGE IN ROM
  (ASSIGNED BY USER THROUGH LOC86)
- LOCATION OF SECOND STAGE IN RAM
  (ASSIGNED BY USER THROUGH LOC86)
- DEVICE SELECTION METHOD
  (ASSIGNED BY USER THROUGH CONFIGURATION)
- FILE SELECTION METHOD
  (ASSIGNED BY USER THROUGH CONFIGURATION)

BOOTSTRAP LOCATION NOTES

- FIRST STAGE MUST BE AVAILABLE AT RESET (USUALLY IN ROM)

- SECOND STAGE MUST NOT OCCUPY MEMORY ALREADY OCCUPIED BY THE SYSTEM TO BE LOADED (CODE AREAS OR INITIALIZED DATA AREAS)

DEVICE SELECTION

- NONE (ONE DEVICE ONLY)
- AUTOMATIC SELECTION (HUNT FOR READY DEVICE)
- MANUAL SELECTION (PROMPT USER FOR DEVICE THROUGH SYSTEM TERMINAL)

DEVICE SELECTION NOTES

- NONE
  - ONE TRY PER RESET. IF DEVICE IS NOT READY: QUIT.
- AUTOMATIC
  - TRY EACH DEVICE IN THE LIST IN ROTATION UNTIL A READY DEVICE IS FOUND. IF NO DEVICE IS FOUND READY, REPEAT LIST.

DEVICE SELECTION NOTES
(CONTINUED)

- MANUAL

  - PROMPT USER FOR A DEVICE NAME THROUGH THE TERMINAL

    IF RESPONSE IS ON THE LIST TRY THAT DEVICE

    IF RESPONSE IS NOT ON THE LIST BEGIN AUTOMATIC DEVICE SELECTION FROM LIST ENTERED AT CONFIGURATION

FILE SELECTION NOTES

- NONE
  - FILE NAMED /SYSTEM/RMX86 IS LOADED FROM SELECTED DEVICE
- AUTOMATIC
  - SAME FILE IS LOADED FROM THE FIRST AVAILABLE DEVICE
- MANUAL
  - IF FIRST CHARACTER IS A COLON, TRY TO PARSE A DEVICE NAME. IF DEVICE NAME IS IN TABLE TRY IT.

FILE SELECTION NOTES
(CONTINUED)

- MANUAL (CONTINUED)
  - IF BOOTSTRAP CANNOT PARSE A DEVICE NAME OR IF NAME PARSED IS NOT IN THE TABLE SWITCH TO AUTO DEVICE SELECTION AND USE STRING AS A FILE NAME.
  - BLANK LINE IS INTERPRETED AS DEFAULT FILE NAME /SYSTEM/ RMX86 WITH AUTO DEVICE SELECTION.
  - :fø: FILENAME = :fø: /SYSTEM/FILENAME
  - :fø: /FILENAME = :fø: FILENAME

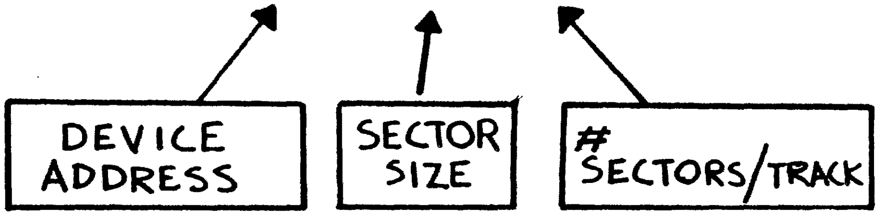
DRIVER CONFIGURATION

- SUPPLY ADDRESS PARAMETERS

- ASSEMBLE THE RESULT

  EXAMPLE:

```
$INCLUDE (:FX:B204.INC)
% B204 (ØAØH, 128, 26)
```


DEVICE ADDRESS

SECTOR SIZE

SECTORS/TRACK

(NOTE: THESE MACROS CHANGE FOR EACH DEVICE. SEE CHAPTER 11 OF THE CONFIGURATION MANUAL.)

BOOTSTRAP CONFIGURATION

- SELECT DESIRED BOOTSTRAP FEATURES
- LIST BOOTSTRAP DEVICES
- CONFIGURE EACH DEVICE
- ASSEMBLE, LINK AND LOCATE THE RESULT

SELECT BOOTSTRAP FEATURES

- **AUTO MACRO**

  (ENABLES AUTOMATIC DEVICE SELECTION)

- **CONSOLE MACRO**

  (ALLOWS RUNTIME FILE SELECTION)

- **MANUAL MACRO**

  (ALLOWS RUNTIME DEVICE SELECTION)

- IF NO MACROS ARE USED, DEVICE AND FILE SELECTION WILL REVERT TO DEFAULTS WITH A SINGLE TRY.

LIST BOOTSTRAP DEVICES

- **DEVICE MACRO**
  - FOR AUTO SELECT DEVICES ARE SCANNED IN ORDER OF THE CONFIGURATION FILE
  - MACRO SPECIFIES:
    - NAME OF DEVICE
    - DEVICE-UNIT NUMBER (SAME AS BIOS)
    - DEVICE INITIALIZATION ROUTINE ENTRY POINT
    - DEVICE READ ROUTINE ENTRY POINT

DRIVER CONFIGURATION

(USER SUPPLIED DRIVERS)

- YOU CREATE DEVICE$INIT AND DEVICE$READ ROUTINES.
- ASSEMBLE WITH ENTRY POINTS AS PUBLICS
- LINK TO REST OF BOOTSTRAP ROUTINES

(NOTE: ROUTINES MUST BE LARGE MODEL OF COMPUTATION)

EXAMPLE BOOTSTRAP CONFIGURATION(S)

- NO DEVICE SELECTION

```
            NAME   SIMPLE
 $INCLUDE (:fx: BS1.INC)
 %DEVICE  (WFØ,Ø, DEVICE INIT215, DEVICE READ215)
 %END
```

EXAMPLE BOOTSTRAP CONFIGURATION(S)

- MANUAL (WITH DEVICE SELECTION)

```
$INCLUDE (:fx: BS1.INC.)
%CONSOLE
%AUTO
%MANUAL
%DEVICE (fØ, Ø, DEVICE INIT 204, DEVICE READ 204)
%DEVICE (bØ,1, DEVICE INIT 254, DEVICE READ 254)
%END
```

EXAMPLE BOOTSTRAP CONFIGURATION(S)
(ASSEMBLE, LINK AND LOCATE)
(SIMPLE CASE)

- AFTER BOOTSTRAP CONFIGURATION FILE AND DEVICE CONFIGURATION FILE(S) ARE PREPARED

```
SUBMIT      :fx: BS1(DATE,ROM,RAM)

WHERE:      DATE  =  DATE IE 07/27/82
            ROM   =  STARTING CODE ADDRESS
                     FOR STAGE 1.
            RAM   =  STARTING ADDRESS FOR
                     STAGE 2.
```

NOTE: MODIFY :fx:BS1.CSD TO REFLECT YOUR ARRANGEMENT BEFORE YOU SUBMIT.

EXAMPLE BOOTSTRAP CONFIGURATION
(ASSEMBLE, LINK AND LOCATE)
(COMPLEX CASE)

STEP 1.	COMPILE	:fx: BCICO.P86 TO GET CONSOLE ROUTINES FOR DEVICE OR FILE SELECTION
STEP 2.	ADD	:fx: BCICO. OBJ TO SUBMIT FILE LINK LIST.
STEP 3.	SUBMIT	:fx: BS1(, ,)

CHAPTER QUIZ

1. WHAT ARE THE THREE MODES OF LOADING?

   A.______________ B.______________ C.______________

2. WHAT ARE 2 OP THE DEVICES I CAN BOOT FROM?

   A.________________ B.________________

3. HOW DOES THE SECOND STAGE GET ON THE DEVICE?

   ____

4. WHAT IS THE FILE NAME FOR THE CONSOLE INTERFACE FILE?

   ____

CHAPTER 4

THE FILES UTILITY

WHAT IS IT?

- THE FILES UTILITY ISA PROGRAM RUNNING ON AN RMX-86/ISIS SYSTEM WHICH ALLOWS YOU TO CREATE RMX-86 FORMAT DISKETTES BEFORE YOU HAVE A WORKING USER CREATED SYSTEM.

FILES UTILITY FUNCTIONS

- FORMAT AN RMX-86 DISKETTE.
- COPY FILES FROM AN RMX-86 DISKETTE TO AN ISIS FORMAT DISKETTE.
- COPY FILES FROM AN ISIS FORMAT DISKETTE TO AN RMX-86 FORMAT DISKETTE
- DELETE FILES ON AN RMX-86 DISKETTE
- CREATE A DIRECTORY FILE ON AN RMX-86 DISKETTE
- DISPLAY THE CONTENTS OF AN RMX-86 DISKETTE DIRECTORY IN SEVERAL FORMATS

HARDWARE REQUIRED

- INTEL DEVELOPEMENT SYSTEM WITH 64K RAM AND AT LEAST ONE DISK DRIVE
  (MDS-800, SERIES II, SERIES III, NDS-1)
- iSBC 86/12A WITH AT LEAST 192 K RAM AND AT LEAST 1 DISK DRIVE
- 957A INTELLEC TO 86/12A INTERFACE AND MONITOR

WHERE DOES THE FILES UTILITY FIT IN?

STEP 1. DEVELOP USER SOFTWARE ON THE INTELLEC SYSTEM (SERIES II, SERIES III, MDS 800)

STEP 2. TEST LOAD AND EXECUTE SOFTWARE USING THE 957A INTERFACE

STEP 3. FORMAT A BOOTABLE DISK AND LOAD TESTED SOFTWARE ONTO IT

STEP 4. PLACE BOOTSTRAP STAGE I INTO 86/12A PROM.

STEP 5. SET UP iSBC SYSTEM, LOAD DISKETTE FROM STEP 3 INTO A DRIVE AND PRESS RESET.

FILES UTILITY USAGE

- TO INVOKE THE FILES UTILITY

a. SET UP HARDWARE AND SOFTWARE

b. TYPE

```
SUBMIT :Fx: FILES(:Fx:)
SBC861
G
```

FILES UTILITY COMMANDS

COMMAND	ABBREVIATION
ATTACHDEVKE	AD
BREAK	BR
CREATEDIR	CD
DELETE	DE
DETACH	DT

FILES UTILITY COMMANDS
(CONT.)

COMMAND	ABBREVIATION
DIR	DI
DOWNCOPY	DC
FORMAT	FO
HELP	HE
UPCOPY	UC

A TYPICAL FILES UTILITY USAGE SEQUENCE

```
-SUBMIT :F1:FILES(:F1:)
-SBC861

ISIS-II iSBC 86/12 LCADER, V2.0

iSBC 86/12 MONITOR V2.0

.L:F1:NUCLUS
.L:F1:IOS
.L:F1:EIOS
.L:F1:FILES
.L:F1:FROCT
.E

-:F0:SUBMIT RESTORE :F1:FILES.CS(:VI:)
-SBC861

ISIS-II iSBC 86/12 LOADER, V2.0

*CONTROL-C*

.G

iRMX 86 FILES UTILITY V3.0

*FORMAT F0 LAB2 IL=5 NF=50 NAMED

*VOLUME FORMATTED - NAMED FILE OPTION

       GRANULARITY = 128
       NUMBEROFNODES = 50
       INTERLEAVE = 5
```

A TYPICAL FILES UTILITY USAGE SEQUENCE

```
*AD :FØ: = FØ

*DIR :FØ:

     Ø FILES

*CREATEDIR :FØ:SYSTEM

    :FØ:SYSTEM  ,CREATED

*UPCOPY :F1:FIRST.LIB TO :FØ:SYSTEM/RMX86

*DIR :FØ:

   SYSTEM

      1 FILES

*DIR :FØ:SYSTEM

   RMX86

      1 FILES

*DETACH :FØ:

    :FØ:     ,DETACHED

*BR
```

A TYPICAL FILES UTILITY USAGE SEQUENCE

```
*BREAK* AT 1800:186A

.E
_
```

WARNING!!!

TO CHANGE A DISKETTE:

1. DETACH

2. CHANGE DISKETTES

3. ATTACH DEVICE (OR FORMAT)

CHAPTER QUIZ

1. TRUE-FALSE THE FILES UTILITY ALLOWS YOU TO DISPLAY THE DIRECTORY OF AN ISIS DISKETTE.

2. NAME THREE DEVICES THAT CAN BE FORMATTED BY THE FILES UTILITY.

   a.____________ b.____________ c.____________

3. WHY CAN'T I REMOVE A DISKETTE AT ANY TIME WHILE I'M USING THE FILES UTILITY?

   ____

WRITING DEVICE DRIVERS FOR THE IRMX 86 I/O SYSTEM

TOPICS TO BE DISCUSSED:

- INTRODUCTION AND CONCEPTS
- DEVICE DRIVER INTERFACES
- COMMON DEVICE DRIVERS
- RANDOM ACCESS DEVICE DRIVERS
- CUSTOM DEVICE DRIVERS
- DEVICE DRIVER CONFIGURATION

REFERENCE MANUALS REQUIRED:

- IRMX 86 BASIC I/O SYSTEM REFERENCE MANUAL
- IRMX 86 SYSTEM PROGRAMMERS REFERENCE MANUAL
- IRMX 86 CONFIGURATION GUIDE
- GUIDE TO WRITING DEVICE DRIVERS FOR THE IRMX 86 I/O SYSTEM

SYSTEM CONSTRUCTION

- THE I/O SYSTEM IS IMPLEMENTED AS A SET OF FILE DRIVERS AND A SET OF DEVICE DRIVERS

- YOUR APPLICATION COMMUNICATES WITH FILE DRIVERS

1. PHYSICAL
   USARTS, PRINTERS . . . .

2. NAMED
   DISK, BUBBLE MEMORY. . . . .

3. STREAM
   A PIPELINE BETWEEN TWO TASKS USING I/O SYSTEM CALLS

SYSTEM CONSTRUCTION

- FILE DRIVERS COMMUNICATE WITH DEVICE DRIVERS
- DEVICE DRIVERS COMMUNICATE WITH DEVICES

APPLICATION TASKS

FILE INDEPENDENT INTERFACE

FILE DRIVERS

DEVICE INDEPENDENT INTERFACE

DEVICE DRIVERS

DEVICES

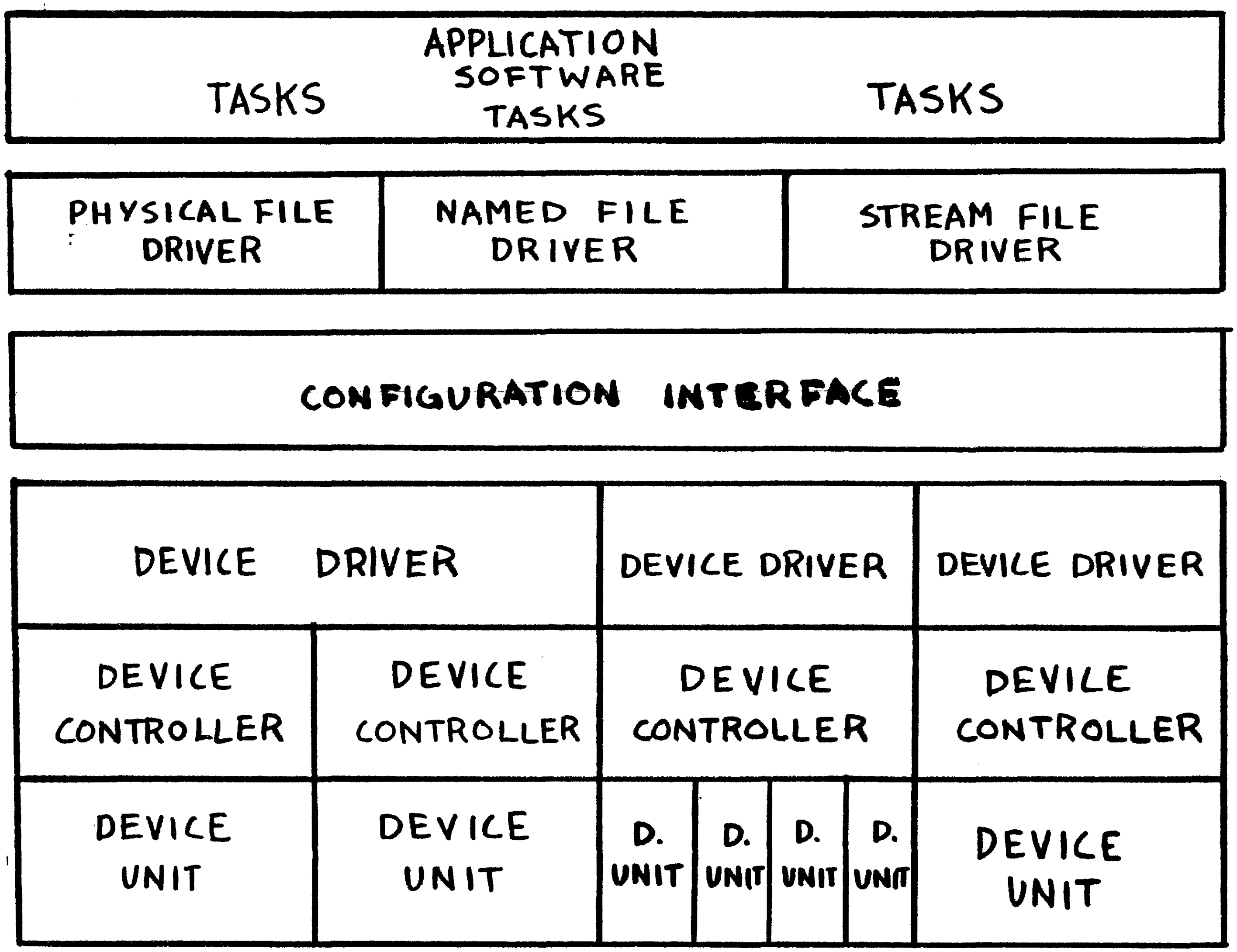
INTERFACE

- THE INTERFACE BETWEEN YOUR APPLICATION AND FILE DRIVERS AND BETWEEN FILE DRIVERS AND DEVICE DRIVERS IS STANDARD
- THIS ALLOWS FOR:
  - DEVICE INDEPENDENCE
  - HARDWARE CONFIGURATION CHANGES WITHOUT EXTENSIVE SOFTWARE MODIFICATIONS
  - A GREATER RANGE OF DEVICES CAN BE SUPPORTED

I/O DEVICE AND DEVICE DRIVERS

- EACH I/O DEVICE CONSISTS OF A CONTROLLER AND ONE OR MORE UNITS
- EACH CONTROLLER IS ASSIGNED A DEVICE NUMBER
- EACH UNIT IS ASSIGNED A UNIT NUMBER FOR THAT DEVICE AND A DEVICE UNIT NUMBER FOR ALL DEVICES IN THE I/O SYSTEM

SCHEMATIC OF SOFTWARE AT INITIALIZATION TIME



I/O REQUESTS

TO THE DEVICE DRIVER A REQUEST IS A REQUEST FROM THE I/O SYSTEM FOR THE DEVICE TO PERFORM A CERTAIN OPERATION

- READ
- WRITE
- SEEK
- SPECIAL
- ATTACH DEVICE
- DETACH DEVICE
- OPEN
- CLOSE

THESE REQUESTS ARE PASSED TO THE DEVICE DRIVER IN A SEGMENT TYPE OBJECT

COMPONENTS OF A DEVICE DRIVER

- AT ITS HIGHEST LEVEL A DEVICE OPERATOR CONSISTS OF FOUR PROCEDURES
    - INITIALIZE I/O
    - FINISH I/O
    - QUEUE I/O
    - CANCEL I/O

FOR EVERY I/O REQUEST THE I/O SYSTEM MAY CALL ONE OR MORE OF THESE PROCEDURES

INITIAL I/O PROCEDURE

- THE I/O SYSTEM CALLS THIS PROCEDURE WHENEVER A RQ$PHYSICAL$ATTACH$DEVICE SYSTEM CALL IS MADE AND THERE ARE CURRENTLY NO OTHER UNITS ATTACHED TO THIS DEVICE

FINISH I/O

- THE I/O SYSTEM CALLS THIS PROCEDURE WHENEVER A RQ$PHYSICAL$DETACH$DEVICE SYSTEM CALL IS MADE AND THERE ARE CURRENTLY NO OTHER UNITS ATTACHED TO THIS DEVICE

QUEUE I/O

- THIS PROCEDURE IS CALLED BY THE I/O SYSTEM FOR ALL USER I/O REQUESTS. THIS PROCEDURE MUST PLACE THE REQUEST ON THE REQUEST QUEUE SO THAT IT MAY BE PROCCESSED WHEN APPROPRIATE.

  IF DEVICE IS NOT BUSY THIS PROCEDURE MUST ALSO START THE I/O FUNCTION

CANCEL I/O

- THIS PROCEDURE IS CALLED BY THE I/O SYSTEM WHEN:
  - A RQ$A$PHYSICAL$DETACH$DEVICE CALL IS MADE WITH THE HARD DETACH OPTION SPECIFIED
  - IF THE JOB CONTAINING THE TASK THAT MADE THE I/O REQUEST SELECTED

INTERRUPT HANDLERS

- AFTER A DEVICE HAS FINISHED PROCESSING AN I/O REQUEST IT SENDS AN INTERRUPT TO THE PROCESSOR.
  AT THIS TIME THE HANDLER MAY SERVICE THE INTERRUPT OR SIGNAL AN INTERRUPT TASK THAT WILL SERVICE THE INTERRUPT

REMEMBER THAT AN INTERRUPT HANDLER IS LIMITED TO THE TYPE OF RMX CALLS THAT IT MAY MAKE

INTERRUPT TASKS

INTERRUPT TASKS FEED THE RESULTS OF THE I/O REQUEST BACK TO THE I/O SYSTEM IF THE REQUEST IS FINISHED.

IF THE REQUEST IS NOT FINISHED THIS TASK WILL INITIATE THE NEXT STAGE OF THE REQUEST.

IF THERE ARE ADDITIONAL REQUESTS ON THE QUEUE THEN THIS TASK MUST START THE NEXT REQUEST.

DEVICE DRIVER TYPES

- COMMON DEVICE DRIVERS

  EASIEST TO IMPLEMENT

- RANDOM ACCESS DEVICE DRIVERS

  MUCH THE SAME AS COMMON DEVICES

- CUSTOM DEVICE DRIVERS

  MORE COMPLEX THAN COMMON OR RANDOM

  NEEDED FOR MORE SOPHISTICATED DEVICES

COMMON DEVICE REQUIREMENTS

- SIMPLE DEVICES – PRINTERS, USARTS

- DATA EITHER READ OR WRITTEN TO THE DEVICE DOES NOT NEED TO BE BROKEN UP INTO SPECIFIC BLOCK SIZES
- A FIRST IN/FIRST OUT QUEUE FOR THE REQUESTS IS SUFFICIENT

- ONLY ONE INTERRUPT LEVEL IS NEEDED FOR THE DEVICE

RANDOM ACCESS DEVICE DRIVER REQUIREMENTS

- DEVICES SUCH AS DISKS AND BUBBLE MEMORY
- THE DEVICE MUST SUPPORT RANDOM ACCESS SEEK
- THE I/O REQUEST MUST BE BROKEN UP INTO SPECIFIC BLOCK LENGTHS (TRACK AND SECTOR, BUBBLE PAGE)
- A FIFO QUEUE IS SUFFICIENT
- ONLY ONE INTERRUPT LEVEL IS NEEDED FOR THE DEVICE

CUSTOM DEVICE DRIVER REQUIREMENTS

- IF THE DEVICE DOES NOT FIT INTO THE CAT GORY OF EITHER COMMON OR RANDOM ACCESS THEN YOU MUST WRITE A CUSTOM DEVICE DRIVER

- ANY DEVICE THAT REQUIRES PRIORITY QUEUES

- ANY DEVICE THAT REQUIRES MORE THAN ONE INTERRUPT LEVEL

- ANY DEVICE THAT REQUIRES THE INTERRUPT HANDLER TO SERVICE MORE THAN ONE INTERRUPT BEFORE SIGNALLING THE INTERRUPT TASK

DEVICE DRIVER QUIZ #1

1. WHAT ARE THE THREE TYPES OF FILE DRIVERS?

2. APPLICATION TASKS CALL FILE DRIVERS-(TRUE -FALSE)

3. WHAT IS THE DIFFERENCE BETWEEN A DEVICE AND A UNIT?

4. WHAT OBJECT TYPE IS AN I/O REQUEST?

5. WHAT ARE THE COMPONENTS OF THE DEVICE DRIVER?

6. WHEN IS THE INITIALIZE I/O PROCEDURE CALLED?

7. WHAT ARE THE DIFFERENCES BETWEEN A COMMON AND A CUSTOM DEVICE DRIVER?

DEVICE DRIVER INTERFACES

- ALL DEVICE DRIVER INTERFACES ARE IN THE FORM OF DATA STRUCTURES

- THERE ARE TWO I/O SYSTEM INTEFACES

  DEVICE-UNIT INFORMATION BLOCKS - DUIBS
  I/O REQUEST/RESULT SEGMENTS - IORS

- DEVICE INTERFACES DEPEND ON THE DRIVER TYPE FOR BOTH COMMON AND RANDOM ACCESS DEVICES THE COMMON DEVICE INFORMATION BLOCK IS USED OTHER DEVICE INTERFACE STRUCTURES ARE USER DEFINED

DEVICE UNIT INFORMATION - DUIB

THIS STRUCTURE HAS THE FOLLOWING FORMAT:

```
DECLARE  DEV$UNIT$INFO$BLOCK  STRUCTURE (

      NAME (14)         BYTE,  NAME USED IN ATTACHDEVICE
      FILE$DRIVERS      WORD,  WHAT FILE DRIVERS CAN BE USED
      FUNCTS            BYTE,  WHAT FUNCTIONS  ARE SUPPORTED
      FLAGS             BYTE,  FOR DENSITY AND SIDE SPEC ON DISKS
      DEV$GRAN          WORD,  FOR DISKS MIN I/O SIZE
      LOW$DEV$SIZE      WORD,  THE SIZE OF THE DEVICE IN BYTES
      HIGH$DEV$SIZE     WORD,
      DEVICE            BYTE,  THE I/O SYSTEM DEVICE NUMBER
      UNIT              BYTE,  UNIT NUMBER FOR THIS DEVICE
      DEV$UNIT          WORD,  THE DEVICE UNIT NUMBER
```

DEVICE UNIT INFORMATION - DUIB
(CONTINUED)

INIT$IO	WORD,	PROCEDURE ADDRESSES
FINISH$IO	WORD,	
QUEUE$IO	WORD,	
CANCEL$IO	WORD,	
DEVICE$INFO$P	POINTER,	TO DEVICE INFO
UNIT$INFO$P	POINTER,	TO UNIT INFO
UPDATE$TIME$OUT	WORD,	NUMBER OF SYS TIME UNITS
NUM$BUFFERS	WORD,	NUM BUFFERS FOR PAD DEVICE
PRIORITY	BYTE,	PRI FOR I/O SERVICE TASK

USING DUIBS

- THE I/O SYSTEM USES THE DUIB TO INVOKE THE DEVICE DRIVER PROCEDURES WHENEVER AN I/O REQUEST IS MADE.

- WHEN AN ATTACH DEVICE CALL IS MADE THE I/O SYSTEM WILL SCAN THE DUIB TABLES FOR A NAME MATCH.

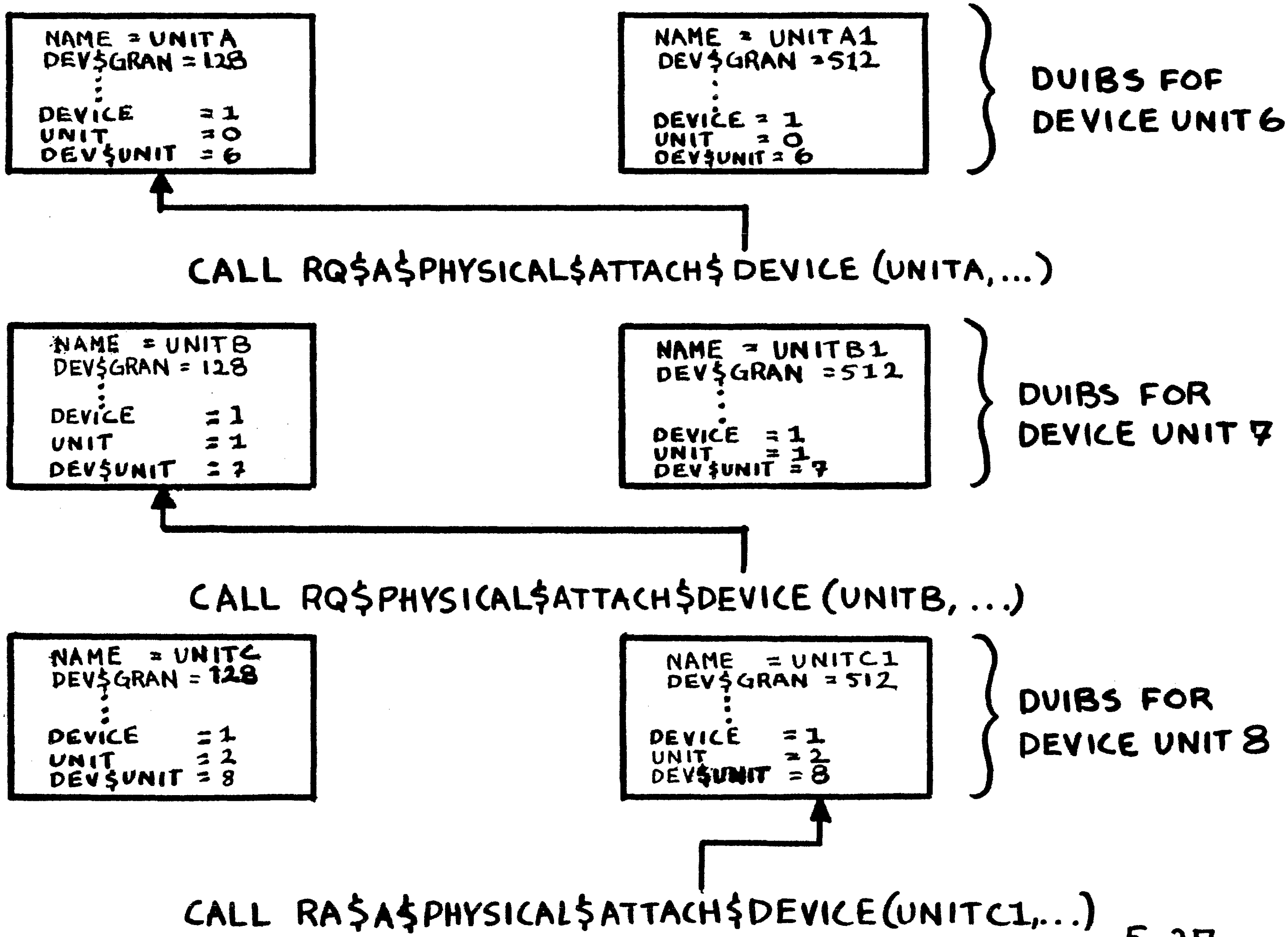
EXAMPLE:

```
CALL  RQ$A$PHYSICAL$ATTACH$DEVICE(@(6,'STREAM'),
                                   2, RMBX, @STATUS);
```

THERE MUST BE A DUIB FOR THE DEVICE NAME 'STREAM' AND IT MUST HAVE STREAM FILE DRIVER CAPABILITY

DEVICE DRIVER INTERFACES

ATTACHING DEVICES



NAME = UNITA
DEV$GRAN = 128
DEVICE = 1
UNIT = 0
DEV$UNIT = 6

NAME = UNITA1
DEV$GRAN = 512
DEVICE = 1
UNIT = 0
DEV$UNIT = 6

DUIBS FOF DEVICE UNIT 6

CALL RQ$A$PHYSICAL$ATTACH$DEVICE (UNITA,...)

NAME = UNITB
DEV$GRAN = 128
DEVICE = 1
UNIT = 1
DEV$UNIT = 7

NAME = UNITB1
DEV$GRAN = 512
DEVICE = 1
UNIT = 1
DEV$UNIT = 7

DUIBS FOR DEVICE UNIT 7

CALL RQ$PHYSICAL$ATTACH$DEVICE (UNITB, ...)

NAME = UNITC
DEV$GRAN = 128
DEVICE = 1
UNIT = 2
DEV$UNIT = 8

NAME = UNITC1
DEV$GRAN = 512
DEVICE = 1
UNIT = 2
DEV$UNIT = 8

DUIBS FOR DEVICE UNIT 8

CALL RA$A$PHYSICAL$ATTACH$DEVICE(UNITC1,...)

DUPLICATION DEVICES

- YOU MAY DUPLICATE DEVICE AND UNIT NUMBERS IN SEPARATE DUIBS IN ORDER TO HAVE DIFFERENT CHARACTERISTICS FOR THE SAME DEVICE

- FOR EXAMPLE IF YOU HAVE A DISK DRIVE THAT CAN HAVE DIFFERENT SECTOR SIZES AND YOU MIGHT WANT TO HAVE ONE INSTANCE FOR 128 BYTE SECTORS AND ONE FOR 256 BYTES

  TO DO THIS YOU DUPLICATE THE DUIB WITH THE EXCEPTION OF THE NAME AND DEV$GRAN FIELD

THE I/O REQEST/RESULT STRUCTURE HAS THE FOLLOWING FORMAT:

```
   DECLARE IORS STRUCTURE (
STATUS          WORD,  CONDITION CODE FOR THE OPERATION

UNIT$STATUS     WORD,  IF STATUS IS E$IO THEN UNIT STATUS SHOULD
                       BE SET
ACTUAL          WORD,  THE ACTUAL AMOUNT OF DATA TRANSFERED

ACTUAL$FILL     WORD,  RESERVED

DEVICE          WORD,  THE DEVICE NUMBER (SAME AS DUIB)

UNIT            BYTE,  THE UNIT NUMBER (SAME AS DUIB)

FUNCT           BYTE,  THE FUNCTION TO BE PERFORMED

SUB$FUNCT       WORD,  USED FOR SPECIAL CALLS

LOW$DEV$LOC     WORD,  THE DEVICE LOCATION IN BYTES, FOR RANDOM
HIGH$DEV$LOC    WORD,  ACCESS DEVICES THIS IS THE SECTOR AND TRACK
```

DECLARE IORS STRUCTURE(
(CONTINUED)

```
BUFF$P          POINTER,   WHERE THE DATA IS TO BE READ FROM .
                           OR WRITTEN TO
COUNT           WORD,      HOW MUCH, IF RANDOM ACCESS THIS
                           WILL ALWAYS BE IN DEVICE  GRAN.
                           MULTIPLES
COUNT$FILL      WORD,      RESERVE
AUX$P           POINTER,   USED FOR SPECIAL CALLS
LINK$FOR        POINTER,   LINKED LIST FOR I/O REQUEST QUEUES
LINK$BACK       POINTER,
RESP$MBX        WORD,      THE RESPONSE MAILBOX FOR THIS REQUEST
DONE            BYTE,      I/O REQUEST  STATUS
FILL            BYTE,      RESERVE
CANCEL$ID       WORD);     THE REQUEST I.D. FOR THE REQUEST
```

COMMON DEVICE INFORMATION INTERFACE

- THIS STRUCTURE IS USED FOR ALL COMMON AND RANDOM ACCESS DEVICE DRIVERS

```
DECLARE COMMON$DEV$INFO  STRUCTURE(
    LEVEL               WORD,       THE INTERRUPT LEVEL USED FOR THIS DEVICE

    PRIORITY            BYTE,       THE INITIAL PRIORITY OF THE INTERRUPT TASK

    STACK$SIZE          WORD,       THE ADDITIONAL AMOUNT OF STACK THAT
                                    YOUR P
    DATA$SIZE           WORD,       THE AMOUNT OF DATA SPACE THAT YOUR
                                    DEVICE DRIVER NEEDS, (NOT STATIC DATA)
    NUM$UNITS           WORD,       HOW MANY UNITS ARE WITH THIS DEVICE

    DEVICE$INIT         WORD,       YOUR INIT PROCEDURE

    DEVICE$FINISH       WORD,       YOUR FINISH PROCEDURE

    DEVICE$ START       WORD,       YOUR START PROCEDURE

    DEVICE$STOP         WORD,       YOUR STOP PROCEDURE

    DEVICE$INTERRUPT    WORD);      YOUR INTERRUPT PROCEDURE
```

YOU MAY APPEND TO THIS STRUCTURE ANY INFORMATION THAT YOUR DEVICE NEEDS, SUCH AS I/O ADDRESSES. . . . . .

RANDOM ACCESS DEVICE UNIT INFORMATION BLOCKS

- FOR RANDOM ACCESS DEVICE YOU MUST HAVE A UNIT INFORMATION BLOCK

```
DECLARE
    RAD$UNIT$INFO$BLOCK          STRUCTURE (
    TRACK$SIZE                   WORD,    THE SIZE IN BYTES OF
                                          A TRACK
    MAX$RETRY                    WORD,    THE MAX NUMBER OF RETRIES
                                          TO BE PERFORMED BY THE I/O
                                          SYSTEM
    RESERVED                     WORD):
```

YOU MAY APPEND TO THIS STRUCTURE AND INFORMATION BY THE DEVICE

WRITING DEVICE DRIVER

GENERAL RULES

- IF PL/M 86 IS USED TO WRITE DEVICE DRIVERS THEN THE COMPACT MODEL OF COMPILATION MUST BE USED.

- IF ASM86 IS USED THEN IT MUST BE WRITTEN TO INTERFACE TO COMPACT PL/M 86 PROCEDURES

- THE I/O SYSTEM CODE CAN NEVER EXCEED 64K OF CODE

WRITING COMMON AND RANDOM ACCESS DEVICE DRIVERS

THEREARECERTAIN PARAMETERS PASSED TO EACH DEVICE DRIVER PROCEDURE

- DUIP$P - A POINTER TO THE DUIB STRUCTURE FOR THE DEVICE
- D$DATA$P - A POINTER TO THE DATA OBJECT THAT WAS DECLARED IN THE COMMON DEVICE INFORMATION BLOCK
- IORS$P - A POINTER TO THE I/O REQUEST SEGMENT
- STATUS$P - A POINTER TO THE I/O SYSTEM STATUS WORD

I/O SYSTEM SUPPLIED PROCEDURES

- INIT$IO
- FINISH$IO
- QUEUE$IO
- CANCEL$IO

USER SUPPLIED PROCEDURE

- A DEVICE INITIALIZATION PROCEDURE
- A DEVICE FINISH PROCEDURE
- A DEVICE START PROCEDURE
- A DEVICE STOP PROCEDURE
- A DEVICE INTERRUPT PROCESSING PROCEDURE

THE ADDRESSES OF YOUR DEVICE DRIVER PROCEDURE MUST BE PLACED IN THE COMMON DEVICE INFORMATION BLOCK FOR THE DEVICE

DEVICE INITIALIZATION PROCEDURE

THE INIT$IO PROCEDURE CALL THIS PROCEDURE TO INITIALIZE THE DEVICE

THE FORM OF THE CALL IS:

```
        CALL DEVICE$INIT(DUIB$P, D$P, STATUS$P);
```

YOU MUST INITIALIZE YOUR DEVICE AND ANY VARIABLES AND SET THE STATUS WORD TO INDICATE THE SUCCESS OR FAILURE OF THIS PROCEDURE

IF YOUR DEVICE DOES NOT NEED ANY INITIALIZATION THEN YOU MAY USE THE DEFAULT$INIT PROCEDURE SUPPLIED BY THE I/O SYSTEM

DEVICE FINISH PROCEDURE

THE FINISH$IO PROCEDURE CALLS THIS PROCEDURE AFTER THE LAST REQUEST HAS BEEN PROCESSED

THE FORM OF THE CALL IS:

```
          CALL DEVICE$FINISH(DUIB$P, D$DATA$P);
```

YOU MUST DO ANY FINAL PROCESSING FOR YOUR DEVICE WHEN THIS PROCEDURE IS CALLED

IF YOUR DEVICE DOES NOT NEED ANY FINAL PROCESSING THEN YOU MAY USE THE DEFAULT$FINISH PROCEDURE SUPPLIED BY THE I/O SYSTEM

DEVICE START PROCEDURE

BOTH QUEUE$IO AND THE INTERRUPT TASK CALL THIS PROCEDURE IN ORDER TO START AN I/O FUNCTION

QUEUE$IO CALLS THIS PROCEDURE WHEN A REQUEST IS MADE AND THERE ARE NO REQUESTS ON THE QUEUE

THE INTERRUPT TASK CALLS THIS PROCEDURE WHEN AN I/O REQUEST IS COMPLETED AND THERE ARE ADDITIONAL REQUESTS IN THE QUEUE

THE FORM OF THE CALL IS:

```
                CALL DEVICE$START(IORS$P, DUIB$,
                                  D$DATA$P);
```

DEVICE START PROCEDURE REQUIREMENTS

- START THE DEVICE PROCESSING THE REQUEST

- RECOGNIZE INVALID REQUESTS

- IF DATA TRANSFERS OCCUR THEN UPDATE THE IORS. ACTUAL FIELD

- IF AN ERROR OCCURS UPDATE THE IORS, STATUS AND IORS. UNIT$STATUS FIELDS

- IF THE REQUEST IS COMPLETE SET THE IORS. DONE FIELD TO TRUE

DEVICE STOP PROCEDURE

THIS PROCEDURE IS CALLED TO STOP THE I/O DEVICE FROM PERFORMING THE CURRENT I/O FUNCTION

THE FORM OF THE CALL IS:

```
CALL DEVICE$STOP(IORS$P, DUIB$P, D$DATA$P);
```

IF YOUR DEVICE GUARANTEES THAT ALL I/O REQUESTS WILL FINISH WITHIN A REASONABLE AMOUNT OF TIME THEN YOU MAY USE THE DEFAULT$STOP PROCEDURE

DEVICE INTERRUPT PROCEDURE

THE DEVICE INTERRUPT TASK CALL THIS PROCEDURE WHEN AN INTERRUPT HAS BEEN GENERATED BY THE DEVICE

THE FORM OF THE CALL IS:

```
        CALL DEVICE$INTERRUPT(IORS$P, DUIB$P, D$DATA$P);
```

YOUR INTERRUPT PROCEDURE MUST DETERMINE IF THE REQUEST IS FINISHED AND SET THE IORS.DONE FIELD TRUE IF IT IS.

IF IT IS NOT COMPLETE YOU MUST INITIATE THE NEXT STEP IN THE PROCEDURE

DEVICE INTERRUPT PROCEDURE

EXAMPLE:

1. YOUR APPLICATION TASK MADE A RQ$A$READ CALL TO A DISK.

2. YOUR START PROCEDURE INITIATED A SEEK REQUEST FOR A DISK DRIVE TO POSITION THE HEAD OVER THE PROPER TRACK.

3. THE DEVICE GENERATED AN INTERRUPT TO SIGNAL THE COMPLETION OF THE SEEK FUNCTION.

4. THE INTERRUPT PROCEDURE STARTED THE READ FUNCTION ON THE DISK.

5. THE DISK GENERATED AN INTERRUPT WHEN THE DATA TRANSFER WAS COMPLETE.

6. THE INTERRUPT PROCEDURE SET THE IORS, ACTUAL FIELD AND THE IORS.DONE FIELD TO INDICATE THE REQUEST WAS COMPLETE

COMMON AND RANDOM ACCESS DEVICE DRIVER QUIZ

1. THE MINIMUN NUMBER OF PROCEDURES THAT YOU MUST WRITE IS?

2. HOW DOES THE I/O SYSTEM KNOW WHEN THE REQUEST IS COMPLETE?

3. HOW DOES THE DEVICE DRIVER INFORM THE I/O SYSTEM OF THE SUCCESS OR FAILURE OF AREQUEST?

4. HOW DOES THE I/O SYSTEM KNOW WHAT DEVICE DRIVER PROCEDURES TO CALL?

5. HOW DOES ADEVICE DRIVER KNOW WHAT THE I/O PORT ADDRESSES ARE FOR ITS DEVICE?

WRITING CUSTOM DEVICE DRIVERS

CUSTOM DEVICE DRIVER PROCEDURES

- INIT$IO - DEVICE INITIALIZATION PROCEDURE
- FINISH$IO - DEVICE FINISH PROCEDURE
- QUEUE$IO - DEVICE QUEUE I/O REQUEST PROCEDURE
- CANCEL$IO - DEVICE CANCEL I/O PROCEDURE

YOU MUST WRITE THESE PROCEDURES AND AN INTURRUPT TASK AND HANDLER IF NEEDED

INIT$IO PROCEDURE

THIS IS CALLED BY THE I/O SYSTEM WHEN THE FIRST ATTACH DEVICE CALL IS MADE.

THE FORM OF THIS CALL IS:

CALL INIT$IO(DUIB$P, D$DATA$P, STATUS$P);

DUIB$P — A POINTER TO THE DUIB FOR THE DEVICE TO BE INITIALIZED

D$DATA$P — A POINTER TO THE WORD WHERE YOU MUST STORE THE TOKEN FOR A SEGMENT OBJECT IF NEEDED BY YOUR DEVICE.

THIS SEGMENT MAY CONTAIN DATA SUCH AS A REGION TOKEN FOR THE QUEUE, A POINTER TO THE FIRST IORS ON THE QUEUE AND A TOKEN FOR AN INTERRUPT TASK IF NEEDED.

STATUS$P — A POINTER TO A WORD WHERE YOU MUST STORE THE RESULTS OF THIS CALL

NOTE: IF NO DATA OBJECT IS NEEDED YOU MUST RETURN ZERO AS A TOKEN.

A POSSIBLE FLOW FOR THIS PROCEDURE MIGHT BE:

1. CREATE A SEGMENT FOR A DATA OBJECT

2. CREATE A REGION FOR ACCESS TO A QUEUE

3. CREATE AN INTERRUPT TASK FOR THE DEVICE

4. SET THE QUEUE TO EMPTY

5. INITIALIZE THE DEVICE HARDWARE AND ANY VARIABLES NEEDED

6. IF ALL WENT WELL THEN SET STATUS TO E$OK

FINISH I/O PROCEDURE

THE I/O SYSTEM CALLS THIS PROCEDURE AFTER THE LAST DETACH DEVICE CALL IS MADE ON THIS DEVICE

THE FORM OF THE CALL IS:

```
CALL FINISH$IO(DUIB$P, D$DATA$T);
DUIB$P     - A POINTER TO THE DUIB FOR THIS DEVICE UNIT
D$DATA$T   - A TOKEN FOR THE DATA OBJECT SEGMENT
```

THE FINISH I/O PROCEDURE MUST DO ANY FINAL PROCESSING ON THE DEVICE IF NEEDED AND DELETE ANY OBJECT THE INIT$IO PROCEDURE CREATED

(SEGMENT, REGION, RESET INTERRUPT TASK....)

QUEUE$IO PROCEDURE

THIS PROCEDURE IS CALLED FOR EVERY REQUEST TO THE DEVICE DRIVER.

THE FORM OF THE CALL IS:

```
CALL QUEUE$IO(IORS$T, DUIB$P, D$DATA$ );
IORS$T  - A TOKEN FOR THE I/O REQUEST SEGMENT
```

THIS PROCEDURE MUST DO THE FOLLOWING:

1. IF THE DEVICE IS BUSY PLACE THE REQUEST ON THE QUEUE
2. IF THE DEVICE IS NOT BUSY THEN START THE I/O FUNCTION
3. IF THE REQUEST CAN BE COMPLETED WITHOUT PLACING THE IORS ON THE QUEUE THEN SET THE IORS.DONE FIELD TO TRUE

NOTE: WHENEVER ACCESSING THE QUEUE YOU MUST FIRST GAIN ACCESS TO IT BY RECIEVING CONTROL OF THE REGION THAT PROTECTS IT.

CANCEL$IO

THIS PROCEDURE IS CALLED BY THE I/O SYSTEM WHENEVER A HARD DETACH DEVICE SYSTEM CALL IS MADE OR A JOB IS DELETED THAT STILL HAS REQUESTS PENDING.

THE FORM OF THE CALL IS:

```
CALL  CANCE$IO(CANCEL$ID, DUIB$P, D$DATA$T);
CANCEL$ID  - THE ID FOR REQUESTS THAT ARE TO BE
             REMOVED FROM THE QUEUE.
```

THIS PROCEDURE MUST REMOVE ANY REQUEST FROM THE QUEUE THAT CONTAIN THE CANCEL ID VALUE

IMPLEMENTING A I/O REQUEST QUEUE

WHEN WRITING CUSTOM DEVICE DRIVERS YOU MUST HAVE SOMESORT OF QUEUE FOR INCOMING REQUESTS.

THE IORS SEGMENT CONTAINS TWO FIELDS THAT ALLOW FOR A LINKED LIST

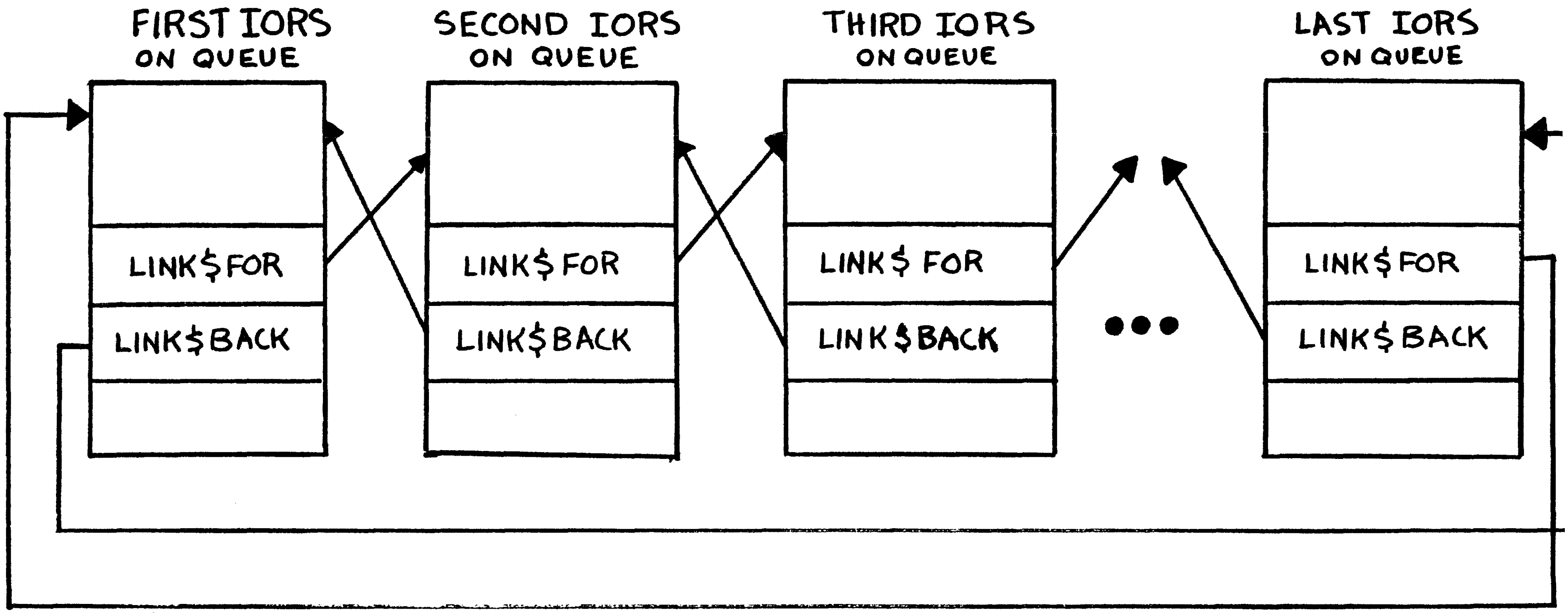
IORS.LINK$FOR, IORS.LINK$BACK

THESE TWO POINTER VALUES CAN BE USED TO IMPLEMENT A QUEUE

IF IN YOUR DATAOBJECT YOU HAVE A VALUE CALLED FIRST$IORS THAT IS SET TO ZERO TO INDICATE AN EMPTY QUEUE.

WHEN A REQUEST NEEDS TO BE QUEUED YOU CAN SET THIS FIELD TO POINT TO THE FIRST IORS AND THE LINK FIELDS OF THE IORS TO POINT BOTH FORWARD AND BACK IN THE QUEUE.

REQUEST QUEUE



INTERRUPT TASKS

INTERRUPT TASKS ARE USED TO RESPOND TO THE INTERRUPT GENERATED BY THE DEVICE.

THE INTERRUPT TASK MUST DO THE FOLLOWING:

1. SERVICE THE INTERRUPT

2. DETERMINE IF THE REQUEST IS COMPLETE

3. IF COMPLETE, GAIN ACCESS TO THE QUEUE

   REMOVE THE IORS FROM THE QUEUE.
   SET THE IORS.DONE FIELD TO TRUE.
   SEND THE IORS TO THE MAILBOX IN IORS.RMBX.
   IF THE QUEUE IS NOT EMPTY THEN START THE NEXT REQUEST.

4. IF THE REQUEST IS NOT COMPLETE THEN INITIATE THE NEXT PROCESS.

QUIZ #3 - CUSTOM DEVICE DRIVERS

1. WHAT IS THE PURPOSE OF THE DATA OBJECT?

2. WHEN IS THE CANCEL I/O PROCEDURE CALLED?

3. IS IT POSSIBLE TO USE DEFAULT I/O PROCEDURES WITH CUSTOM DEVICE DRIVER?

4. WRITE A PROCEDURE TO PLACE REQUESTS ON THE QUEUE AND ONE TO REMOVE A REQUEST FROM THE QUEUE.

   (ASSUME THAT YOU ALREADY HAVE ACCESS TO THE QUEUE)

LINKING DEVICE DRIVERS TO THE I/O SYSTEM

AFTER YOU HAVE WRITTEN YOUR DEVICE DRIVER CODE YOU MUST LINK IT TO THE I/O SYSTEM.

THE FOLLOWING COMMAND CAN BE USED TO ACCOMPLISH THIS:

```
     LINK 86
             :F0: IOS.LIB(ISTART),   &
             :F1: ITABLE.OBJ,        &
             :F1: IDEVCF.OBJ,        &
             :F1: DRIVER,OBJ,        &
             :F0: IOOPT1.LIB,        &
             :F0: IOS.LIB,           &
             :F0: RPIFC.LIB.         &
        TO   :F1: IOS.LNK           (LINKER OPTIONS)
```

CONFIGURING INTO THE I/O SYSTEM

TO CONFIGURE YOUR DEVICE DRIVERS INTO THE I/O SYSTEM YOU MUST ADD THE NECCESSARY DEVICE DRIVER INTERFACE STRUCTURES TO THE FILE IDEVCF .A86

THIS CONSISTS OF ADDING DUIB'S FOR EACH DEVICE UNIT AND THE REQUIRED COMMON AND UNIT INFO. BLOCKS AS NEEDED.

CHAPTER 7

EXTENDED INPUT/OUTPUT SYSTEM

(EIOS)

REVIEW QUIZ

NAME 3 FILE TYPES

____

____

____

TERMINOLOGY

- I/O USER
- USER OBJECT
- DEVICE
- DEVICE CONNECTION
- FILE
- ACCESS RIGHTS
- FILE CONNECTION

BASIC I/O SYSTEM
INTERACTION SEQUENCE

1. OBTAIN USER TOKEN USING A STRUCTURE OF USER ID AND ALIASES

```
USERTKN = RQCREATEUSER (@ STRUCT, @ STATUS);
/* TEST STATUS */
```

2. OBTAIN DEVICE CONNECTION TOKEN USING THE PHYSICAL DEVICE NAME

```
CALL RQAPHYSICAL ATTACH DEVICE (DEV NAME, FILE
DRIVER, RESPMBX, @ STATUS);
/* TEST STATUS TO CHECK SYNCHONOUS PORTION OF
   CALL*/
TKN = RQRECIEVE MESSAGE (MBX, TIME,    , @ STATUS);
```

BASIC I/O SYSTEM
INTERACTION SEQUENCE

2. (CONTINUED)

```
/* CHECK TOKEN RECIEVED. IF TYPE =101H YOU
   HAVE A CONNECTION. IF TYPE = 6, YOU HAVE
   A PROBLEM */
```

3. OBTAIN FILE CONNECTION USING THE DEVICE CONNECTION TOKEN, USER TOKEN, AND A FILE NAME SUBPATH

```
CALL RQAATTACH FILE (USER, DEVTKN, SUBPATH,  ,@ STATUS);
/* TEST STATUS TO CHECK SYNCHRONOUS PORTION OF CALL */
TKN= RQ RECIEVE MESSAGE (MBX1, TIME,  ,@ STATUS);
/* CHECK TOKEN TYPE. IF TYPE 101 H YOU HAVE A FILE
   CONNECTION. IF TYPE = 6 YOU HAVE A PROBLEM */
```

BASIC I/O SYSTEM
INTERACTION SEQUENCE

4. OPEN FILE FOR USAGE USING THE FILE CONNECTION AND THE MODE AND SHARING METHOD

```
CALL  RQA OPEN(CONN, MODE, SHARING, RESPMBX, @ STATUS);
/* TEST STATUS TO CHECK SYNCHRONOUS PORTION OF CALL */
MSGTKN = RQ RECIEVE MESSAGE (RESPMBX, TIME,   , @
STATUS);
/* TEST STATUS FIELD OF IORS RETURNED TO CHECK
   ASYNCHONOUS PORTION OF CALL. */


/* FINALLY YOU CAN READ OR WRITE!! */
```

DIVERSION: THE CONNECTION
BASIC I/O STYLE

TO ACCESS A FILE WE MUST HAVE A CONNECTION TO IT

WE GENERALLY OBTAIN THIS CONNECTION IN TWO STEPS

1. OBTAIN DEVICE CONNECTION USING:

   RQA PHYSICAL ATTACH DEVICE

   PASS DEVICE NAME

   RECIEVE TOKEN

DIVERSION: THE CONNECTION
BASIC I/O STYLE

2. OBTAIN FILE CONNECTION USING

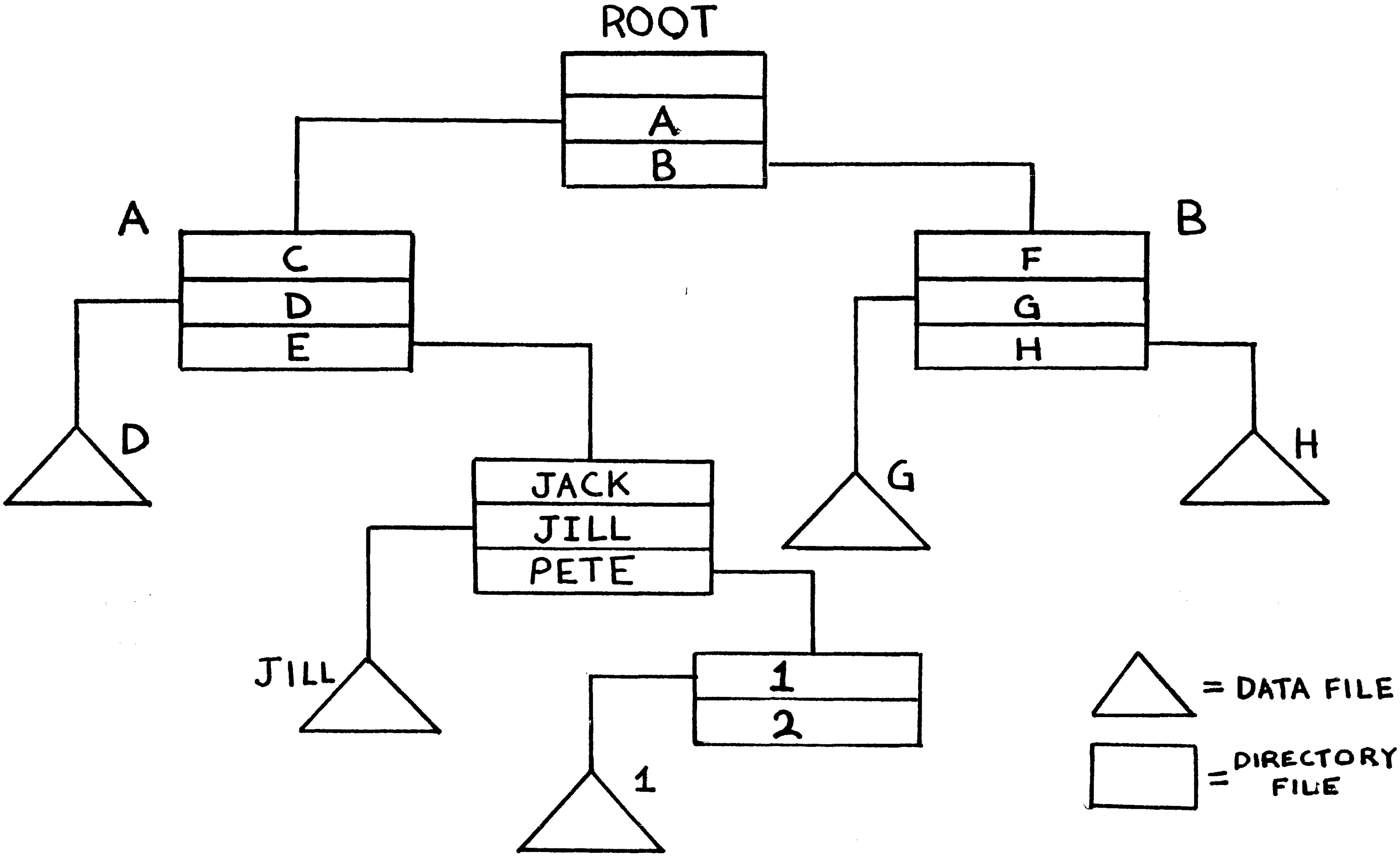
   RQA ATTACH FILE

      PASS PREFIX (USUALLY THE DEVICE TOKEN), AND SUBPATH

      RECIEVE FILE CONNECTION TOKEN

YOU NOW USE THE FILE CONNECTION TOKEN FOR ALL FUTHER INTERACTION WITH THE FILE.

AN EXAMPLE


ROOT
A
B
A
C
D
E
B
F
G
H
D
JACK
JILL
PETE
G
H
JILL
1
2
1
= DATA FILE
= DIRECTORY FILE

EXAMPLE CONTINUED

LETS SAY THE DEVICE HAS BEEN ATTACHED TO AND WE HAVE ITS TOKEN.

POSSIBILITIES:

	PREFIX		SUBPATH		
TO GET TO JILL:	TOKEN	+	A/E/JILL		
		OR			
STEP 1	TOKEN	+	A	=	NEW TOKEN
STEP 2	NEW TOKEN	+	E/JILL		

(TRY SOME OTHERS !)

EIOS TERMINOLOGY

IN ADDITION TO THE BASIC I/O SYSTEM TERMINOLOGY WE ADD:

- LOGICAL NAMES
- I/O JOBS
- DEFAULT PREFIX AND PATH PTR PARAMETERS

THE LOGICAL DEVICE NAME

DEFINITION: A NAME ATTACHED TO A PHYSICAL DEVICE AT CONFIGURATION OR RUN TIME WHICH HAS MORE MEANING TO THE USER.

EXAMPLES:

PHYSICAL	LOGICAL
FØ	:FØ:
FX1	:HD FLOPPY:
WD1	:WINNY:
FØ	:SYSTEM:
F1	:PATIENT:

TWO WAYS TO CREATE A LOGICAL DEVICE NAME

ONE

- USE RQA PHYSICAL ATTACH DEVICE

  PASS PHYSICAL DEVICE NAME

  RECIEVE TOKEN

- CATALOG THE TOKEN USING RQA CATALOG CONNECTION

  PASS TOKEN, LOGICAL NAME, JOB

(WITH THIS METHOD YOU CAN CATALOG THE CONNECTION IN ANY JOBS DIRECTORY)

TWO WAYS TO CREATE A LOGICAL DEVICE NAME

TWO

- USE RQA LOGICAL ATTACH DEVICE
  PASS LOGICAL NAME, DEVICE NAME

(LOGICAL DEVICE OBJECT IS CATALOGED IN THE ROOT JOB UNDER THE LOGICAL NAME)

(NOTE: THE LOGICAL DEVICE OBJECT IS NOT A CONNECTION. THE EIOS WILL CREATE A DEVICE CONNECTION DURING THE FIRST EIOS CALL THAT USES THE LOGICAL NAME)

THE LOGICAL FILE NAME

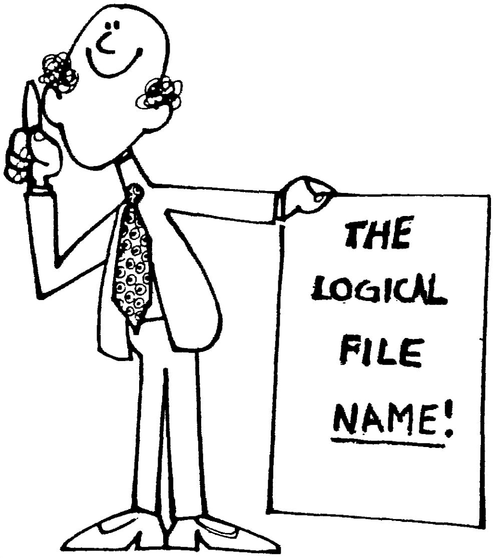
DEFINITION: A NAME ATTACHED TO A FILE CONNECTION AT RUNTIME FOR USE OF USER.

EXAMPLES:

:OUR_DATA:

:MY_DIRECTORY:

:A:



(MORE ON THIS IN A MINUTE!)

THE I/O JOB

TO USE EIOS CALLS YOUR TASK MUST BE RUNNING IN AN I/O JOB.

DEFINITION: AN I/O JOB IS AN RMX-86 JOB WITH THREE EXTRA ATTRIBUTES.

1. A CATALOG ENTRY IN ITS OWN DIRECTORY UNDER THE NAME "RQ GLOBAL" (JOB TOKEN)
2. A CATALOG ENTRY OF A CONNECTION UNDER THE NAME "$". (DEFAULT PREFIX)
3. A CATALOG ENTRY OF A USER TOKEN UNDER THE NAME R?USER. (DEFAULT USER)

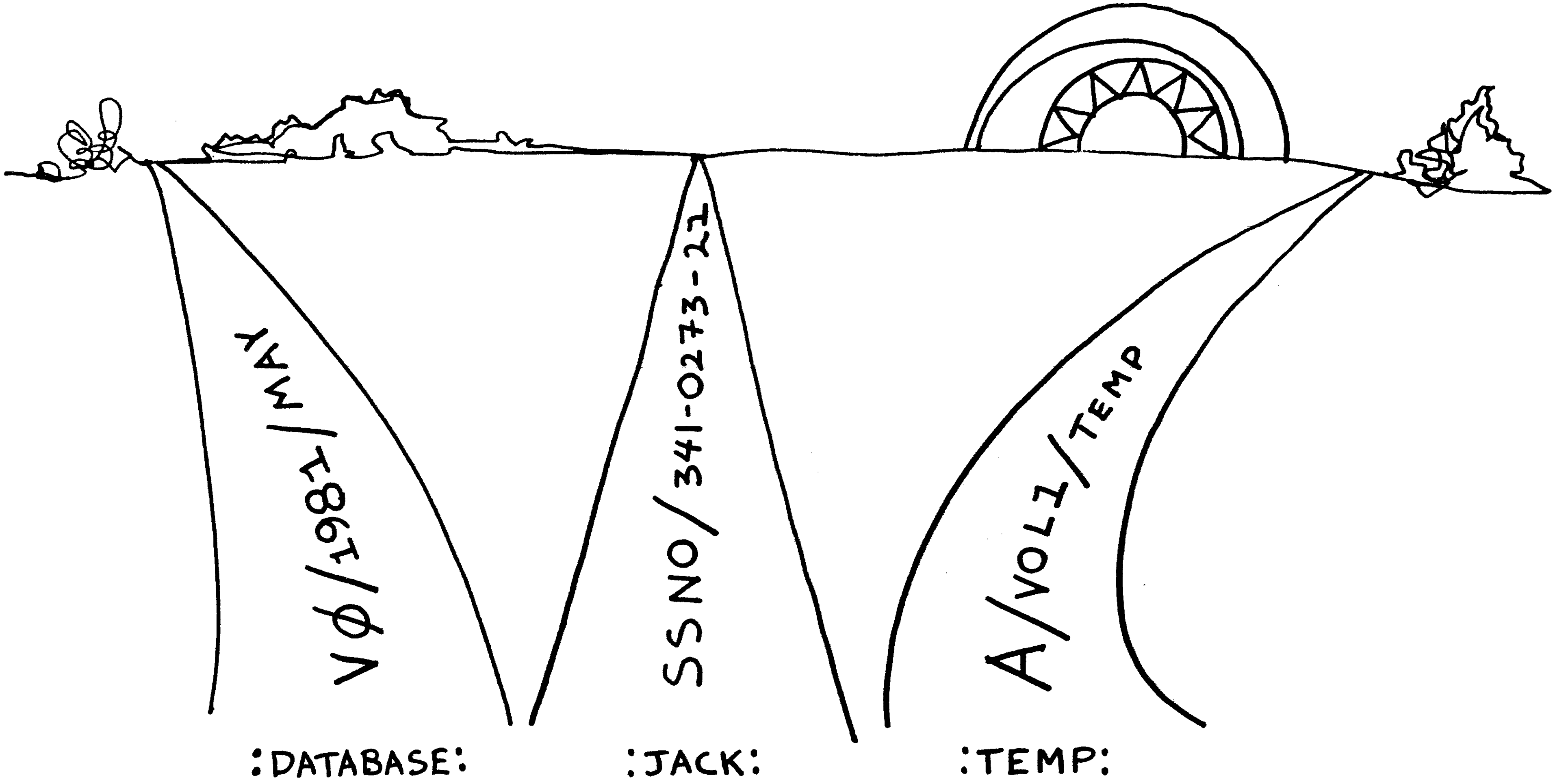
TO CREATE AN I/O JOB

- CREATE AT SYSTEM CONFIGURATION USING THE EIOS MACRO.

- USE THE CREATE I/O JOB SYSTEM CALL DURING RUN TIME.

PROBLEM: THIS CALL CAN ONLY BE MADE FROM A TASK RUNNING IN AN I/O JOB.

LOGICAL NAMES AND PATHS



DEFAULT PREFIX

- PURPOSE: REDUCE PROGRAMMER EFFORT AND ERRORS BY ALLOWING REFERENCE TO A DEFAULT CONNECTION (TO A FILE OR DEVICE) WHICH IS CATALOGED IN THE I/O JOB DIRECTORY.

- EXAMPLE: A PARTICULAR I/O JOB MUST FREQUENTLY ACCESS A DATA FILE. OBTAIN THE CONNECTION FOR THE FILE AND CATALOG IT IN THE I/O JOB DIRECTORY UNDER "$". AFTER THIS IS DONE ANY ATTACH FILE A CALL WITH A NULL PATH WILL AUTOMATICALLY ATTACH TO THE DATA FILE.

CREATING A LOGICAL FILE NAME

1. ATTACH TO A DEVICE
2. RECIEVE TOKEN (OPTIONAL: CATALOG AS A LOGICAL DEVICE)
3. ATTACH TO THE DESIRED FILE

    RQS ATTACH FILE

    PASS PATHNAME STRING

    RECIEVE CONNECTION

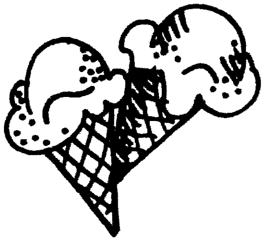
4. CATALOG THE CONNECTION

    RQS CATALOG CONNECTION

    PASS CONNECTION, JOB, LOGICAL NAME

PATH NAME STRING

4, COUNT'EM, 4 FLAVORS!



STRING PASSED	EIOS ACTION
NULL	USE DEFAULT PREFIX
LOGICAL NAME ONLY	USE PATH CATALOGED
SUBPATH ONLY	DEFAULT PREFIX + SUBPATH
LOGICAL NAME + SUBPATH	USE PATH CATALOGED TO GET TO DIRECTORY THEN FOLLOW SUBPATH FROM THERE

PATH NAME STRINGS
(EXAMPLES)

- NULL

ASSUME DEFAULT PREFIX IS:

FØ/A/B

PASS NULL FOR ATTACH FILE AND GET CONNECTION TO FØ/A/B

- LOGICAL NAME ONLY

ASSUME :DATABASE: IS THE LOGICAL NAME FOR:

WD1/TUE/SECOND/DATA

PASS THE LOGICAL STRING :DATABASE:

GET CONNECTION TO DATA FILE

PATH NAME STRINGS
(EXAMPLES)

- SUBPATH ONLY

ASSUME DEFAULT PREFIX :FØ:

POINTS TO FØ (DEVICE NAME)

PASS SUBPATH Q/1979/FILE 1

- LOGICAL NAME + SUBPATH

ASSUME LOGICAL NAME :PATIENT:

POINTS TO FØ/1979/PATIENT

PASS SUBPATH :PATIENT: JACK/STRANGE

RECIEVE CONNECTION TO:

FØ/1979/PATIENT/JACK/STRANGE

THE DEFAULT USER

TO ATTACH TO A FILE YOU NEED

- PATH STRING
- USER ID

THE DEFAULT USER

THE EXTENDED I/O SYSTEM ATTACH CALL HAS ONLY 2 PARAMETERS, PATH PTR AND STATUS

HOW DOES THE USER ID GET PASSED? SIMPLE, THE EIOS USES THE DEFAULT USER ID OF THE JOB (IO JOB OF COURSE) THAT CONTAINS THE CALLING TASK!

EIOS INTERACTION SEQUENCE

1. ATTACH TO A DEVICE USING A LOGICAL NAME, PHYSICAL NAME AND FILE DRIVER DESIRED

```
CALL RQLOGICAL ATTACHDEVICE (@(9, ':PATIENT:'),
                             @(2, 'FØ'), 4,
                             @ STATUS);
```

FØ IS IN THE SYSTEM DUIB'S

2. ATTACH TO THE FILE SPECIFYING THE PATH NAME

```
CONNTKN = RQS ATTACHFILE(@(12, 'JONES/ROBERT'),
                         @ STATUS);
```

EIOS INTERACTION SEQUENCE

3. OPEN THE FILE SPECIFYING THE MODE AND NUMBER OF BUFFERS DESIRED

```
CALL RQS OPEN(CONNTKN, 3,2);
```

EOIS CALLS OVERVIEW

- RELATING TO LOGICAL NAMES
    - RQS CATALOG CONNECTION
    - RQS LOOKUP CONNECTION
    - RQS UNCATALOG CONNECTION

- CREATE FILE OR CONNECTION
    - RQS ATTACHE FILE
    - RQS CREATE DIRECTORY
    - RQS CREATE FILE

EOIS CALLS OVERVIEW

- DATA MANIPULATION
  - RQS OPEN
  - RQS CLOSE
  - RQS READMOVE
  - RQS SEEK
  - RQS WRITEMOVE
  - RQS TRUNCATE FILE

- DEVICE RELATED CALL
  - RQS SPECIAL

EOIS CALLS OVERVIEW

- CHANGING ACCESS, RENAMING, OBTAINING STATUS
  - RQS CHANGE ACCESS
  - RQS RENAME FILE
  - RQS GET CONNECTION STATUS
  - RQS GET FILE STATUS

- DELETING FILES AND CONNECTIONS
  - RQS DELETE CONNECTION
  - RQS DELETE FILE

EOIS CONFIGURATION

- SELECT THE EOIS CALLS TO BE INCLUDED IN THE FINAL SYSTEM

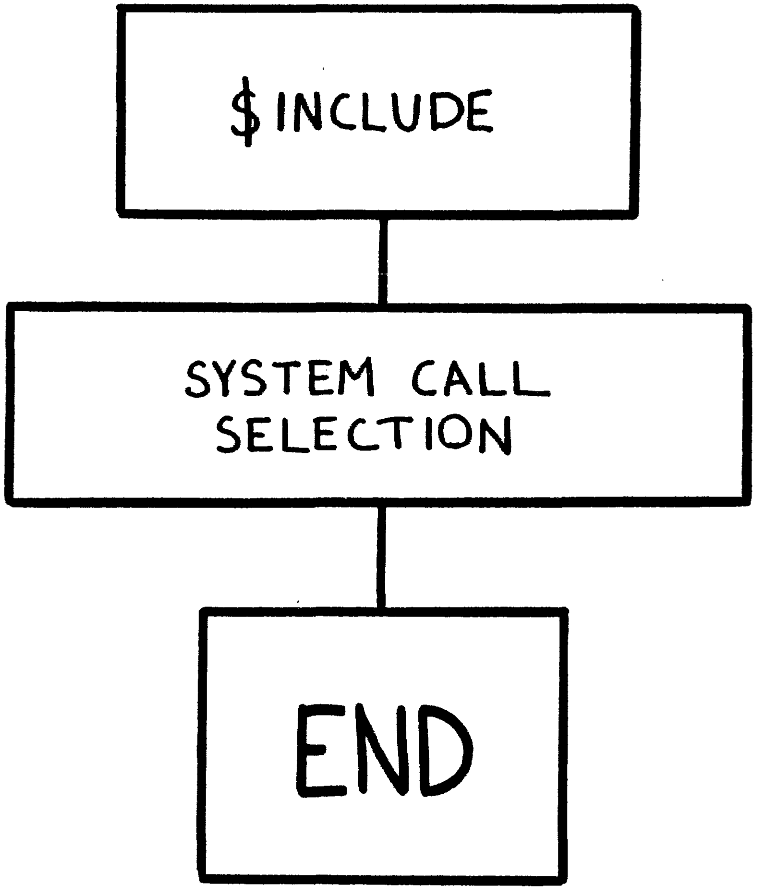
- SELECT THE LOGICAL DEVICES TO BE INITIALIZED IN THE FINAL SYSTEM

- CREATE THE INITIAL I/O JOB(S) IN THE SYSTEM

EOIS CONFIGURATION

FILES	PURPOSE
ETABLE.A86	SYSTEM CALLS
EDEVCF.A86	LOGICAL DEVICES
EJOBCF.A86	I/O JOB

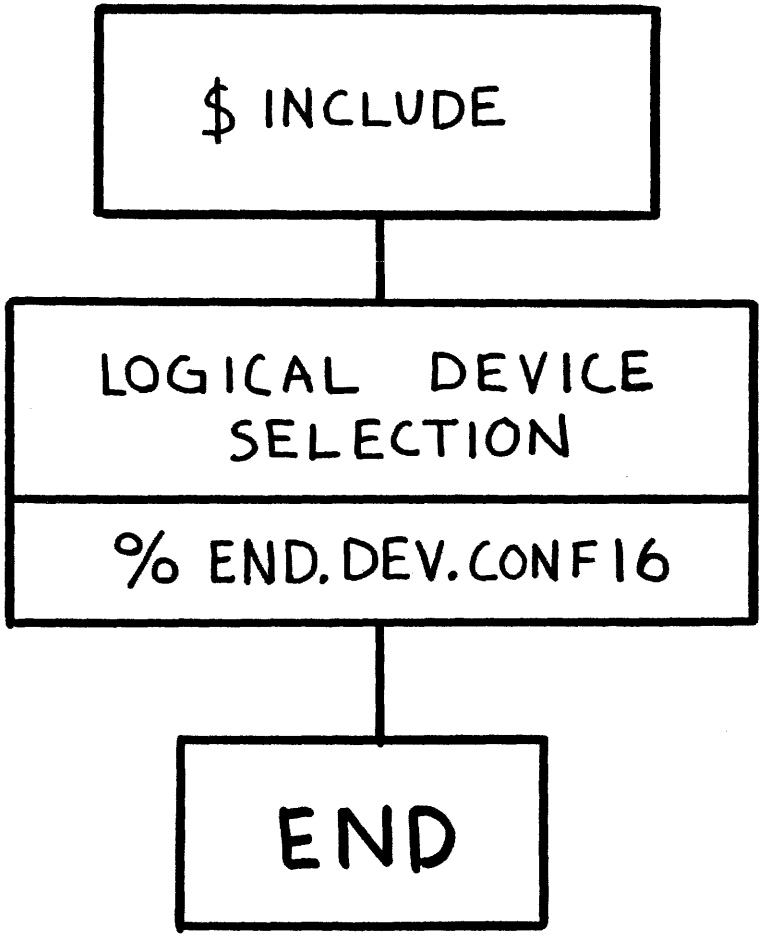
ETABLE A86



ETABLE A86

```
NAME

$INCLUDE(:F2:ETABLE.MAC)

;
;    JOB INTERFACE
;
                  %RQCREATEIOJOB
                  %RQEXITIOJOB
;
;    CONFIGURATION INTERFACE
;
                  %RQLOGICALATTACHDEVICE
                  %RQLOGICALDETACHDEVICE
;
;   SYNCHRONOUS INTERFACE
;
                  %RQSCREATEFILE
                  %RQSATTACHFILE
                  %RQSDELETECONNECTION
                  %RQSLOOKUPCONNECTION
                  %RQSCATALOGCONNECTION
                  %RQSUNCATALOGCONNECTION
                  %RQSCREATEDIRECTORY
                  %RQSDELETEFILE
                  %RQSRENAMEFILE
                  %RQSCHANGEACCESS
                  %RQSOPEN
                  %RQSCLOSE
                  %RQSREADMOVE
                  %RQSWRITEMOVE
                  %RQSSEEK
                  %RQSTRUNCATEFILE
                  %RQSGETFILESTATUS
                  %RQSGETCONNECTIONSTATUS
                  %RQSSPECIAL

                  END
```

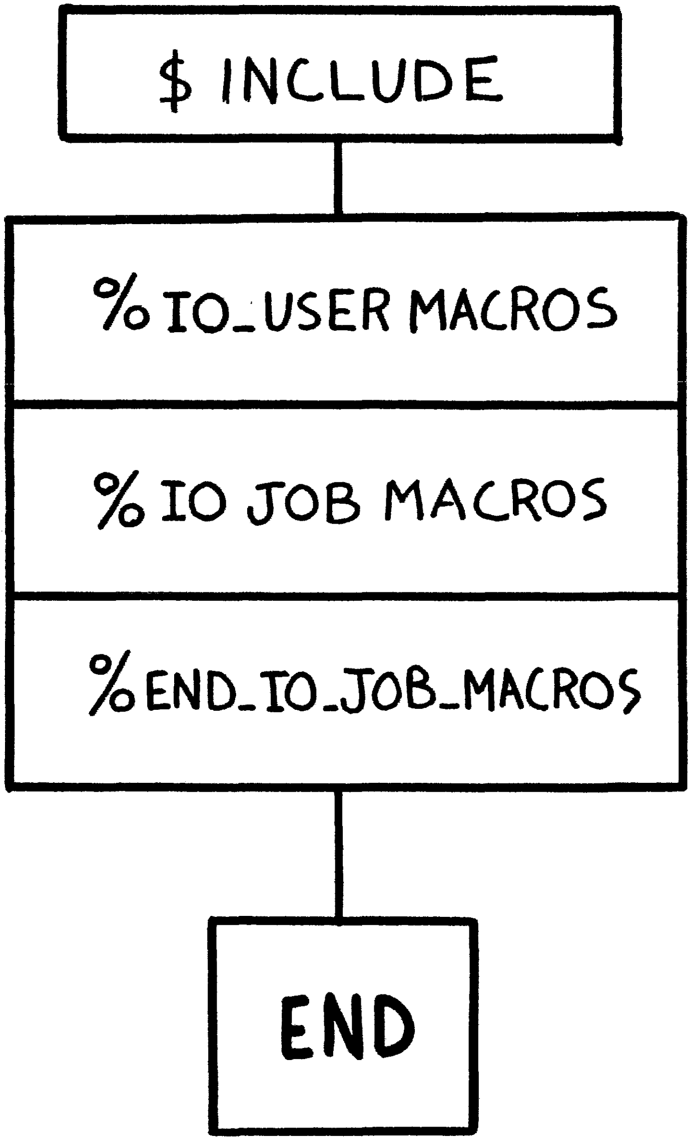
EDEVCF.A86



EDEVCF.A86

```
NAME

CGROUP

$INCLUDE(:F2:EDEVCF.MAC)

;
;    BYTE-BUCKET
;
         %DEV_INFO_BLOCK('BB','BB',PHYSICAL)
;
;    TERMINAL
;
         %DEV_INFO_BLOCK('TØ','TØ',PHYSICAL)
;
;    SHUGART 2Ø4, UNIT Ø, DRIVE Ø
;
         %DEV_INFO_BLOCK('FØ','FØ',NAMED)
;
;    SHUGART 2Ø4, UNIT 1, DRIVE 1
;
         %DEV_INFO_BLOCK('F1','F1',NAMED)
;
;    218 WINCHESTER FLOPPY SS/SD, UNIT Ø, DRIVE Ø
;
         %DEV_INFO_BLOCK('WFØ','WFØ',NAMED)
;
;    218 WINCHESTER FLOPPY SS/SD, UNIT 1, DRIVE 1
;
         %DEV_INFO_BLOCK('WF1','WF1',NAMED)
;
;    STREAM
;
         %DEV_INFO_BLOCK('STREAM','STREAM',STREAM)

         %END_DEV_CONFIG(1Ø24)

                  END
```

EJOBCF.A86



EJOBCF.A86

```
NAME

CGROUP

$INCLUDE(:F2:EJOBCF.MAC)

;
;    USER 'WORLD' DEFINITION
;
         %IO_USER('WORLD', 0FFFFH)
;
;    EIOS TEST JOB
;
         %IO_JOB('T0', 'WORLD', 260H, 0FFFFH, 0:0, 0, 0, 155, 1800:0, 1A00, 0:0, 1200, 0)

         %END_IO_JOB_CONFIG(40)

                  END
```

NOTE: THE CONFIGURED IO_JOB IN THE RELEASE FILE
IS FOR THE HUMAN INTERFACE.

ASSEMBLING, LINKING AND LOCATING THE EIOS.

(THIS IS TOUGH, SO PAY ATTENTION!!)

```
SUBMIT :fx: EIOS(DATE, LOC_ADR)
```

BEFORE DOING THIS SUBMIT YOU SHOULD PRINT THE FILE ON A TERMINAL OR A HARD COPY TO INSURE THAT THE FILE WILL NOT CALL FOR RESOURCES THAT YOU DO NOT HAVE.

ADDING THE EIOS TO THE SYSTEM

- ONE JOB MACRO REQUIRED AT SYSTEM CONFIGURATION TIME.

- PARAMETERS FOR MACRO ARE FOUND IN THE iRMX-86 CONFIGURATIONS GUIDE.

CHAPTER QUIZ!

1. GIVE A PHYSICAL DEVICE NAME. ______________________

2. GIVE A LOGICAL DEVICE NAME. ______________________

3. WHAT ARE THE CHARACTERISTICS OF AN I/O JOB?

____

____

____

4. WHAT IS THE "GOTCHA" IN THE CREATION OF AN I/O JOB? ______________________

CHAPTER QUIZ (CONT.)

5. WHAT IS A...

   A. DEFAULT USER ____________________

   B. DEFAULT PREFIX ____________________

6. MATCH THE FOLLOWING

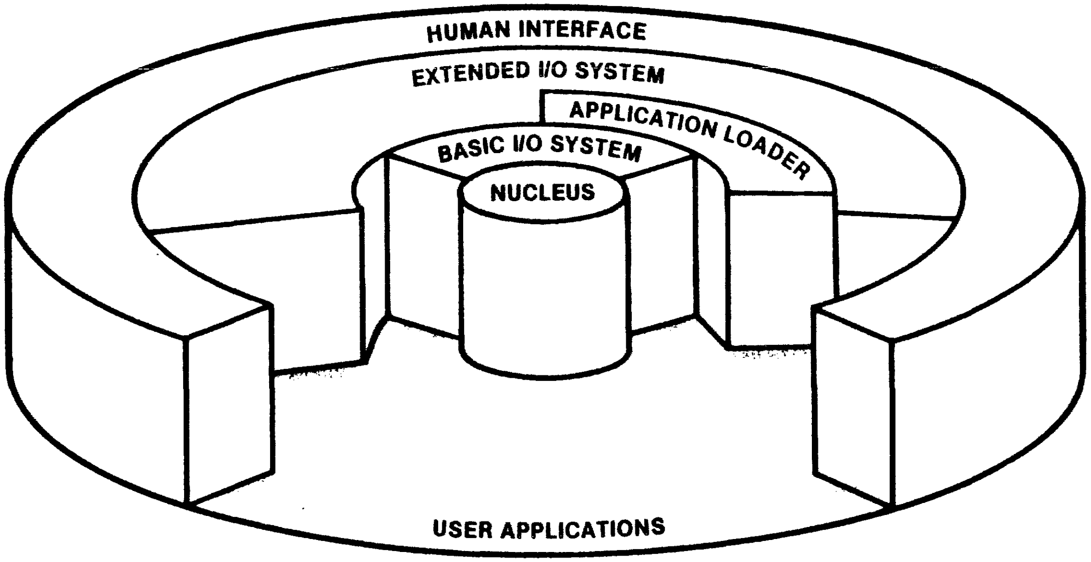
A. ETABLE.A86	____ LOGICAL DEVICES
B. EJOBCF.A86	____ SYSTEM CALL SELECTION
C. EDEVCF.A86	____ IO JOB CREATION

THE HUMAN INTERFACE

OVERVIEW

THE HUMAN INTERFACE IS A LAYER OF THE RMX-86 SYSTEM THAT ALLOWS THE OPERATOR TO LOAD, EXECUTE AND SUBSEQUENTLY INTERACT WITH PROGRAM FILES.

RMX-86 AND THE HUMAN INTERFACE



RESIDENT/NON-RESIDENT PROGRAMS

RESIDENT: PROGRAMS LOADED AT SYSTEM RESET WHICH REMAIN IN MAIN MEMORY. (COULD BE IN ROM)

NON-RESIDENT: PROGRAMS WHICH ARE LOADED INTO MAIN MEMORY FROM SECONDARY STORAGE UPON PROGRAM OR OPERATOR COMMAND

SOME EXAMPLES

SYSTEM/RESIDENT:	APPLICATION LOADER, EXTENDED I/O SYSTEM
SYSTEM/NON-RESIDENT:	COPY, DIR, DELETE
USER/RESIDENT:	DATA COLLECTION, INTERRUPT DRIVEN TASKS.
USER/NON-RESIDENT:	DATA REDUCTION, DATA ANALYSIS PROGRAM.

HUMAN INTERFACE SERVICES

- NON-RESIDENT COMMANDS

- RESIDENT SYSTEM SERVICES

NON-RESIDENT COMMANDS

- FILE MANIPULATION
  - ATTACH DEVICE
  - CREATE DIR
  - DETACH DEVICE
  - DOWNCOPY
  - RENAME
  - COPY
  - DELETE
  - DIR
  - FORMAT
  - UPCOPY
- GENERAL UTILITY
  - DATE
  - SUBMIT
  - DEBUG
  - TIME

HUMAN INTERFACE

COMMAND SYNTAX

COMMAND INPATHLIST [PREPOSITION OUTPATHLIST] [PARAMETERS]

WHERE:

INPATHLIST = ONE OR MORE FILES TO BE USED AS INPUT DURING COMMAND EXECUTION

PREPOSITION = HOW YOU WANT OUTPUT HANDLED

OUTPATHLIST = ONE OR MORE FILES TO RECIEVE OUTPUT DURING COMMAND EXECUTION

PARAMETERS = REQUESTED OPTIONAL SERVICES

PATHLISTS

PATHNAME [, PATHNAME] . . .

EXAMPLES:

MY FILE/DATA

YOURFILE/1979/DATA,JACKFILE/SAMP 1

A/B, A/C, A/D, E/Q/Z

PREPOSITIONS

TO-OUTPUT TO NEW FILE
(IF OLD FILE IS SPECIFIED, A QUERY RESULTS)

OVER-OUTPUT TO OLD FILE OVER OLD DATA
(WHETHER OR NOT TARGET FILE EXISTS)

AFTER-OUTPUT APPENDED AFTER DATA IN TARGET FILE
(WHETHER OR NOT TARGET FILE EXISTS)

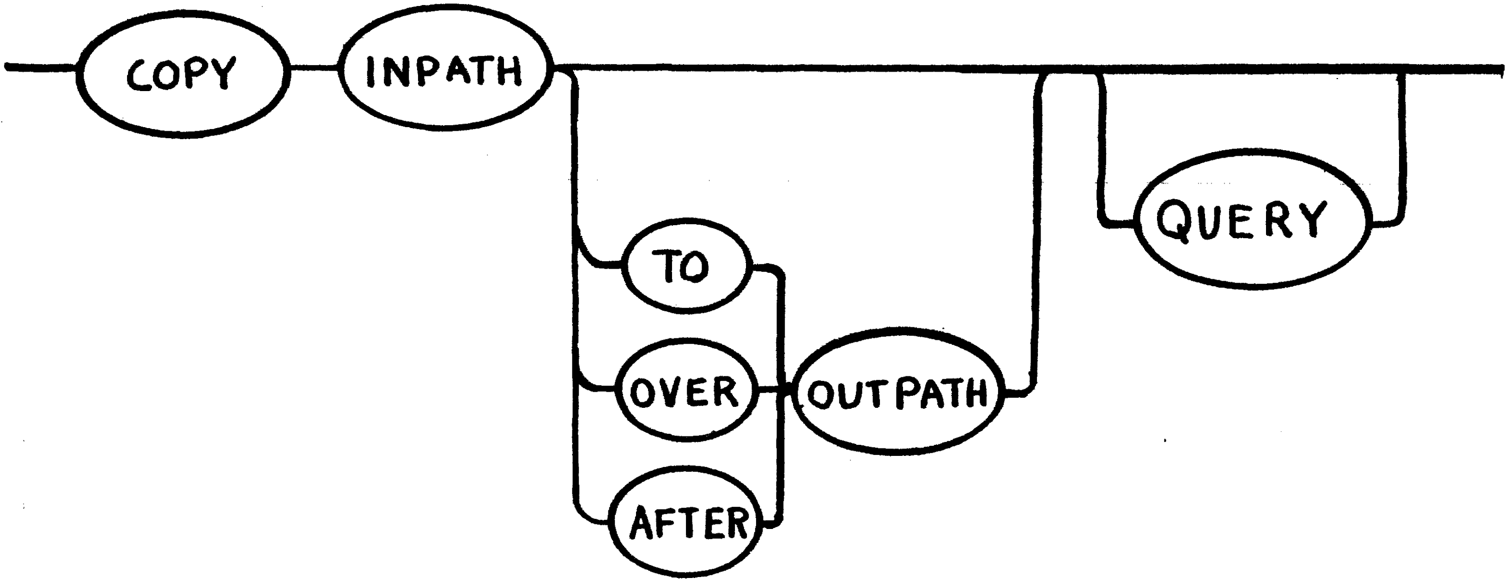
AS - ASSOCIATES A PHYSICAL DEVICE TO A LOGICAL
NAME (ONLY FOR THE ATTACH DEVICE COMMAND)

CONTROL CHARACTERS

CHARACTER	MEANING
↑Z	END OF FILE
↑C	PROGRAM ABORT
↑D	INVOKE DEBUGGER
↑O	SUPRESS/RESTORE OUTPUT
↑S	SUSPEND OUTPUT
↑Q	RESUME OUTPUT
↑X	DELETE CURRENT INPUT LINE
↑R	REPEAT CURRENT LINE OR PREVIOUS LINE IF CURRENT LINE IS EMPTY

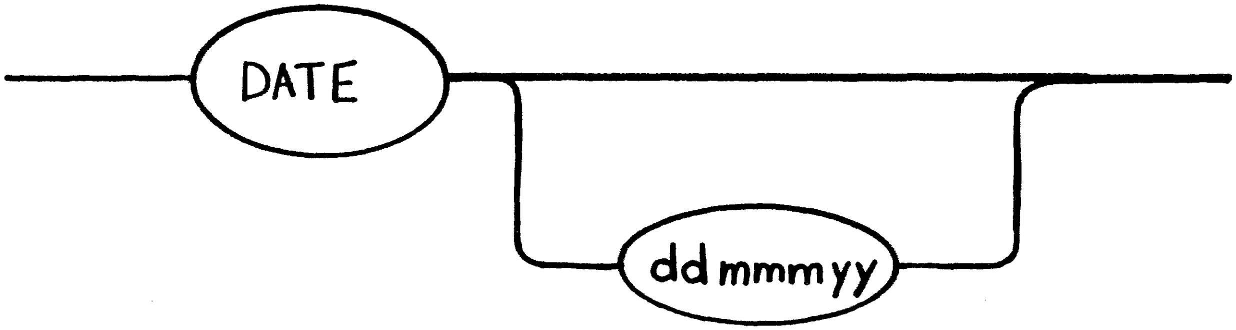
COPY

COPY DATA FROM INPUT FILE(S) TO OUTPUT FILE(S)



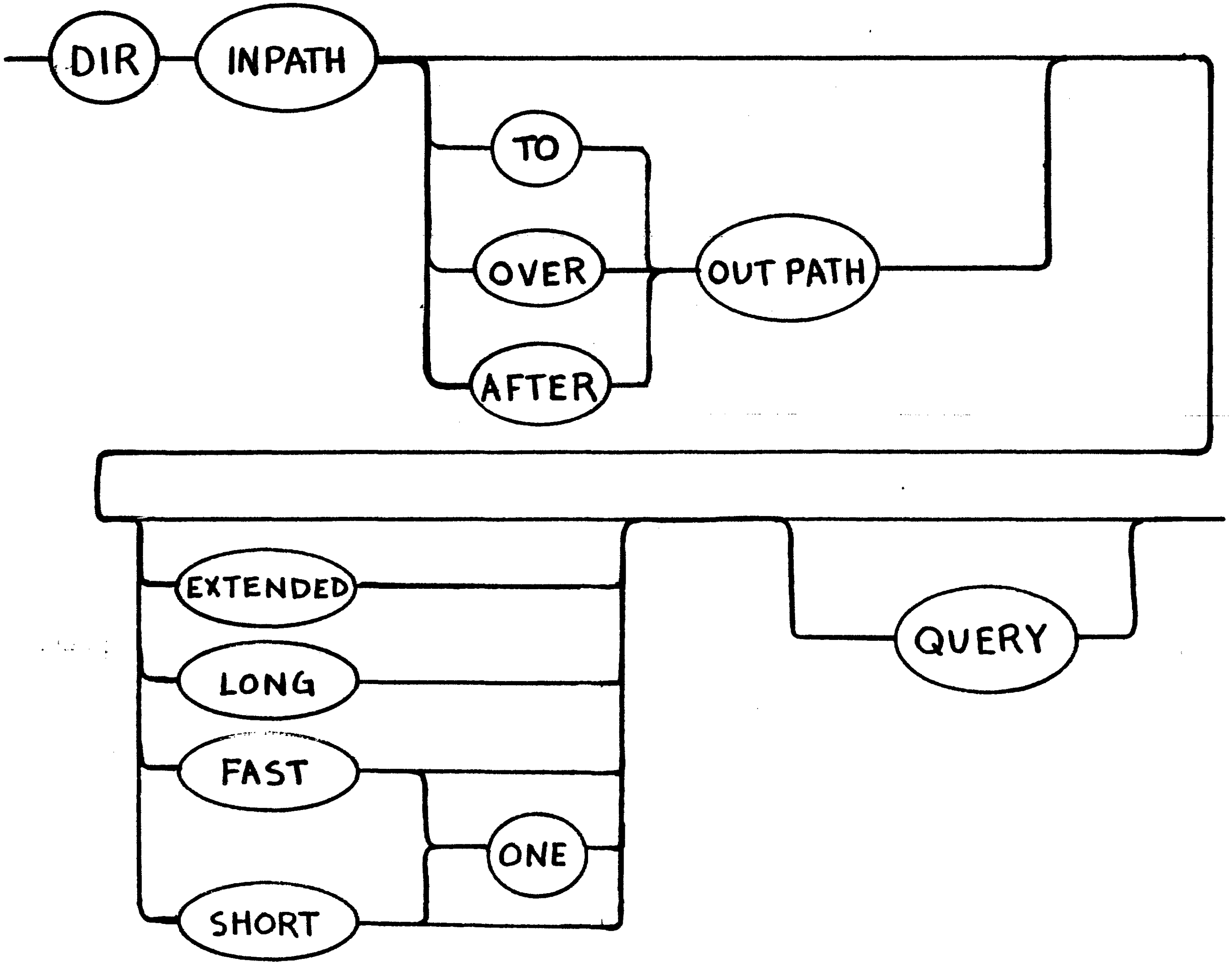
DATE

SET OR DISPLAY CURRENT DATE



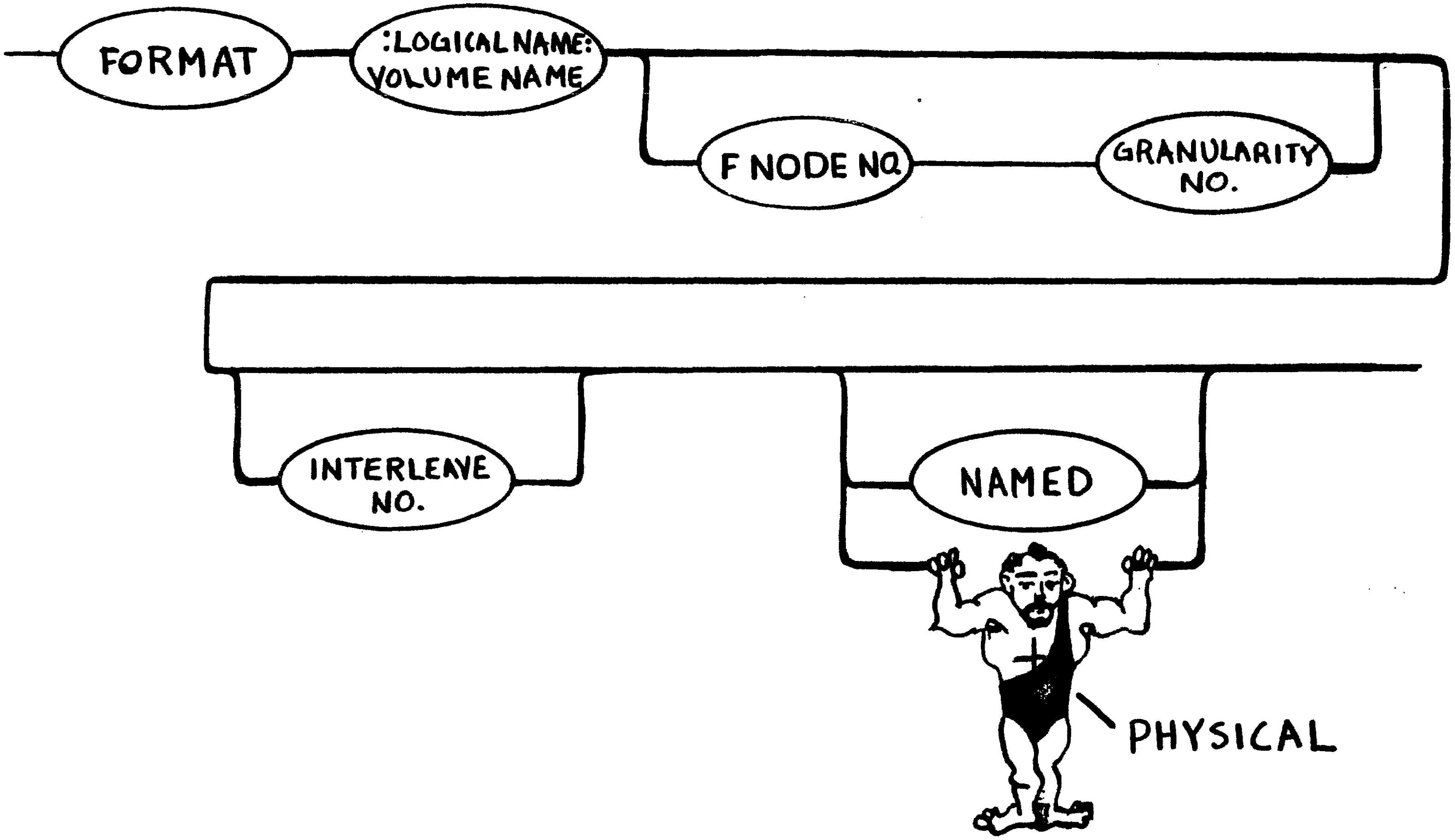
DIR

LIST THE NAMES AND ATTRIBUTTES OF FILES IN A SELECTED DIRECTORY.



FORMAT

FORMAT OR REFORMAT A VOLUME ON A SECONDARY STORAGE DEVICE (DISK, DISKETTE, BUBBLE)



RESIDENT SYSTEM SERVICES

- I/O PROCESSING CALLS

- COMMAND PARSING CALLS

- MESSAGE PROCESSING CALLS

- COMMAND PROCESSING CALLS

- PROGRAM CONTROL CALL

I/O PROCESSING CALLS

- C GET INPUT CONNECTION

  PASS INPUT PATHNAME

  RETURN EIOS CONNECTION

- CGET OUTPUT CONNECTION

  PASS OUTPUT PATHNAME

  RETURN EIOS CONNECTION

COMMAND PARSING CALLS

- CGET INPUT PATHNAME

  RETURN PATHNAME FOR STANDARD INTO FILE

- CGET OUTPUT PATHNAME

  RETURN PREPOSITION AND PATHNAME FOR STANDARD OUTPUT FILE

- CGET PARAMETER

  RETURN NEXT PARAMETER FROM INPUT LINE AS KEYWORD NAME AND VALUE

COMMAND PARSING CALLS

- C SET PARSEBUFFER
  SWITCH TO NEW BUFFER

MESSAGE PROCESSING CALLS

- C FORMAT EXCEPTION

  PASS EXCEPTION CODE

  RETURN MESSAGE IN USER BUFFER

- C SEND CO RESPONSE

  SEND MESSAGE TO COMMAND OUTPUT

  READ RESPONSE FROM COMMAND INPUT

- C SEND EO RESPONSE

  SEND MESSAGE TO ERROR OUTPUT

  READ RESPONSE FROM ERROR INPUT

COMMAND PROCESSING CALLS

- C CREATE COMMAND CONNECTION

  RETURN COMMAND CONNECTION TOKEN

- C DELETE COMMAND CONNECTION

  PASS COMMAND CONNECTION TOKEN

  DELETE CONNECTION

- C SEND COMMAND

  RECIEVE COMMAND LINES FROM CONSOLE

  SEND TO COMMAND DATA SPACE AND EXECUTE

PROGRAM CONTROL CALL

- C SET CONTROL C

  SEND NEW CONTROL-C SEMAPHORE TOKEN

HOW DOES ALL OF THIS WORK?

PHASE 1. COMMAND LINE INTERPRETER PARSES THE COMMAND LINE TO BREAK OUT THE PATHNAME TO THE PROGRAM FILE.

JACK/PROG1 ⇨ :PROG:JACK/PROG1 (FIRST)

OR :SYSTEM:JACK/PROG1 (SECOND)

:F9:JACK/PROG1 ⇨ :F9:JACK/PROG1 (ONLY)

HOW DOES ALL OF THIS WORK?

PHASE 2. PROGRAM EMPLOYS HI COMMANDS TO CARRY OUT ITS OWN PROCESSING.

EXAMPLE: PROGRAM TO ENCODE A DATA FILE

```
GET INPUT PATHNAME
GET OUTPUT PATHNAME
GET INPUT CONNECTION
GET OUTPUT CONNECTION
PROCESS FILE
DELETE INPUT CONNECTION
DELETE OUTPUT CONNECTION
EXIT I/O JOB
```

CREATING A NEW CUUP
(COMMONLY USED USER PROGRAM)

1. WRITE THE PROGRAM

2. ASSEMBLE OR COMPILE THE PROGRAM

3. LINK CODE TO APPROPRIATE RMX-86 LIBRARIES
   USE BIND, NOINITCODE AND MEMPOOL DIRECTIVES
   TO CREATE LTL OR PIC MODULE [SERIES III]

-OR-

CREATING A NEW CUUP

3. USE LINK AND LOCATE WITH NOINIT CODE AND MEMPOOL DIRECTIVES TO CREATE AN ABSOLUTE MODULE. (THERE MUST BE RESERVED SPACE IN WHICH TO LOAD IT!) [SERIES III]

-OR-

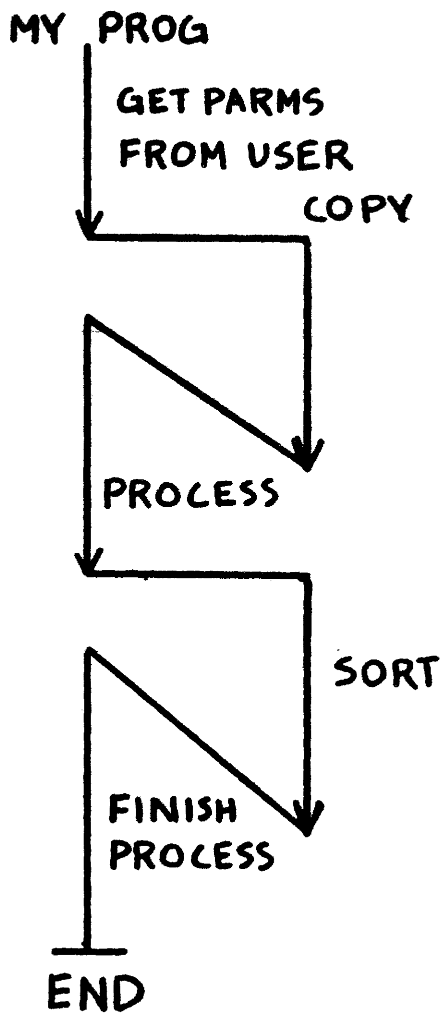
3. USE LINK AND LOCATE ON A SERIES II TO CREATE AN ABSOLUTE MODULE (ONLY)

CREATING A NEW CUUP

4. PLACE PROGRAM IN AN APPROPRIATELY NAMED FILE IN EITHER THE :SYSTEM: DIRECTORY OR THE :PROG: DIRECTORY

THE COMMAND CONNECTION
OR
THE ULTIMATE SUBROUTINE

PROBLEM: I HAVE A PROGRAM WHICH WILL COPY, PROCESS, SORT AND FURTHER PROCESS A FILE OF DATA, I HAVE A SYSTEM COPY AND SORT ALREADY AND WOULD LIKE TO USE THEM LIKE:



THE COMMAND CONNECTION

- A BOND BETWEEN YOUR PROGRAM AND THE COMMAND LINE EXECUTOR.
- USED WHEN YOUR PROGRAM WANTS TO SEND A COMMAND LINE TO BE EXECUTED.
- CAN BE ESTABLISHED ONCE AT PROGRAM START AND USED THROUGHOUT THE PROGRAM RUN

SEND COMMAND

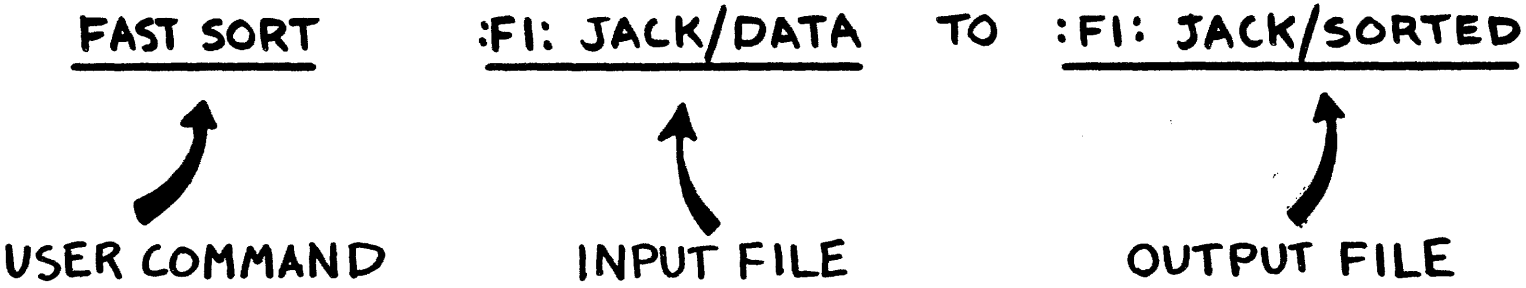
- A SYSTEM PROGRAM TO MOVE A BUFFER OF DATA (A COMMAND) TO THE COMMAND CONNECTION.

- IF BUFFER CONTAINS A CONFIGURATION CHARACTOR SEND COMMAND RETURNS IMMEDIATELY OTHERWISE IT RETURNS AFTER COMMAND IS EXECUTED.

AN EXAMPLE

OUR SORT PROGRAM.

PROGRAM INVOCATION-



```
FAST SORT    :F1: JACK/DATA  TO  :F1: JACK/SORTED
```

USER COMMAND

INPUT FILE

OUTPUT FILE

AN EXAMPLE

1. GET INPUT PATHNAME INTO A PRIVATE BUFFER

2. GET OUTPUT PATHNAME INTO A PRIVATE BUFFER

3. CREATE COMMAND CONNECTION

4. FORMAT COPY COMMAND IN PRIVATE COMMAND BUFFER USING INPUT AND OUTPUT PATHNAMES

5. SEND ASSEMBLED COMMAND TO COMMAND CONNECTION

COPY PROGRAM RUNS

AN EXAMPLE

6. PROCESS COPIED DATA

7. FORMAT SORT COMMAND IN PRIVATE COMMAND BUFFER AGAIN USING INPUT AND OUTPUT PATHNAMES

8. SEND ASSEMBLED COMMAND TO THE COMMAND CONNECTION

SORT PROGRAM RUNS

9. DELETE COMMAND CONNECTION

10. FINISH PROCESSING AND EXIT

ANOTHER USE

SINCE THE PRIVATE COMMAND BUFFER COULD BE FILLED FROM ANY SOURCE, IMAGINE...

1. READ A FILE INTO COMMAND BUFFER

2. SEND COMMAND

3. REPEAT FOREGOING AS LONG AS "DATA" EXISTS IN THE FILE.

WHAT DOES THIS REMIND YOU OF?

HUMAN INTERFACE CONFIGURATION

- DESIGNATE PATHNAMES FOR THE LOGICAL NAMES REQUIRED BY THE HUMAN INTERFACE
- SPECIFY THE SIGN ON MESSAGE
- SPECIFY THE MAXIMUM COMMAND NAME LENTGH
- SPECIFY THE DIRECTORIES AND THE SEQUENCE THAT THE HUMAN INTERFACE WILL SEARCH THEM IN FOR USER PROGRAMS

PATHNAME - LOGICAL NAME SPECIFICATION

- FOUR DIRECTORIES - SYSTEM
PROG
DEFAULT
WORK

- LOGICAL DEVICE NAME (:FØ: IN SUPPLIED FILE) MUST BE CONFIGURED IN THE EXTENDED I/O SYSTEM

THE SIGN ON MESSAGE

- MAXIMUM LENGTH IS 255 CHARACTERS

- ESSENTIALLY "ANYTHING GOES!"

  (WITHIN THE BOUNDS OF GOOD TASTE, OF COURSE.)

- SOME EXAMPLES

  "JACLYN SYSTEM 2000 V1.0"

  "WORDCRUSHER V2.9 JOEN MFG COPYRIGHT 1987"

COMMAND NAME LENGTH

- THEORETICALLY COULD BE $2^{16}-1$

- HOWEVER, A SINGLE LINE (80) MAKES A BIT MORE SENSE.

DIRECTORIES AND SEARCH SEQUENCE

- A MAXIMUM OF 255 DIRECTORIES CAN BE AUTOMATICALLY SEARCHED
- USER SUPPLIES A STRING TABLE OF NAMES
- SYSTEM SEARCHES DIRECTORIES IN SEQUENCE GIVEN.
- IN ALL CASES THESE DIRECTORIES MUST BE CONFIGURED IN THE EXTENDED I/O SYSTEM (MUST EXIST BEFORE THE HUMAN INTERFACE BEGINS RUNNING)

LINKING AND LOCATING THE HUMAN INTERFACE

(ANOTHER BIG ONE)

- SUBMIT :fx: HI(DATE, LOC)

- WHERE DATE = MM/DD/YY OR
  DD MMM YY

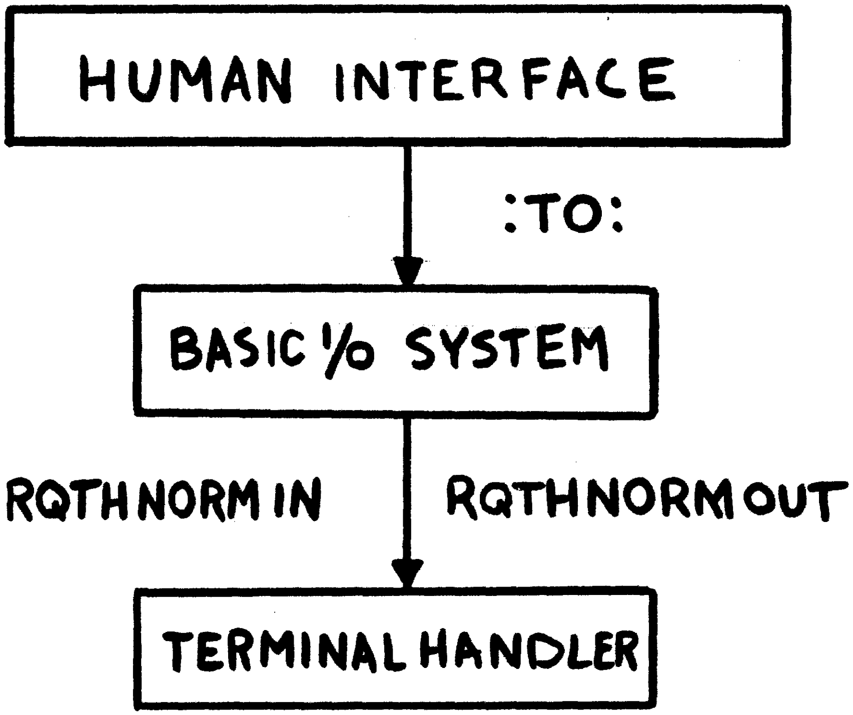
  LOC = LOCATION OF HUMAN
  INTERFACE WHEN SYSTEM
  IS LOADED.

HUMAN INTERFACE PREREQUISITS

- NUCLEUS
- DEBUGGER OR TERMINAL HANDLER
- BASIC I/O SYSTEM
- EXTENDED I/O SYSTEM
- APPLICATION LOADER

IN ALL CASES ABOVE THE CALLS REQUIRED BY THE HUMAN INTERFACE MUST BE CONFIGURED.

TERMINAL HANDLER REQUIREMENTS



TERMINAL HANDLER REQUIREMENTS

- IF YOU WANT TO USE ↑C MODULE FROM HUMAN INTERFACE FOR PROGRAM CONTROL (ABORT)

MODIFY	MTH·CSD or DB.CSD
ADD	:fx: HI. LIB(HCONTC), &

BASIC I/O SYSTEM REQUIREMENTS

- FILE DRIVERS- PHYSICAL
  STREAM
  NAMED

- DUIBS - TØ (TERMINAL DEVICE)
  BB (BYTE BUCKET)
  STREAM (STREAM FILE DEVICE)
  ? (ANY DISK OR BUBBLE DEVICES REQUIRED)

- DEVICE DRIVERS FOR ALL DUIBS

EXTENDED I/O SYSTEM REQUIREMENTS

- CONFIGURATION FILE (EDEVCF.A86) MUST INCLUDE:

  TØ

  BB

  STREAM

- I/O JOB FILE (EJOBCF.A86) MUST INCLUDE AN I/O JOB MACRO FOR THE HUMAN INTERFACE

- MEMORY POOL FOR EIOS MUST BE LARGE ENOUGH TO INCLUDE THE HUMAN INTERFACE

CHAPTER QUIZ

1. WHAT IS AN EXAMPLE OF A NON-RESIDENT USER PROGRAM? ________________________________

2. GIVE 2 NON-RESIDENT USER COMMANDS

   ________________ ________________

3. WHAT IS THE EFFECT OF THE AFTER PREPOSITION?

   ____

4. WHAT IS THE DIFFERENCE BETWEEN ↑O AND ↑S? ________________________________

CHAPTER QUIZ!

5. WHAT 2 CALLS CAN BE USED TO GET AN INPUT CONNECTION FROM THE COMMAND LINE?

   ____

   ____

6. WHAT IS A COMMAND CONNECTION?

   ____

7. WHAT IS THE FILE FOR HUMAN INTERFACE CONFIGURATION? __________________________

INTEL WORKSHOPS

Introductory Workshops

- Introduction to Microcomputers (4 days)
- Intellec Development Systems (3 days)
- Operating Systems Fundamentals (2 days)

8080, 8085 System Design Workshops

- MCS-80/85 System Design (5 days)
- PASCAL Programming (5 days)
- PL/M Programming (5 days)
- iRMX 88,80 Operating Systems (5 days)

8086, 8088 System Design Workshops

- iAPX 86,88 System Design (5 days)
- iAPX 86,88 Advanced Assembly Language (5 days)
- ICE 86,88 and iAPX 86/21 (5 days)
- iAPX 286 Architecture (3 days)
- PASCAL Programming (5 days)
- PL/M Programming (5 days)
- iRMX 88,80 Operating System (5 days)
- iRMX 86 Operating System (5 days)
- iRMX 86 I/O Operating System (5 days)

432 Workshops

- iAPX 432 Architecture (3 days)
- Ada Programming (4 days)

Programming Language Workshops

- PASCAL Programming (5 days)
- PL/M Programming (5 days)
- iAPX 86,88 Advanced Assembly Language (5 days)
- Ada Programming (4 days)

Single Chip Microcomputer Workshops

- MCS 48/49 System Design (5 days)
- MCS-51 Microcontroller (5 days)
- 2920 Signal Processor (5 days)

Peripheral Chips Design Workshops

- Data Communication Chips (4 days)
- IEEE-488 GPIB Chips (3 days)
- Bubble Memory Design (3 days)

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